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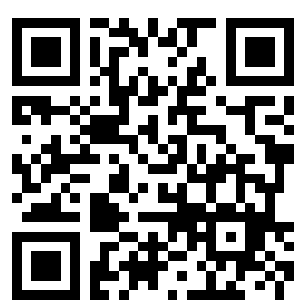

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Binding Cases for Vol. III. may now be ordered, price 2s. each, post free 2s 4d. Readers can have their volumes bound by their own bookseller; or they may send their numbers to us, carriage paid (with the reader's name and address), and a remittance of 4s 6d, under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad.

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SUMMARY

The Incorporated Municipal Electrical Association met at Nottingham on Tuesday to hold its thirteenth Annual Convention, under the presidency of Mr. Herbert Talbot, Chief Electrical Engineer to the Nottingham Corporation. In his Presidential Address Mr. Talbot put in a plea for the better encouragement of assistant engineer members of the Association, suggesting that many could be spared from the station at this time of the year, and that their expenses should be paid by their Committees. Other points touched on by Mr. Talbot were the use of metal filament lamps, the maximum demand system of charging, the registration of wiring contractors, destructor stations, reserve funds, purchasing meters out of revenue, uniformity of plant, and the desirability of "continuity" of Chairmen and members of Committees. A Paper by Bailie Wightman, Convener of the Govan Electricity Committee, was next discussed, and the speakers were unanimous that the Chairmen of the Electricity Committees should not intervene in technical matters at all, but should leave these entirely to their engineers. Alderman Pearson, Chairman of the Bristol Electricity Committee, stated that on the occasion of the fire at their electricity works he had not even telephoned to Mr. Proctor, the engineer-in-chief, but had gone to bed with the assurance that he would see matters through. There was also an agreement as to desirability of continuity in Chairmen and Committees. Most of the speakers had been successful in this, but one Councillor complained that his Committee had had the experience of five Chairmen in two months. (Page 5.)

As considerable attention has been directed of late to the fact that under the new Patents Act British patents may be revoked if the patented article or process is manufactured or carried on solely or mainly abroad, we publish once more the full text of the clause in question. It only applies to patents four years after they have been filed, and comes into force on August 28th next. The clause will eventually lead to an increase in the number of metal filament lamps manufactured in this country, and we may look for a considerable development in this direction even before the end of this year. (Page 10.)

The equipment of the Aldgate and Bow section of the L.C.C. tramways which has recently started running under electric traction, is on the Griffiths-Bedell system already in successful use on a short line at Lincoln. The principal feature of the system is the provision under the studs in the road of a bare feeder cable partly of magnetic material supported on insulators in an earthenware pipe. The body of each stud contains a plunger normally held up by a spring, which, however, becomes magnetic and attracts itself down to the cable and makes contact with it when the powerful

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magnet on the car passes over it. The heads of the studs are of cast-iron, and are sunk into granite blocks, so that they do not project appreciably above the surface of the roadway. The action of the flexible chain which forms the actual collector on the car is somewhat similar to that of the plunger within the stud. Lying normally clear of the road surface in a groove in the surface of the wide pole face of the car magnet, it is attracted down to the iron stud-head and makes contact as it passes over. The plungers in the studs are provided with carbon contacts, although they are not usually required to break the circuit, as the studs are so spaced that the collector does not leave one stud before it has made contact with the next in front. Provision is to be made for through running on the conduit lines, and for this purpose the cars are to be equipped with the ordinary plough as well as the collecting chain. The cars at present running are, however, fitted only with the surface-contact apparatus. (Page 11.)

AMONG the electrical exhibits at the German Shipbuilding Exhibition now being held in Berlin is an interesting electrically operated system for the coaling of ships at sea. Turbo-generator sets of particularly light and compact construction and motor generators for supplying constant current for searchlights are also shown. (Page 16.)

A PAPER was read by Mr. J. HÄRDEN at the last meeting of the Faraday Society upon the Electric Induction Furnace, in which improved forms of the Kjellin Röchling-Rodenhauser electric induction furnaces were described. Quite a number of induction furnaces are already in use in this country, including a 150-kw. Kjellin furnace used by Messrs. VICKERS, SONS & MAXIM, and a 60-kw. experimental furnace at Battersea. (Page 17.)

THE results of some severe tests on a pair of slow speed 1,500-kw. continuous-current generators supplied by SIEMENS BROTHERS' DYNAMO WORKS to the War Department are of interest, as these are amongst the largest machines with commutating poles which have been constructed. Some tests on a 100-h.p. motor with a range in speed of one to six are also given. (Page 20.)

SOME new switchboard apparatus and meters, including a three-phase potential transformer, a portable ampere hour meter and a double reverse current relay for continuous current, are described in a short illustrated article. (Page 21.)

THE collective exhibit which was organised by the Electric Supply Companies of London in the Machinery Hall at the Franco-British Exhibition is now complete. The display consists of a central reception room and information bureau, opposite which is a complete furnished model flat fitted up to demonstrate the domestic applications of electricity. Surrounding these are a number of stands occupied by leading electrical firms. A wide range of electrical activity is represented, and not the least interesting amongst the exhibits are the examples of no less than four new British-made metal filament lamps shown by the SUNBEAM LAMP CO., the EDISON & SWAN CO., the BRITISH THOMSON-HOUSTON CO., and the STEARN ELECTRIC LAMP CO. respectively, some of which are exhibited for the first time. Examples of the new high tension switchgear of Messrs. REYROLLE & CO. are on view, and an interesting feature of the furnished flat is the complete electrical kitchen equipped by Messrs. RASHLEIGH, PHIPPS & CO. (Page 23.)

Mr. F. J. ALLAN, Medical Officer of Health to the City of Westminster, has found the tubercle bacillus in the mouth-piece of a telephone at a public call-office. He had six mouth-pieces in these situations tested by Dr. KLEIN, and only one was so infected. Three years ago Dr. COLLINGRIDGE, Medical Officer of Health to the City of London, made a similar investigation in the case of twelve mouth-pieces, but none were found to be infected either with the tuberculosis or diphtheria bacillus. It is desirable that a better system of ventilation should be adopted in public telephone boxes. (Page 29.)

UNDER "Electrochemistry and Electrometallurgy" is a note on the suggested use of iron resistances for regulating current when charging batteries. At the last meeting of the Faraday Society Mr. A. JOUVE read a Paper upon the new applications of Electrometallurgical Alloys, dealing mainly with the use of silicon alloys, particularly with ferro-silicon. (Page 29.)

UNDER "Electrical Science," in the British and American Section, is an abstract of a Paper on secondary radiation from metals. At the second conversazione of the Royal Society, two new exhibits of electrical interest were shown. In the Continental Section an apparatus devised by JÉGON for testing the sensitiveness of detectors is described. In a Paper by DEMBER, the author claims that he has liberated canal rays from zinc by means of ultra-violet light. An analysis of microphone oscillations by means of the oscillograph is described by DEVAUX-CHARBONNEL. (Page 29.)

THE Radio-Telegraphic Convention came into force on Wednesday. We give an outline of the provisions of the Convention and a list of countries adhering. (Page 10.)

THE accounts of the Bradford Tramway Department show considerable increase in revenue over last year. The receipts per car mile amounted to 10.591d., which is slightly less than last year, but the gross profit has increased from £72,524 to £75,154. The tramway lines from Dalmuir to Balloch, which form the last link of the through route from Glasgow to Loch Lomond, were opened for traffic last Thursday.—The Exeter Electric Lighting Accounts show a net balance of £2,604, which is the largest obtained in any year since the Council acquired the undertaking.—The past year's working of the Fulham Electricity Department has resulted in a surplus of £4,408, of which £1,000 is to be transferred to machinery, maintenance and reserve accounts.—The net surplus shown by the Manchester Electricity Department accounts for the past year is £19,543, of which £10,000 has been paid in aid of rates. (Pages 31-33.)

A LOCAL GOVERNMENT BOARD enquiry has been held into an application by the Manchester Corporation for the loan of £130,500 for extensions to generating plant representing some 12,000-kw. We are able to give particulars of a large number of projected new buildings in London and the provinces which will be of interest to wiring contractors. (Pages 34-35.)

THE tenders of Messrs. SIEMENS BROS. for laying telegraph cables between Victoria and Tasmania has been accepted at the price of £47,955. The tender of Messrs. DICK, KERR & CO. for the construction of tramways between Frien Barnet and New Southgate has been accepted. An order has been given to the OERLIKON CO. for two 6,000 turbo generators for Stockholm. It is announced that the Metropolitan District Railway is about to discontinue the use of pneumatic doors to their carriages and to substitute hand operation. (Pages 35-37.)

THERE was a very good attendance at the Special General Meeting of the Institution of Electrical Engineers on Tuesday last, when the question of the proposed acquisition of the building known as the Medical Examination Hall was under consideration. The financial side of the question was dealt with by Mr. R. HAMMOND, and Mr. W.

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M. MORDEY discussed the subject from the general point of view. Certain members present objected to the hurry in which the matter was being rushed through, and others expressed themselves dissatisfied with the building. An amendment was proposed referring the matter back to the Council, but this amendment was lost by a large majority. The resolution sanctioning the purchase of the building was finally carried unanimously. (Page 38.)

ON Friday Lord CROMER'S Committee passed the preamble of the London (Westminster and Kensington) Electric Supply Companies Bill. This Bill gives the five West End Electric Lighting Companies power to link up for the purpose of mutual supply and also power to supply electrical energy in their respective areas for use outside. A further clause related to the certification of meters. On Monday the Committee commenced consideration of the clauses of the London and District Electric Power Bill. (Page 39.)

A NEW type of automatic switch for use with small auto-transformers supplying metal filament lamps has been devised. The switch is particularly simple in construction and is combined with the transformer in a single case. By a simple arrangement of the connections, the meter shunt losses during periods of inactivity, as well as the transformer no-load losses, are obviated. (Page 40.)

IN accordance with the Census of Production Act of 1906, which comes into force this year, forms are being sent out to electrical engineers requesting statistical information with regard to their business. (Page 41.)

A NEW type of wall connection which can be fixed to the wall without screws, and a new porcelain lamp-holder specially suitable for use in the presence of acid fumes, are described. (Page 41.)

AT the meeting of the British Electric Traction Co., on Thursday, Sir C. RIVERS WILSON, who presided, stated that an unwarranted impression seemed to prevail that the general position of the company was not satisfactory. He wished to emphasise, however, that this was entirely erroneous, for whereas the total amount on the debit side of the balance sheet was £5,009,165, there were assets amounting to £5,658,653. He claimed that very few companies in England could show an equally strong financial position. At the end of his speech he made some remarks with regard to the effect upon the electrical industry of municipal trading. (Page 43.)

A METHOD of changing from series to parallel connection in the control of series-wound traction motors is the subject of a Patent Specification by the BRITISH THOMSON-HOUSTON Co. The change over is effected without breaking the motor circuit. Among the other specifications published on Thursday last was one by G. MARCONI, describing a form of wireless telegraph transmitter for emitting oscillations in regular groups so as to produce a recognisable note in the telephone at the receiving station. An improved arrangement of aluminium electrolytic rectifiers is described in a specification by SIEMENS BROTHERS & Co., and another by the AMALGAMATED RADIO-TELEGRAPH Co. refers to the resistance of microphones used in wireless telegraphy. A specification by the ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT relates to flexible supports for metal filaments. A process for the hardening of tantalum is the subject of a specification by the SIEMENS & HALSKE AKT.-GES., and SIEMENS BROTHERS & Co. have another describing a method of protecting the wires of thermo-electric pyrometers from the action of the vapours and gases given off from molten metal and other baths. (Page 44.)

THE adoption of a surface contact system by the London County Council for a short section of their tramways in the Mile End Road, has been looked askance upon by several groups of persons. These include not only conservative tramway engineers, who will never admit that any good can possibly come of a surface contact system, but also those whose words are prompted by political rather than engineering considerations, and search to find fault with the system because it was adopted by a party not of their way of thinking in other matters. The former point to the small degree of success attending certain other surface contact tramways, from reasons not present in this case, and the latter keep careful record of the few trivial cases of live studs which occurred before the cars were running and before the adjustments were complete. The G.B. system has met with a considerable measure of success at Lincoln, and as the detailed description of the L.C.C. line in our columns this week will show, the equipment possesses one or two most interesting features. The magnetic action by which the collection chain is made to approach the stud at the right moment, and which causes the stud to so to speak lay its finger on the live cable underneath, is ingenious as it is simple. The working parts are few and robust, and there is little to go wrong. A good deal of misunderstanding has apparently arisen as to the cause of the long interval which elapsed between the completion of the track equipment and the running of the cars. This was, however, due entirely to what may be described as geometrical difficulties in the combination in a limited space of the surface contact collecting gear with the plough required for through running on the conduit lines, and must be no more attributed to faults of the surface contact system than to complications of the conduit equipment. We trust that the G.B. system will now receive the fair trial by which its reputation must stand or fall, as a system withstanding the ordeal of the exacting conditions of London traffic can with safety be adopted for almost any class of tramway work.

MR. HERBERT TALBOT, in his Presidential Address to the Incorporated Municipal Electrical Association on Tuesday, dealt with a number of matters which are occupying the attention of borough electrical engineers and their committees, and some that are being discussed in a wider field. An important question which may be included in the category of home politics, and is frequently recurring, is the relation of the assistant electrical engineers to the Association. We must confess that we can quite sympathise with the attitude of the chief assistant who asks what object he can have in joining the Association, since he is not able to go to the meetings when his chief is also absent from home, and as he can also read the Papers and reports of the discussions in his weekly technical journal. In the majority of cases it is obviously not desirable that both the chief engineer and his chief assistant should be away from their towns simultaneously, and in no cases would it be possible for several assistants to be away on leave at the same time; so that it is only when the meetings are at a large centre, such as London or Manchester, near

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which there are a large number of municipal electricity works within a half-hour's or an hour's journey, that any considerable attendance of assistant engineers would be possible. The travelling scholarship scheme suggested by Mr. McARTHUR BUTLER, Secretary of the Association, and taken up with cordial approval by the Council, certainly appeared to be an excellent one, but its results have been disappointing. It only produced one Paper last year, and none at all this year, and has not had the effect of increasing the number of assistant engineers who have joined as Associate Members or Associates. There can be no doubt that it would be an advantage, both to the Association and to the men themselves, if they joined, in greater numbers, the body which identifies itself with the interests of municipal electrical work, and we would urge that consideration be given once more to a proposal which, we believe, was put forward at one time but was withdrawn owing to the lack of enthusiasm of the few assistant engineers who are at present connected with the Association. It is not only these few who are to be thought of, however, but the far larger number who have not found it worth their while to become members of an Association which can offer them only a limited inducement to join. Our proposal is that there be periodical conventions of Associates and Associate Members, for the discussion of Papers and for the same general objects as the present meetings of Members. The section comprising Associate Members and Associates should have their own Committee and a Chairman, who would have access to the actual Council of the Association, and various other details of organisation would have to be elaborated to make the scheme complete. It may be objected that such meetings of Associates and Associate Members only would tend to create a kind of trade union tone among this class, and that grievances would be aired, and combined action threatened against their employers, but we do not believe that there would be any risk of this. The assistant engineer is too well acquainted with trades union methods to wish to imitate them. If meetings were held three or four times a year, every Associate would have an opportunity of attending at least once in the year, for we are confident that there would be no difficulty in obtaining leave for this. A large amount of valuable information would be exchanged, and not only would the whole standing of the assistant engineer be improved, but his knowledge and views of technical and administrative matters would be greatly broadened. Although there are very able men among the ranks of the assistant electricity works engineer, there is certainly room for much improvement generally in this respect. We put this proposal forward as a means of extending advantageously the sphere of utility of the Association, and we trust that it will be taken up once more by those in authority.

IN the discussion on Bailie WIGHTMAN'S Paper, on Tuesday, some speakers made a grievance of the fact that only one Paper invited discussion on subjects of particular interest to Chairmen and Members of Electricity Committees, and urged the Council of the Association to make arrangements for two Papers of this nature at future meetings. Those who spoke, however, do not realise the extreme difficulty that the Council have even in obtaining a single Paper from among the Chairmen of the Electricity Committees. There is a general invitation to any of them to submit Papers, and a number are written to individually and asked to contribute one for discussion, but each year practically all are too modest to express their views in this form. An amusing but eminently practical suggestion was made to us at Tuesday's meeting. One of the engineers should be asked to contribute a Paper on "How to Manage a Chairman," and his Chairman should read a Paper on the same day on "How to Choose an Electrical Engineer." The discussion on such a pair of Papers would be interesting, although it might be necessary that the authors' replies should be curtailed, and that the two writers should be billeted at different hotels.

ARRANGEMENTS FOR THE WEEK

TO-DAY, THURSDAY, JULY 2ND.

Incorporated Municipal Electrical Association.

10 a.m. Third Day of Convention at Nottingham. Annual General Meeting at the University College.

2.30 p.m. Meeting at the University College, when the following Papers will be read and discussed:—(1) "Some Considerations on the Design of a Generating Station," by H. Richardson (Dundee); (2) "The Reconstructions of an Electric Lighting Scheme with Observations on the Working of a Combined Steam and Water Power Plant," by C. M. Shaw (Worcester).

7.30 for 7.45 p.m. Association Dinner at the Exchange Hall.

Royal Society of Arts.

9 p.m. to 12 p.m. Conversazione at the Natural History Museum, South Kensington, S.W.

FRIDAY, JULY 3RD.

Incorporated Municipal Electrical Association.

10 a.m. Fourth Day of Convention at Nottingham. Meeting at the University College, when the following Papers will be read and discussed:—(1) "A.C. Accumulator Sub-station, and the Use of Accumulators for Peak Loads," by A. M. Taylor (Birmingham); (2) "The Work and Equipment of a Testing and Standardising Department," by H. A. Ratcliff (Manchester).

THURSDAY, JULY 9TH.

Tramways and Light Railways Association.

11 a.m. First Day of Annual Congress. Meeting in the Congress Hall of the Franco-British Exhibition, when Sir Clifton Robinson (vice-president) will give a lecture on "The Tramways of the World," followed by a Paper on "Tramway Rail Joints," by Mr. A. H. Gibbings.

FRIDAY, JULY 10TH.

Tramways and Light Railways Association.

11 a.m. Second Day of Congress. Meeting in the Congress Hall of the Franco-British Exhibition, when Prof. C. A. Carus-Wilson will deliver a lecture on "Rail Corrugation."

7.30 p.m. Association Dinner at the Banqueting Hall of the Franco-British Exhibition.

Students' Summer Visit to Newcastle.—The Students' party of the Institution of Electrical Engineers leaves St. Pancras at 10 o'clock on Monday morning, July 6th, going first to Derby, where the works of the Midland Railway Company will be visited. Newcastle will be reached that evening, and on Tuesday afternoon the party will visit the works of Messrs. Ernest Scott & Mountain. The works of Messrs. Armstrong, Whitworth & Co., and those of Messrs. J. H. Holmes will be viewed on Wednesday. On Thursday the party goes over the works of Messrs. Clark, Chapman, Ltd., and the Consett Iron Works. The shipyards of Messrs. Swan, Hunter & Wigham Richardson, and the works of the Harden Collieries will occupy the greater part of Friday, and the Carville power station will be visited on Saturday, the party returning in the afternoon to London. Mr. Moss, Chairman of the Students' Section, will take charge of the party after leaving London.

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THE THIRTEENTH CONVENTION OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION

THE 1908 Convention of the Incorporated Municipal Electrical Association was opened at Nottingham on Tuesday and will be continued to-morrow. The Association met at 10.30 a.m. at the University College, the attendance being about 200. The Mayor of Nottingham (Mr. Councillor Spalding) and the Sheriff (Mr. Councillor Carey) were present and welcomed the Association.

The MAYOR said that this was an exceptional year for Nottingham, for no less than nine or ten conferences were to be held there, but the Corporation would be pleased to welcome them all. He was pleased on this occasion to welcome the Incorporated Municipal Electrical Association, for as far as municipal electricity was concerned, Nottingham was exceptionally fortunate. It was due in a great measure to Mr. Talbot, the President of the Association, that the undertaking had been such a great success. Last year the Electricity Committee contributed no less than £11,500 towards the relief of rates, which must be unique throughout the whole country. Although there might be a little cause for complaint with respect to the price that was charged in Nottingham for lighting, still he thought, on the whole, the inhabitants were to be congratulated on the great success which had attended the undertaking. He trusted that the result of the conference would be beneficial, not only to the Association, but also to the various towns represented by its members. In the name of the citizens of Nottingham he bade the Association a very hearty welcome.

Mr. COUNCILLOR CAREY, Sheriff of Nottingham, said he felt it a great honour to be able to join in the welcome to the Association. It had been said that Edinburgh was the first city in the world, and that Nottingham was second. Although he held that Nottingham was one of the finest cities, it was a great question to him as to whether it could really be classed as second in the world. Nevertheless, he could assure them that they would see much to gratify them and much to please them, not only in the scenery round Nottingham, but also in the various enterprises which the city of Nottingham carried on so successfully.

Mr. H. TALBOT, the Chief Electrical Engineer to the Nottingham Corporation, having proposed a vote of thanks to the Mayor and Corporation for their welcome, which was acknowledged by the Mayor, then delivered his Presidential Address, which is given below.

PRESIDENTIAL ADDRESS.

BY HERBERT TALBOT.

(*Chief Electrical Engineer, Nottingham.*)

Mr. MAYOR, LADIES AND GENTLEMEN—

We are assembled this morning as representatives of Municipal Electricity Supply, either as members of electricity committees or electrical engineers, to commence our Thirteenth Annual Convention. The common ground on which we meet is that of giving an efficient and cheap supply of electricity to all consumers and for all purposes, consistent with the principle that the long hour consumer shall not be called upon to pay part of the cost incurred in supplying the short hour, or in other words, the non-profitable consumer, and I assume that one of the main ideas at these Conventions is to strengthen and encourage one another in our efforts for this attainment.

Before continuing, I beg to thank the members of the Association most sincerely for the great honour they conferred upon me when they elected me President. It is the highest honour which you are able to bestow, and one which any member might be proud to accept. I fully appreciated the great responsibilities of the position, and accepted it with great diffidence, knowing well what able engineers had held the office previously.

I wish to congratulate the members on the continued success of the Association. When it was formed thirteen years ago there were many, I think, who were of opinion that it would be of little use, and would become defunct in the course of a few years. I am pleased to see how much the work of the Association is appreciated by all classes of its members. This, I think, is proved by the continued membership and by the number of members who attend the Annual Conventions. There can be no question to my mind of the utility of an Association like ours, and of the benefits derived by both chairmen of committees and engineers attending our Conventions, for they all have every opportunity of meeting gentlemen interested in exactly similar undertakings, and they are enabled to compare notes and obtain most useful and valuable information, which could hardly be obtained in so pleasant a manner elsewhere.

One very important work which has been carried out by the Association during the last few weeks, which will be mentioned in the Annual Report, has been in connection with the "Home Office Regulations," and I should like to place on record my very high appreciation of the way in which your Honorary Solicitor, Alderman Pearson, your Honorary Secretary, Mr. H. Faraday Proctor, and your Vice-President, Mr. W. W. Lackie, worked in connection with the Conference that was held in Westminster by the Commissioner appointed by the Home Office to hear the views and suggested amendments proposed by a large body of objectors.

ASSISTANT ENGINEERS.

Two years ago your President, Mr. Edgcome, in his address, mentioned the fact that out of a possible 800 assistant engineers eligible for election as Associates, only sixty-one had joined the Association. Although your Council, with the view of encouraging assistant engineers to take an interest in the Association by writing papers, offered travelling studentships for competition, only one such studentship was gained last year by Mr. McCourt, of Harrogate, for his very complete and interesting Paper on "The Value of Photometry in Central Station Work." This year no Paper has been received from any Associate, and the number of Associates has slightly decreased. Now there must be some cogent reason why such apparent apathy is shown by assistant engineers, and I do not think we have far to seek for a solution of the difficulty. With my own assistants, I have asked them on several occasions why they do not join the Association, and the answer invariably is: "Why should we? We *cannot* attend the Convention, and we can read the Papers and Discussions when the proceedings are published." Everyone will admit that many of the assistant engineers of to-day will eventually become chief engineers somewhere or other in the course of time, and I would strongly advise the chairmen of committees and chief engineers to see if something cannot be arranged so that assistant engineers can be induced to join the Association, and thereby become interested in the valuable Papers that are read at our Conventions and in the more valuable discussions which take place. As the Conventions always take place in the summer, when stations are working at their minimum output, it ought to be quite feasible to allow one or more assistants to attend the Convention, and should a difficulty be found in the matter of expense to the assistant, I do not see why his expenses should not be paid by his committee, for most certainly the assistant would become more useful in his work, and the advantage would be with his committee, and at a very trifling cost.

METALLIC FILAMENT LAMPS AND SYSTEMS OF CHARGING.

In his address last year your President, Mr. Fedden, said it was more difficult year by year to prepare matter which contains anything novel and instructive, and as he touched upon almost every subject, I find it much more difficult to do so this year, and as I do not wish to detain you or tire you, I will abbreviate my address as much as possible, as I am certain you will be more interested in the discussion of the various Papers than you would be in any address I could prepare. Having briefly touched upon a few points in connection with our Association, we may, perhaps, turn our attention with advantage to some of the more important considerations which affect our undertakings and the supply of electricity for lighting purposes.

The past year has been comparatively uneventful, with the exception of one feature. I refer to the continually increasing use of metallic filament lamps. It is certainly interesting to note that after over 30 years' careful work in improving the carbon filament lamp, a return should be made to the use of metals and their alloys for the substance of the filament, and it would be interesting to know whether the advent of these lamps will not result in the carbon filament lamps becoming obsolete. What ultimate effect these new lamps will have upon our undertakings it is, of course, impossible to predict, but there can be no doubt that any improvement in

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the present extravagant methods of producing light must eventually prove beneficial to every one.

Of course, the use of these new lamps necessarily involves a considerable reduction in the revenue of an undertaking, but at the same time it is to the immediate advantage of the consumer who keeps his installation up-to-date. One of our up-to-date consumers told me the other day that, by using metallic filament lamps, he would soon bring the cost of lighting his shops down to less than it used to cost him for gas. This reduction of revenue can only be temporary, as the cheapening of the light will have the effect of enormously increasing the number of our consumers, and so necessitate a larger output in the near future, although for the time being it may go hard with contractors for electrical plant, as extensions will not be required so soon.

This brings us to the point as to the best means of increasing the number of our consumers, and I think the fairest way is to offer special inducements to the most profitable ones. This naturally raises the much vexed question of "Flat Rate *v.* Other Methods of Charging." There can be no doubt that the flat-rate method of charging is unjust, and that its only recommendation is its extreme simplicity. The use of a scale of discounts increasing with the number of units consumed only tends to aggravate the injustice. The "maximum demand" system is, after all, the fairest and most equitable method of charging which has been devised up to the present. It falls short of absolute equity, inasmuch as we are unable to differentiate between those who do and those who do not make use of their maximum demand at the time of maximum load on the supply station, but this, I think, is of very slight importance. In Nottingham we use the maximum demand method of charging, and during last year 491 consumers, whose average price was under 3d. per Board of Trade unit, consumed 46 per cent. of the total output of electricity supplied for lighting purposes. The remaining 2,840 lighting consumers took the other 54 per cent. I mention this as my Committee has recently been approached by the Combined Traders' Association, asking them to adopt a flat rate not exceeding 3d. per unit, and when I say that the average price per unit of some of our largest consumers is as low as 1·92d., it seems unreasonable to penalise them for the benefit of the consumers upon whom we lose money.

There seem to be very great difficulties in getting the average consumer to understand this system; difficulties which appear to be in inverse proportion to the number of units obtained at the lower rate. If we could devise some simple method of educating the consumer to understand that a capital expenditure of £4 to £6 must be incurred by the undertakers for every 16 candle-power lamp, or its equivalent supplied, and that approximately 80 per cent. of the plant in the generating station is of necessity standing idle for the greater part of the year, I think he would then admit that, as a consequence, the only rational method of charging is one which allocates to each consumer such share of the standing charges as is incurred on his behalf.

The Registration of Electrical Contractors.

The Corporation of Birmingham has lately issued an announcement stating that it is their intention to register wiring contractors who are authorised to carry out installations in the city. This is a matter which requires much careful consideration. At the outset it must be admitted that a municipality does not appear to be endowed with power to authorise or prevent the carrying out of an electrical installation by any contractor or other person. Nor would it seem that they can refuse to supply such an installation unless the work be done in such a manner as not to comply with one or other of the various Regulations of the Board of Trade. Nevertheless, I cannot but think, and I am sure you will all agree with me, that some scheme whereby workmen should be certified as competent, would prove advantageous alike to the consumer, the supply authorities, and the contractors themselves. Of course, registration would only be a means of minimising, and would not prevent, bad and scamped work, but it would, at least, tend to guard against the deplorable ignorance of some of the electrical workmen of to-day.

It would hardly appear desirable for the municipalities individually to take this work in hand, as a purely local registration would be far too narrow a basis on which to carry out such a scheme. Neither do I think it would be competent for the Association to undertake the work, as it should be of an entirely national character, and would be better carried out by the Electrical Contractors' or similar Association. The registration should be conditional on the gaining of a certificate for the passing of a fairly elementary examination on somewhat similar lines to that instituted by the Worshipful Company of Plumbers.

Town's Refuse as Fuel for Generating Electricity.

At one time it was thought that great results would be obtained by the combination of a generating station with a refuse destructor. There are even now people who refuse to believe that a refuse destructor is not a great financial acquisition to an electricity supply undertaking. Undoubtedly, looked at from the broadest standpoint of the ratepayer, the combination is, perhaps, desirable, as the refuse must be destroyed, and that as effectually and as cheaply as possible. It is a certain fact, notwithstanding, that the handling and burning of the refuse alone costs more than the same output could be obtained for at the coal-fired generating station.

In the case of the Eastcroft Destructor at Nottingham, 28,302 tons of refuse were destroyed during the last year, producing 1,069,885 units. Wages amounting to £2,146, which were paid for stoking this refuse and providing additional engine drivers—otherwise unnecessary, as this output, averaging about 240 kw., could easily have been generated at the main generating station without extra help—brings the cost up to 0·48d. per unit, which would more than pay for the extra steam power required, and to this must be added the increased maintenance and capital charges for plant, &c., at the destructor. Although of such small capacity, the destructor station runs fourteen to eighteen hours per day with a load factor of 28 per cent., and generates 9 per cent. of the total electricity supply for the city.

For the moment this sounds extraordinary and certainly appears to justify the enthusiasm of destructor advocates. They very naturally say: "You have turned out 9 per cent. of your total supply for £2,146, and you say this has cost more than you could have generated it for at your main station. Your total revenue for 11,116,855 units is £90,921. Clearly, therefore, you should pay something for the refuse." A very little consideration, however, will show the higher up the peak of our load curve we get, so does the cost of supplying each unit generated increase out of all proportion, till we come to the last unit at the very top of the maximum load curve, which only occurred one evening in the whole year, which necessitated a capital expenditure of £45, and which brought in the magnificent revenue of 5d. The destructor station of necessity supplies cheap units at the bottom of the curve, and leaves to the main station the task of supplying the expensive ones at the top, with a consequent reduction of the load factor. It must not be thought that I am disparaging the utility of destructors. Towns' refuse must be disposed of, and burning is the most effectual method. This being the case, the cost of burning must inevitably be borne, whether the heat be utilised or not. Under these circumstances it would be a pity not to utilise the heat, even if in so doing the electricity undertaking be asked to contribute indirectly towards the expense of destroying the refuse.

Gas Engines.

As I said at the beginning of my address, our united aim must ever be the giving of a cheap and efficient supply. Unfortunately, in this country we are not blessed to any extent with natural water power, but I think we may look forward with some interest to the possible future introduction of large gas engines, supplied from the waste gases of our blast furnaces. Though the large gas engines at Johannesburg do not appear to have been a success, the report of those engineers who were privileged to view the German installations in October last, was very satisfactory, and I do not think we should neglect to make use of any source of cheap energy.

Batteries.

Much also has been said and written on the subject of batteries for supplying the expensive short hour consumers, who are responsible for the undesirable upper portion of our load curves. I am sure we shall have a most interesting discussion on this subject after the very able paper to be given by Mr. Taylor, who, as you are aware, has devoted much time and attention to this problem.

Reserve Fund.

The vital question of the reserve fund does not appear to receive sufficient attention in many undertakings, although in the early days of a station it may not be possible to set aside a portion of the net profits for this purpose. I do think, though, that as early as possible, this most important fund should be started and added to each year, before anything is given to the relief of the rates. The amount allowed under the Electric Lighting Acts, of one-tenth of the aggregate capital, may, or may not, be sufficient for this purpose, but I am of opinion that it is a wise policy to reach this amount before the plant is

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worn out, or, more likely, becomes antiquated. I suggest that, further than this, and as soon as convenient, a depreciation fund should also be started. With these two funds in existence an undertaking would be placed on a sound financial basis. In Nottingham our reserve fund stands to-day at £43,926, and this sum is invested outside the Corporation.

PURCHASE OF METERS OUT OF REVENUE.

In several of the recent sanctions for loans under the Electric Lighting Acts, the Local Government Board have advised that meters, and so-called short-lived assets, should be purchased out of revenue. This may also be a sound policy, but it must of necessity reduce the profits of the undertaking by the amount so spent. I think it is found in practice that when a trading concern has once given an amount to the relief of the rates, the Finance Committee, or those responsible for making the rate, expect at least the same amount each year, and this will be impossible so long as plant which certainly should be charged to capital account, has to be paid for out of revenue.

UNIFORMITY OF PLANT.

It is surprising when visiting generating stations how many of them look more like museums than modern stations, and why is it? It cannot be that the plant has cost less, or that it is more efficient, for in some stations you will find the same type of engine coupled to various types of generators, and *vice versa*. To have good sound efficient plant should be the first care of every committee. That this can be obtained with uniformity at the same time is a fact that many of us are agreed upon and appreciate. After having decided upon the type of plant to be installed, why change every time an extension of the plant becomes necessary? There are some who will probably say that it is purely a question of cost, but is it? I am glad to say that my committee has provided as good a plant as it is possible to obtain, and as far as practicable have kept to uniformity, and this at no extra cost. It follows that a contractor will make, say, a dozen machines of one pattern cheaper than he will make the same number of different patterns, and you must therefore gain great advantages in the cost. During the fourteen years our stations have been in operation we have only had to repair four armatures and one field coil, and with the exception of one short stoppage during the daytime, the supply has not been interrupted. I hold no brief for the contractors responsible for our plant, but I must admit how much I appreciate the foresight of the members of my committee.

"CONTINUITY" OF COMMITTEES.

Before concluding I should like to say a few words about the continuity of the chairmen and members of committees, and the advantage of the same. If, instead of frequently changing, the same gentlemen remain in office, it allows them to become conversant with all the details of the undertaking, and they eventually must be of more service to the municipality in watching the interests of all concerned. In this city we have been fortunate in retaining two members on the committee for nearly twenty years, one, Sir John Turney, having been chairman for over sixteen years. He was brought up to the engineering profession, and you can readily understand that with his engineering experience it would have been impossible to select a more suitable man to fill the position.

In conclusion, I have again to thank you for the honour you have conferred upon me, and it will be my duty and pleasure to try and make this Convention as instructive and enjoyable as any of the previous ones.

The morning's proceedings concluded with the discussion of Bailie Wightman's "Experiences":—

THE EXPERIENCES OF A CONVENER.

BY BAILIE WIGHTMAN, J.P.

(Convener of the Govan Electricity Committee.)

INTRODUCTION.

When in the usual course the writer was asked by the Committee to suggest a subject for a Paper he replied by sending in the one which he now proposes to deal with. The Committee very courteously asked him to take it up, to which he consented: but he disclaims any intention of pretending that his experience has been of great importance. His hope, he explained, was to bring out the experiences of others who have held a similar position in other towns.

It is about fifteen years since the Govan Order was acquired. It was not obtained with the immediate intention of putting it into operation, but merely as a precautionary measure, and some years later, when the writer was convener of the Watching and Lighting Committee, the first step was taken to enforce it. A Committee was appointed who contented themselves with marking time, until a new interest was awakened by an application from two separate companies and an inquiry from the Board of Trade as to the Corporation's position in relation to the Order. They declined to entertain the proposals of the London companies, and intimated to the Board of Trade that they were at present considering the matter. Another alternative was to hand over the Order to Glasgow, their near neighbour; but the anti-annexation feeling was too keen for this to be done, and they decided to do the work themselves. They therefore asked an eminent London engineer for a report, and requested him to state his fee in the event of their failing to go on with the scheme, as they still wanted to remain free to go back on their tracks. His answer was that he would make no report unless they were prepared to go ahead.

They then turned to a local engineer who was more amenable to their views. He got out a scheme, and after consideration it was agreed that it should be carried out. "Viewed in the light of to-day," Bailie Wightman continued, "it was not a bad scheme. It is quite true that ultimately we found that the buildings might have been erected of a greater height and a greater breadth, and this would have saved us the trouble and expense of taking a good part of them down."

In the staffing of the station, the Committee did not always follow the advice of the consulting engineer, nor did they allow the resident engineer after his appointment to guide them altogether in the subordinate appointments. In spite of these eccentricities, said the author, it is surprising to be able to say that the venture met with such success. He considers it due to the simplicity of the system, the three-wire continuous current, and the perfection of the plant.

Their experience of breakdowns was limited but peculiar, but before relating them, Bailie Wightman pointed out that they had had none during the last five years—at least, none that had come to the writer's knowledge. Once in their first year, when the Bailie was about to retire for the night, a message came from the Chief Constable that all the lamps were out. The Bailie 'phoned the resident engineer, and the answer received was that the "whole thing had burst up." Upon reaching the station, and not being able to get any satisfaction, the writer sent for the consulting engineer, who had the eastern end of the Burgh disconnected from the rest of the system, and set the installation agoing again. It was discovered next day that a slight breakdown in the insulation of one of the feeders near a junction box had caused all the trouble. "The results in the station were sufficiently alarming to cause the 'burst up' message. Alarming, indeed, to one who had never experienced anything of the kind before. A tremendous rattle and maddening whirl of machinery, a sudden flash, and lightning sparks upon the switchboard."

The next breakdown was also graphically described by Mr. Wightman, who added, "it would be more correct to call it a stoppage of supply." "One Sunday evening immediately following the lighting up for the night, through some cause which was not apparent, the lights gradually died away again into blackness. There being no sign of their going on again, the writer 'phoned to the station, and found there was something wrong with the engine. It would not go. On arrival at the station it was suggested by some one to put on the other engine, and in the act of doing so the cause of the trouble was discovered to be want of steam. The stop valve was examined next day, and found in good working order."

The author next referred with some bitterness to the effect which the first year's deficits of an Electricity Committee have on the Convener's chances in the November elections. Another trouble which was alluded to nearly lost the Bailie his seat. "Five and a half years ago our enterprise had reached a point when we needed to make a large extension, and the writer was severely heckled upon the contemplated expenditure. That same year, and at the same meeting, a charge was made against the department of gross extravagance in accepting an offer for goods which it was alleged could be had, and which had been offered at half the cost. In the contract in question, a certain class had been barred, and one tender which did not comply with the requirements was not put by the engineer in his report. When the figures were given and also the maker's name, the writer had to confess that he had never heard of the firm, knew nothing of the offer, and could give the meeting no satisfaction with regard to the charge, further than that he would strictly investigate the matter. A man was put up against him, but ultimately he did not go forward. The writer believes if he had been opposed on that occasion he would have gone down. The condition of the department at that particular time was critical and not strong enough to resist attack."

The Paper next referred with satisfaction to the successful efforts that were made by the Burgh of Govan to prevent the promoters of the Caledonian Power Bill and the Clyde Valley Electrical Power Bill from getting Govan included in their area of supply. The Burgh opposed both Bills, and the grounds of objection were identical: "Having set up under our statutory powers an electrical undertaking, and being able and willing to supply all the wants and requirements of the burgh in the matter of electricity, it would not be in the public

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interest to subject the burghal undertaking to the evil effects of the opposition of a commercial concern—the more so as that company proposed to use our streets and roads for the purpose of the opposition."

After a fight which lasted for nearly three weeks the Committee, of which Sir James Woodhouse was chairman, threw out the Caledonian Bill, and passed the Clyde Valley, but excepted Govan and Partick on the other side of the Clyde, as well as three other towns. In the case of these towns power was given to lay mains through them. This power was refused in Govan unless with consent of the local authority. The author has no doubt that, although probably Govan would, in any case, have been excised from the Bill, it would have been placed similarly to Paisley, through which power was given to lay mains, but for its proximity to the city of Glasgow. Situated as Govan is, unless power was got to go through Glasgow there was no possible use of having such powers in Govan.

Up to that point in their history, the energies of the Burgh of Govan had apparently been directed chiefly towards lighting; as a matter of fact, the designation of the station as printed up on one of the gates was Govan Electric Light Station, and the Committee was known as the Electric Light Committee. The writer thinks that the promotion of the power companies, and their attempts to get a footing in the town, helped to give the Committee a proper view of their position and opportunities. When another extension was considered, they took a much larger and broader view of the situation. It also influenced them in making up their mind that they had come to the point when they might with advantage appoint an engineer with skill to advise them upon this extension, but one also with tact and experience to make the undertaking a commercial success. The usual course of advertising in the local and electrical papers was followed. From the replies received, and judging from their testimonials and experience, a long leet of ten was selected. The writer and another member interviewed the candidates upon the scene of their employment. They wanted to know both the men and their environment, to assist them in forming an opinion. The result was that they were able to present the names of five gentlemen, any of whom they felt confident would be equal to the position.

We give the remainder of Bailie Wightman's Paper in full :—

THE RELATION OF THE CONVENER AND THE ENGINEER.

This is a very interesting point in the development of an undertaking. To determine clearly the line of demarcation, how far and to what extent, the committee as represented by the convener should take part in carrying on the work.

Personally, the writer has no experience of public companies, and can speak with no authority as to the function of a chairman of directors. He can easily imagine that in many companies with a business, no greater than that of our undertaking, the chairman being a paid director with large private interests in the concern, he will take a fairly active part in the direction of affairs.

In a municipal concern the members of the committee are all to a greater or lesser extent engaged upon their daily avocations, and though in our town we have a healthy public spirit, it is too much to ask and more than should be expected, that a public man should give that attention to affairs which probably does obtain in public companies. In the writer's opinion we will best discriminate the relation between the committee and the engineer by determining first the duties and what we expect from the official. His duties as engineer require that he should report upon all proposals which involve capital expenditure, whether they have been initiated by himself or by any member of committee, with a view to their consideration, and when passed it is his duty to carry out the proposals into execution. As manager they involve his superintendence and supervision of the undertaking in all its departments. The appointment of his staff, or by delegation, all salaries and wages of the staff appointments to be approved by the committee.

The duty of the convener, on the other hand, at least so far as the executive part is concerned is purely honorary, and he will be a wise man indeed if he keeps it strictly so. There is nothing the writer can imagine more vexatious to an official than to find his committee meddling and interfering with the work of his staff. There are occasions when opportunity is given him of showing his interest and sympathy with them in their work. The circumstances of municipal management combine to make it absolutely necessary that a good understanding should prevail between the committee and the chief executive officer. This can only be attained if there be mutual sympathy on the part of the convener and the official, and in order to secure this it should be a necessary part of the engineer's duties to keep the convener constantly informed of the doings of his department. He should acquaint him with its progress and developments, and also with all disappointments or "regrettable incidents" which may have occurred. Complete confidence on the part of the chairman in the official, and reliance and trust on the part of the official in the chairman, are essential to success.

At meetings of his committees the convener is the spokesman of the official, and he should be in a position to afford explanations to his committee upon all the details of the work of the undertaking. He would be able to appreciate special difficulties and cases, and confer with and advise the official. Not only would the work of the committee be facilitated, but there is no doubt their joint work would result to the ultimate advantage of the enterprise under their care. When any matter is likely to be the subject of debate it is most desirable that the engineer and convener should know each other's minds with regard to it. They may not hold the same opinions, but it is most conducive to harmonious working if the head of the committee and the head official understand one another's position beforehand.

In conclusion, the writer would be very much at fault if he failed to refer to these annual conventions as being one of the most pleasant experiences of a convener. It is always an interesting thing to talk upon a subject, which one has very much at heart. It has been the writer's privilege for some years now to foregather with kindred spirits, representative of the municipal authorities from Exeter to Aberdeen, engaged in the same work, possessed with the same idea, giving and receiving sympathy, encouragement, and guidance, so that the undertakings which they direct may continue to flourish and be fruitful of much good to every community, and prove a source of strength to the nation.

DISCUSSION.

ALDERMAN PEARSON (Chairman of the Bristol Electricity Committee) said it was always a pleasure to him to attend these annual conventions, and to discuss electrical matters with other chairmen of committees. They had had their troubles in Bristol, but he had very little sympathy with the early remarks of the author where he spoke of getting a provisional order with a view to keeping somebody else out. He did not believe in a dog in the manger policy, and if any municipality had not the pluck to take up an enterprise itself, it should stand aside and make room for somebody else who was better able to do it. As an advocate of the extension of large borough boundaries, he rather thought, if he had been in Govan, he would have been inclined to lean upon his large neighbour, Glasgow, than to endeavour to have a small local station, but possibly looking at Govan from the outside and from the inside the circumstances would be somewhat different. So far as the consulting engineer referred to by the author was concerned, he thought he was wise in refusing to submit a scheme until he knew there was a probability of the work being carried out. Referring to Bailie Wightman's remarks as to breakdowns, Alderman Pearson said that at Bristol, in which city he was Chairman of the Electricity Committee, they had had a very severe fire, and as a matter of fact, to use Bailie Wightman's expression, the whole thing did "burst up" for the moment. The main switchboard was burned out, and for all practical purposes they were dead and gone for some hours. But he did not telephone anybody himself; they telephoned him, and having heard from various directions of the very terrible calamity, he early arrived at the conclusion that a chairman at the station would only be in the way, and that, further, if he had presumed to telephone or telegraph his engineer, his natural ability for blasphemy would be very materially increased. He therefore went to bed and waited until the next morning, when he sent to the engineer a message that when he knew anything about the fire and had anything to report, and had time to report it, he (the chairman) would call a committee and hear what there was to be said. He agreed heartily with the author as to the relationship which should exist between the engineer and the chairman. They had had the services of their engineer at Bristol since the works were first commenced, and he and the engineer had been working together ever since, a fact which had, in his opinion, gone for the good of the undertaking. He warned towns against being too ready to change either the chairman or the engineer under the impression that by so doing they might bring about an improvement. Concerning the author's reference to Parliamentary fights, the Bristol Corporation had had to fight a power company, which eventually was given the right to supply in Bristol under certain conditions. He had no fear of this competition, however, although it must not be assumed that because he had no fear of their competition he did not do his best, in the Parliamentary fight, to see that the possibility of it was reduced to a minimum. He certainly felt that whilst they could afford to treat their attacks with a certain amount of contempt it was wise to see that the attacks were minimised as much as possible, and although Bristol had failed to get total exclusion, they succeeded in putting the power company under such conditions that he should say their getting in was practically impossible. The company had had the powers for four or five years, and the only thing they were lacking to-day, and had been lacking for the whole time, was money. On the question of power supply, for the first two or three years in Bristol they had none, and after three years' working, they rejoiced in being in the position of having two motors, with an aggregate power of 4 h.p., and these two motors vegetated in Bristol for three years. Then, due more to pressure from outside than anything else, they were driven to develop their power load, and during the past seven years they had put on something like 7,000 h.p., which showed that a committee, not too energetic, could secure a power load, and in Bristol he certainly believed that, as time

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went on, this would be one of their most profitable loads. At Bristol they also made the initial mistake which the author said was made at Govan, viz., they began in too small a way. Bristol had a population of 350,000, and they started with two 75 kw. sets. They thought this was as much as they dare go to, and in the summer months they were even frightened to run one of these to supply the comparatively small load; it seemed too extravagant, and they bought a 15 h.p. gas engine, which was solemnly installed under the advice of an eminent consulting engineer, to take the day load in the summer. What became of it he did not know. But they were not going to perpetuate that blunder of doing things on too small a scale. Where they found there was a likely load eight miles away at the mouth of the River Avon, where the new docks were being built, they thought it better to take the extra high tension cables the whole distance from the present station rather than to erect a small station to deal with the Avonmouth district. There would be a loss at the commencement, but in the end they believed the loss would be less than if they had dealt with this new load by the erection of a small station.

Bailie FINLAY (Member of the Glasgow Electricity Committee) said that at Glasgow they also began in a humble way, and when the question of the erection of works was under discussion about 14 years ago, they made a dreadful mistake. They were advised by the wise men of the West to go cautiously, and, consequently, a station was built in the centre of the town, and they paid £9 per square yard for the land. Some of them had preferred a station upon land where there were facilities for water, and rail accommodation for coal and ashes, so that it could be extended from time to time, but when this came before the Council, only three members supported it—himself, a gentleman who had had to leave the country for the country's good, and Bailie Robert Crawford. As pioneers, they were laughed at, but the laugh was on the other side 10 years later. The small station which was put up grew rapidly, and they had to build a new one. Now they had two large stations, one on the north side, and the other on the south side, of the river, the original station having been converted into offices for the electricity department. They were now supplying an enormous amount of electricity for power purposes, and had consumers taking 500,000 units per annum. Moreover, by this means they were gradually making the city free from smoke. He fully agreed that they should not interfere with the technical man at the head of affairs. In Glasgow they had a fire department, of which he was Chairman, and when there was a fire he did not rush out with a hose-pipe to try and put it out.

Col. SINCLAIR (Chairman of the Swansea Electricity Committee) said that, as Chairman of a small installation, he appreciated the troubles of the author. At Swansea they had not started in quite such a small way as some other towns, for they commenced with 500 kw.; with the advent of a power load, however, they soon outgrew this. He had spared no pains to push the power load, holding the opinion from the beginning that this was absolutely necessary to ensure success. In Swansea they had some very small and some very large power users, and they despised neither the half horse-power nor the hundred horse-power consumer. He agreed that when trouble arose at the works, the best place for the Chairman was at home in bed, and not at the works interfering with the man at the wheel. The relationship between a Committee and Chairman and their engineer should be of the closest kind, because the engineer had to depend on the Committee for policy, and he could not carry out his work in a proper manner unless he trusted his Committee, and took them into his confidence, and advised them in every possible way, so that really upon his advice they could shape the policy. He could not let the opportunity go by without once more impressing the great importance of a power load. With the advent of metal filament lamps, undoubtedly the revenue from lighting would be considerably less, and unless this was made up to a very large extent by increasing the power load, the effect would be bound to show itself in the balance-sheet. He advocated giving a power supply at the very smallest margin of profit, because if they got hold of a good customer taking a large number of units, it did not require very much profit per unit to give a handsome result at the end of the year. He felt that some Committees asked too much for power, and frightened the consumers away. In thanking Bailie Wightman for his Paper, he expressed the opinion that there should be two Councillor Papers at each convention, for the Chairman who came to these annual conventions desired to have the opportunity of discussing matters from the commercial standpoint.

Alderman SMITH (Deputy Chairman of the Liverpool Electricity Committee) thought that there was a possibility of Govan meeting with the troubles they had, even if an eminent consulting engineer had advised them. He was prepared rather to look upon the opinions of a man who knew the condition of things in the district for which he was advising, as being the more reliable than those of the man with a big name and a big reputation. He strongly believed in the continuity of Chairmen, and also in looking carefully to the advice of their own engineers, and giving them an opportunity of showing what they could do. In Liverpool they purchased a company's undertaking, and afterwards they took very much the line taken by Bristol, and put one big station some distance out of the town, where land was not £9 per yard, but three shillings and fourpence. They now had another station on a canal, and at both there were all the necessary facilities with regard to coal and water. In Liverpool the output of their undertaking had grown in 10 years from 1,500,000 units to 51,000,000 units, and he thought they might congratulate themselves on having made very considerable progress. Attendance at these meetings had resulted in adding to their knowledge on a good many things that they thought would add to the prosperity of the undertaking. They had tried hiring of motors, not with very much success up to the present, but it was growing.

Alderman BRODIE (Chairman of the Blackpool Electricity Committee) did not agree with the Paper, because his opinion was that there should not be little electrical undertakings. With regard to continuity of service, at Blackpool they had had five Chairmen in two months, and his own qualification for the chairmanship of the Electricity Committee was that he knew nothing about it. They had previously had a consulting engineer, an electrical engineer, and an amateur engineer, with the result that the undertaking had come almost to a standstill. But they had only had three engineers, viz., Mr. Hesketh, who was now in Australia, Mr. Quin, whose sad death they all deplored, and their present engineer, Mr. Furness. He could state that plant had been installed in their works at about £17 or £18 per kw., and within the past twelve months plant had been put in at as low a cost as £5 to £6 per kw., and, moreover, since Mr. Furness had been at Blackpool, the coal and oil costs had been halved, and they turned out between 60 per cent. and 70 per cent. more current.

Bailie MURRAY (Convener of the Edinburgh Electricity Committee) said that in Edinburgh they had received a lot of advice upon running their undertaking. One day a man came to him with a great idea, saying that a great economy could be made if they made the hole in the cable a little bigger; it would not then require so much pressure to get the electricity through. With such ideas prevalent, it was no wonder that conveners who did not know very much about electricity were sometimes a little at sea, and he was very heartily in accordance with the suggestion in the Paper that the Chairmen should restrict themselves to the business part of the undertaking and leave the engineers to themselves.

Alderman COATES (Chairman of the Hanley Electricity Committee) said that his experience as a Chairman for eight years, and a Vice-Chairman for fourteen years, had taught him that a a Chairman should always try to carry his Committee with him. Further, he should give his engineer credit for honesty of purpose and soundness of judgment, and then his engineer would not lead him far wrong. Many errors in their stations had been brought about through not trusting sufficiently the man at the head of affairs. He personally would not dream of interfering with the technical part of the work, but he had always been particularly anxious about the commercial side. He had come to the conclusion that some small stations would of themselves always prove very unprofitable undertakings. Good or splendid results could only be obtained with large undertakings. Taking the case in the Potteries, at Hanley they had a high-pressure alternating-current plant, but what they had lacked all through was a day load. Ten years ago, when the Light Railways Act came into force, Hanley, being a county borough, could have adopted it. But he could not carry his Committee with him on this point, although the running of tramways by the Corporation would have made the electricity undertaking a success. Instead of that, Hanley, being in the centre of six other smaller towns, failed to get co-operation between them, and consequently the North Staffordshire Tramways Co.'s light railway Order was passed, and the lines were run by the British Electric Traction Co. all through the Potteries. In the Potteries three or four electric supply stations had been erected, not one of them very remunerative, all within two or three miles of each other. If these were converted into one large station supplying 250,000 people instead of 60,000, as in Hanley, the success of the undertaking would be assured. He was glad to be able to say that the Potteries were trying to federate, and if they did, and could work upon the lines suggested, viz., to have one large station just on the borders, he did not think any commercial undertaking could be more successful than the supply of electricity in the Potteries.

Bailie JACKSON (Convener of the Partick Electricity Committee) did not agree that it was unwise to take the advice of a local engineer; he might have better knowledge of the district, and be a better guide than an expert from a distance. The Partick undertaking had grown at a very rapid rate during the five or six years of its existence. In Partick the output was 2,000,000 units a year, and they were in the privileged position of having all their streets and public buildings lighted by electricity. The power demand had grown rapidly during the past two or three years, and he thought they could claim to be in a fairly prosperous way as municipal undertakings went.

Bailie FISHER (Convener of the Paisley Electricity Committee) corrected Bailie Wightman in his reference to the Parliamentary decision upon the Caledonian and Clyde Valley Power Bills, and the power given to the latter to lay mains through Govan

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with the consent of the Corporation. As far as Paisley was concerned, he said that the company had to prove before the Board of Trade that it was absolutely necessary to pass through with their mains before they could do so, and evidence was brought to show that from their Yoker power station the company could get to Johnstone at less expense than going through Paisley. He did not agree with some of the author's remarks. At Paisley they had spent £200,000 on the faith of their Provisional Order. They started with a load of 600,000 or 700,000 units a year, but it was now 3,800,000 units per annum. They had not been able to relieve the rates, and he hoped they never would relieve the rates, even when profits were made. The system had been changed from single-phase to two-phase, and the power load was being constantly added to. They also had a tramway load, and he believed the Partick undertaking would prove as profitable as any.

Bailie WIGHTMAN, in his reply, referred to the remarks made as to the employment of the expert. Some gentlemen seemed to imagine that all expert engineers were in London. That was not the case. They had got them in Scotland too, and the expert in question was not only a local, but an expert electrical engineer, even though local, and there was no doubt that he was in a line with experts at that particular time.

After a vote of thanks was accorded the author, on the motion of the President, the meeting adjourned to luncheon at the invitation of the Chairman of the Nottingham Electricity Committee, Sir John Turney, J.P. After some excellent speeches, and the drinking of the toast of Sir John Turney, the Mayor, and the Sheriff with musical honours, the car-sheds and repair-shops of the Nottingham tramways were inspected, and also the St. Ann's power house, which supplies part of the tramways and lighting load of the town.

On Wednesday the whole day was spent in an excursion to Matlock, Bath, and Dovedale. To-day (Thursday morning) the Annual General Meeting will be held, and this afternoon and to-morrow morning technical papers will be read and discussed. Members are also invited to inspect the electricity works at Derby, the Brush Electrical Engineering Co.'s works at Loughborough, the telephone manufacturing works of the British L. M. Ericsson Co. at Beeston, and some of the lace factories in Nottingham.

FOREIGN MANUFACTURERS AND BRITISH PATENTS

THE daily papers are just awakening to the importance of the new Patent Act, which received Royal Assent on August 28th last year. We published the contents of the Act at length last September, and again called attention to its new provisions and the procedure in connection with them in our first January issue, when the major part of the Act came into force; yet, in view of the attention that has recently been given to the "revocation" clause, the operation of which is deferred until August 28th next, we need make no apology for returning to the subject.

Hitherto it has been possible for a foreigner to patent an invention in this country as well as in his own, and the patent remains valid even if he does not manufacture here. In fact, if he had any reason for such a course, he could refuse to import the patented article into this country at all, and even in such circumstances he could proceed against anyone else who manufactured the thing. The Patent Act of 1902 gave anybody interested, and desirous of manufacturing under the patent, the power to put certain procedure into force to obtain a compulsory licence in such a case, but the provision has been practically a dead letter. The new Act of 1907, besides simplifying the compulsory licence clause, gives a more decisive means of action against a foreign inventor who has not manufactured in this country.

If, after four years of the date of the patent, the patented article or process is manufactured or carried on "exclusively or mainly" outside the United Kingdom, the patent is liable to be revoked, on application by "any person." In order that there should be no harshness under this Clause of the Act in the case of patents which were already four years old when the Act came into force, this provision only applies after August 28th next, so that the foreign patentee will have had a whole year to make the necessary arrangements for manufacturing in this country.

Germany and America have both protested against this clause, but public feeling is so strong in its favour that there is little likelihood of the Government sanctioning the principle of exempting any foreign country from its provision. Germany in particular has been persistent, for the first effect of the new clause will be upon a number of processes for the manufacture of dyes, patented by Germans, which have hitherto not been carried out in this country at all. The first effect upon the electrical industry will probably be upon the manufacture of metal filament lamps. Arrangements are already practically complete for the manufacture of tungsten lamps in this country by the General Electric Co., both under the Auer (Osram) and the Just Hanaman process, and the same is the case with other owners of British patents for foreign-metal filament lamps. In many cases there is no great urgency from the manufacturer's point of view, as the patents are not yet four years old, but the tantalum lamp would come under the action of this clause before the end of the current year if Messrs. Siemens have not completed an English works for its manufacture by then. Probably we shall hear more of the matter in the near future.

For the sake of completeness we give the "revocation" clause (Clause 27) of the Act in full:—

(1) At any time not less than four years after the date of a patent, and not less than one year after the passing of this Act (*i.e.*, after August 28th, 1908), any person may apply to the Comptroller for the revocation of the patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom.

(2) The Comptroller shall consider the application, and, if after inquiry he is satisfied that the allegations contained therein are correct, then, subject to the provisions of this section, and unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or gives satisfactory reasons why the article or process is not so manufactured or carried on, the Comptroller may make an order revoking the patent either—(*a*) forthwith; or (*b*) after such reasonable interval as may be specified in the order, unless in the meantime it is shown to his satisfaction that the patented article or process is manufactured or carried on within the United Kingdom to an adequate extent.

Provided that no such order shall be made which is at variance with any treaty, convention, arrangement, or engagement with any foreign country or British possession.

(3) If within the time limited in the order the patented article or process is not manufactured or carried on within the United Kingdom to an adequate extent, but the patentee gives satisfactory reasons why it is not so manufactured or carried on, the Comptroller may extend the period mentioned in the previous order for such period not exceeding twelve months as may be specified in the subsequent order.

(4) Any decision of the Comptroller under this section shall be subject to appeal to the Court, and on any such appeal the Law Officer, or such other Counsel as he may appoint, shall be entitled to appear and be heard.

A Long Lamp Record.—Mr. G. M. Boddy & Co. inform us that a 220-volt metal filament lamp of the type they sell has been burning in a sloping position in an electricity works for 3,170 hours, and does not show any serious blackening. The current is alternating.

Kent Collieries Electrical Plant.—In the Official Referee's Court before Mr. Muir Mackenzie on Monday last, the case of Ernest Scott & Mountain, Ltd., against the Kent Collieries, Ltd., again came up on the question of costs. The judgment, according to which the former company was awarded £2,945 as the balance of the contract price, and the latter company £1,117 on the counterclaim, was given on page 987 of our last week's issue. Mr. C. A. Russell, K.C., for the plaintiffs, held that the plaintiffs had been perfectly justified in bringing the action, and that defendants should pay all costs excepting as regarding that part of the counterclaim on which the defendants had won. Mr. Muir Mackenzie directed the plaintiff's costs of the claim to be taxed as if there had been no counterclaim, and the costs of the counterclaim, relating to those issues on which the defendants had succeeded, to be taxed and the amount deducted from plaintiff's costs.

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THE G.B. SURFACE CONTACT SYSTEM ON THE L.C.C. TRAMWAYS

THE circumstances which led up to the decision of the London County Council last July to adopt a surface-contact system for the Aldgate and Bow section of their tramways have been dealt with in our columns from time to time (see ELECTRICAL ENGINEERING, Vol. II., July 25th, p. 124). The conduit system in use on the Council's other lines could only have been installed in a modified form and at great expense on account of the very small available depth under the roadway over the tunnels of the Whitechapel and Bow Railway, and the ordinary overhead trolley construction was ruled out of court by the refusal of the Stepney Borough Council to allow its erection, although in the neighbouring district of Poplar no such objection was upheld. Recourse was therefore had to the surface-contact system designed by Messrs. Griffiths and Bedell, which has been running with so much success on a smaller scale for more than two years at Lincoln, and previously on an experimental line at Ilford. It was possible to install this system without difficulty within the minimum limits of depth available, and the additional equipment required on the cars could be fitted without interfering with the provision for the plough and trolley of the cars intended for through running on to sections equipped on the conduit or overhead systems (see ELECTRICAL ENGINEERING, Vol. II., p. 107). The cost of installation of the system is considerably less than for the conduit system, but, of course, exceeds, though not greatly, that of the overhead trolley. The comparative costs of maintenance on such a busy route as between Aldgate and Bow remains yet to be seen, although, judging by experience at Lincoln and the simplicity of the system, this is not likely to be heavy. Details of the working costs for the short line at Lincoln for the first year of working were given in ELECTRICAL ENGINEERING, Vol. II., p. 163.

The system as installed on the L.C.C. tramways differs but little in the equipment of the track from that of the pioneer line at Lincoln, but some modifications have been introduced into the arrangement of the collecting gear on the cars owing to the presence of the plough for through running on the conduit lines. The principal feature of the system is the provision under the studs in the road of a bare feeder cable partly of magnetic material supported on insulators in an earthenware pipe. The body of each stud contains a plunger normally held up by a spring, which, however, becomes magnetic and attracts itself down to the cable and makes contact with it when the powerful magnet on the car passes over it. The heads of the studs are of cast-iron, and are sunk into granite blocks, so that they do not project appreciably above the surface of the roadway. The action of the flexible chain which forms the actual collector on the car is somewhat similar to that of the plunger within the stud. Lying normally clear of the road surface in a groove in the surface of the wide pole face of the car magnet, it is attracted down to the iron stud-head and makes contact as it passes over. The plungers in the studs are provided with carbon contacts, although they are not usually required to break the circuit, as the studs are so spaced that the collector does not leave one stud before it has made contact with the next in front.

The general arrangement of the conductor and studs is seen in Fig. 1. The principal differences from the Lincoln equipment lie in the different shape of the earthenware pipe containing the conductor, which is made of an egg-shaped section instead of being circular as at Lincoln, and in the slightly reduced overall length of the studs, which are 1 in. shorter than at Lincoln. The studs are also spaced 6 ft. apart instead of 9 ft., owing principally to the fact that the presence of the plough carrier on the cars only permits of a portion of the car length being available for the collecting apparatus. The available depth above the Whitechapel and Bow tunnel was almost everywhere sufficient for the installation of the equipment, but at one place the level of the roadway had to be raised about 2 in. over a short distance.

The pipe itself is of vitrified stoneware of 5 in. horizontal internal diameter and 6 in. depth; the shape of its section is shown in Fig. 1. It is laid in concrete, and great care has been taken with the jointing. Ordinary duct strip is first placed round the pipe, and a sheet-iron former is then placed over the joint and bitumen poured in. The formers are, however, not removed. Every alternate length is provided with a T projection, on to which is fitted the short, vertical earthenware tube accommodating the body of the studs. The total overall depth of the tube below the rail level does not exceed 17 in. Fig. 2 shows the arrangement of the access boxes which are provided for drawing in the cable at intervals varying from 200 to 400 yd. Drainage pipes are taken from the access boxes, and also from points on the pipe between them, to a concrete sump at the side of the road, as shown in Fig. 3. It has not been thought necessary to connect these sumps to the sewers, as very little water can find its way into the conduit pipe.

The conductor cable itself is of a special construction, as its magnetic properties have to be considered as well as its electrical conductivity and suitability for making contact with the stud switch. The overall diameter of the cable is 1-3/16 in. It consists of a layer of copper strands over a jute core, and then a layer of galvanised iron strands. The external covering consists of a series of iron sleeves 6 in. in length. The smooth, cylindrical surface obtained in this way is found to give a better contact with the carbon block of the switch plunger than the plain stranded cable which was originally employed at Lincoln. The sleeves are simply threaded on to the cable, and not in any way joined together, so that the cable is still sufficiently flexible for convenient drawing in. The cable is laid in lengths of from 130 to 150 yd. The conductivity of the cable is equal to that of a No. 00 trolley wire. Heavier currents could be carried in a cable of the same size by putting in more copper strands and diminishing the jute centre. The insulators upon which the cable is supported are made of vitrified glazed earthenware, and are placed at intervals of 6 ft. immediately under the studs. They are mounted on horizontal galvanised iron pins fixed in the conduit pipe, as shown in Fig. 1. Their form and method of support enables them to act as rollers when the cable is drawn in or out. The arrangement of the access boxes has already been shown in Fig. 2, which illustrates the methods adopted at the section insulators. The coiled up portions of the connections that will be noticed are for the purpose of allowing a certain amount of end-wise movement of the cable when it is desired to expose fresh portions to the stud-switch contacts. The arrangement of the feeders is practically the same as on the L.C.C. conduit lines; one of the insulators is shown in Fig. 4. The feeder cables are run at the side of the street, and connections are brought at intervals to the junction boxes through iron pipes. The working conductor is divided into half-mile sections in the usual way. It will be noticed that the insulator pins are each brought out at one end through the side of the pipe. These projections are bonded together with an earthed iron strip in the ground alongside the pipe. This arrangement,

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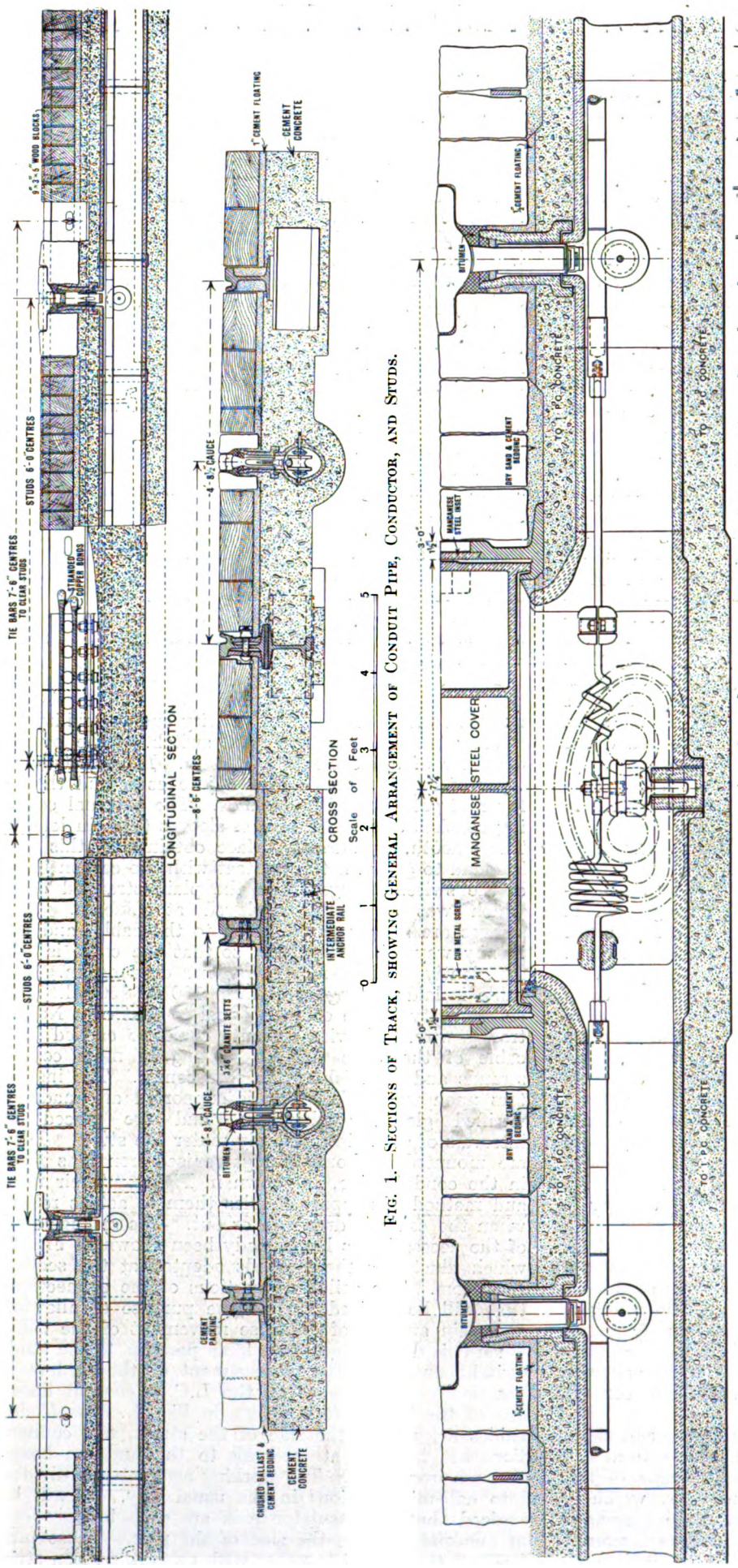

FIG. 1.—SECTIONS OF TRACK, SHOWING GENERAL ARRANGEMENT OF CONDUIT PIPE, CONDUCTOR, AND STUDS.

FIG. 2.—SECTION THROUGH ACCESS BOX.

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which was used at Lincoln, is found to diminish osmotic effects on the insulators and to obviate trouble with leakage due to this cause. The conduit pipe is shown in place in Fig. 5.

The most interesting portion of the track equipment is, of course, the stud itself; a section of the standard stud as used on the L.C.C. line is shown in Fig. 6. The head of the stud is of cast-iron, with a chilled surface 10 in. long and 2½ in. in width. The surface is only very slightly convex, and is practically flush with the granite block into which it is recessed. The body or stalk of the stud is of soft iron, and is attached by a bolt to the head. The lower part of this forms a fork lined with brass. Between the prongs of this fork is suspended the iron switch plunger, which is the only moving part of the track equipment. The movement is limited within a certain range by a pin through the prongs of the fork which passes through a slot in the moving plunger. The iron part of the plunger is enamelled as a protection, and, as we have already said, is provided with a carbon contact block at its base. The carbon contact piece is held in a copper clip, which also extends up the sides of the plunger, and to which are attached flexible copper connections for taking the current to the stud-head. Considerable care has been taken in the design of the helical springs by which the plunger is held up clear of the cable when not magnetised; the making of the stud "dead" after the car has passed depends entirely upon their action. The springs are made of steel piano wire heavily coated with copper, and further covered with a preservative compound. The maximum possible extension to which they can be subjected is well within the elastic limit, and exhaustive experiments have been made equivalent to the extensions that would be experienced in a 20 years' service, but no appreciable alteration in the elasticity was found. The action of the plunger in being, so to speak, repelled by the fork is interesting from the magnetic point of view, and has been the subject of experiments by Prof. J. T. Morris, who has investigated the distribution of magnetism and the force on the plunger (see ELECTRICAL ENGINEERING, January 2nd, p. 7). Under working conditions, the flux density near the end of the fork is about 4,000 lines per sq. cm. Fig. 7 shows the granite blocks for the reception of the studs in position before the paving is completed, and the manner in which the studs can be inserted and withdrawn complete is shown in Fig. 8. When in place, the entry of water into the conduit is prevented by pouring bitumen round the stud.

In addition to the standard studs described above, a few studs of another type are used near junctions and at similar places where there is a possibility of

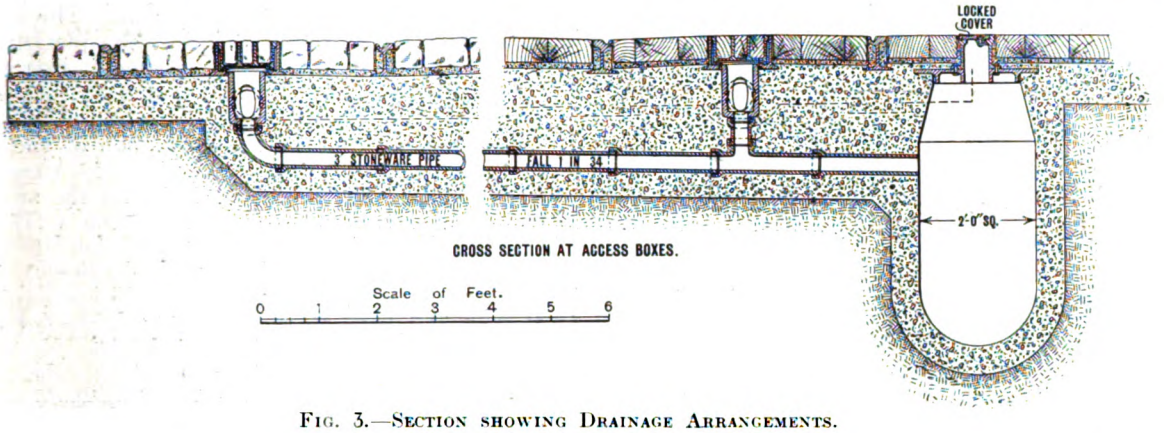

FIG. 3.—SECTION SHOWING DRAINAGE ARRANGEMENTS.

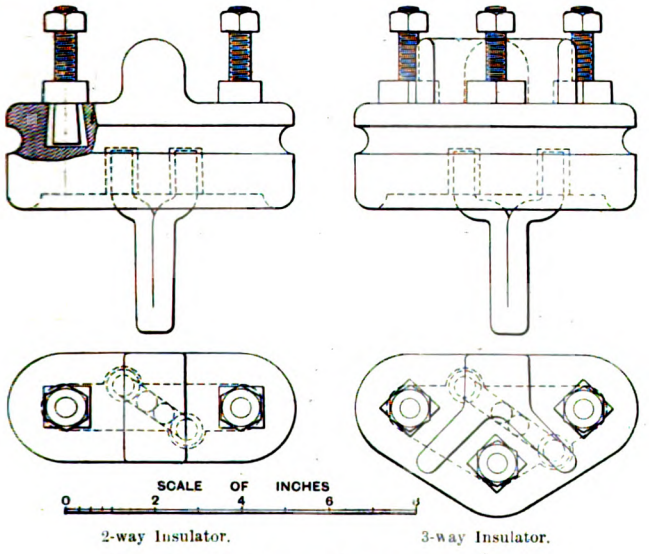

FIG. 4.—DETAILS OF FEEDER INSULATORS.

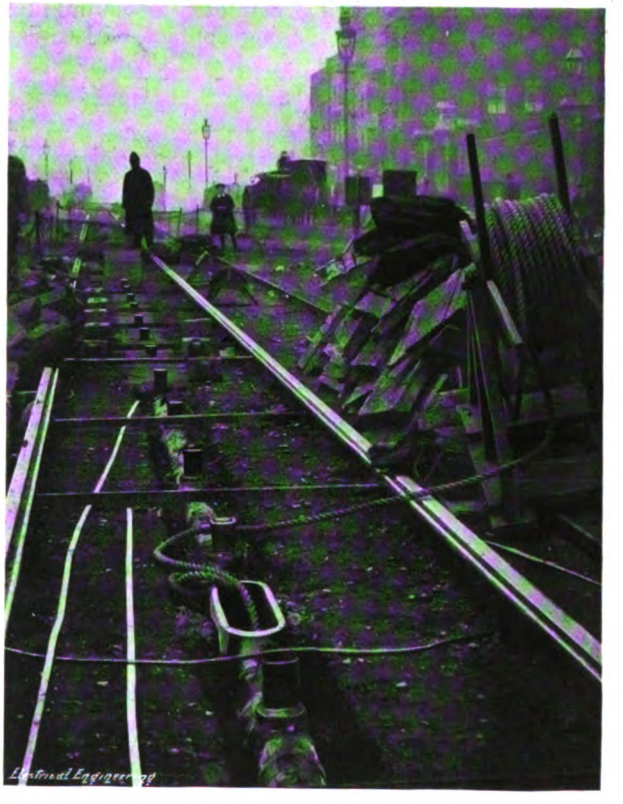

FIG. 5.—VIEW OF TRACK UNDER CONSTRUCTION, SHOWING CONDUIT TUBE IN PLACE.

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pieces of scrap-iron, &c., being picked up by the magnetic collector on the car and caused to trail across the rails and studs so as to form a short circuit. In these special studs, a section of one of which is shown

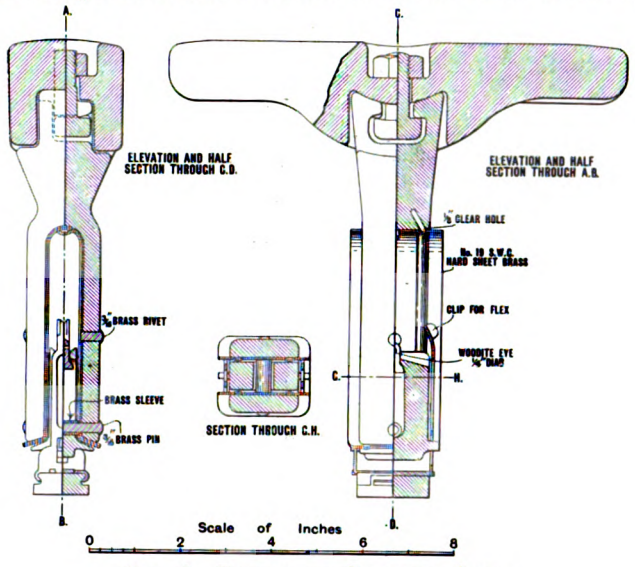

FIG. 6.—DETAILS OF STANDARD STUD.

in Fig. 9, the head is insulated by mica from the lower part, and connections are taken to a resistance of about 8 ohms contained in a pit, so that the short-circuit current is limited to about 60 amperes. About 100 of these resistance studs are required on the section under consideration. In order to avoid the flexible collector being attracted down and producing short circuits by making contact with rails at

FIG. 7.—TRACK UNDER CONSTRUCTION, READY FOR PAVING.

crossings, short sections of rail of a special manganese steel, consisting of about 88 parts of iron to 12 of manganese, and with a permeability of only about $\mu = 1{\cdot}4$, and therefore practically non-magnetic, are employed. It may be said here that the leakage is not any greater per mile of track than with the ordinary conduit system. At Lincoln, for the three miles of single track, it is under 0·2 ampere.

At Aldgate, where the junction occurs with the conduit lines, a short length of both the up and down line is provided with both forms of construction, the surface contact studs remaining in the centre of the track with the conduit to one side. The conduit is arranged to form a loop, so that the plough of a car which has approached from the conduit line can, after being detached, be led round and fixed to a returning car on the other track.

The contract for the reconstruction of the track on the three miles of route was given to Messrs. Dick, Kerr and Co., but all the material for the surface-contact equipment was supplied by the G.B. Surface Contact Co., under whose supervision it was laid. The total value of the contract was £79,850, including cables and ducts (but not including car equipments). Messrs. Bolckow, Vaughan and Co. supplied the rails; the special work was from Hadfield's Steel Foundry

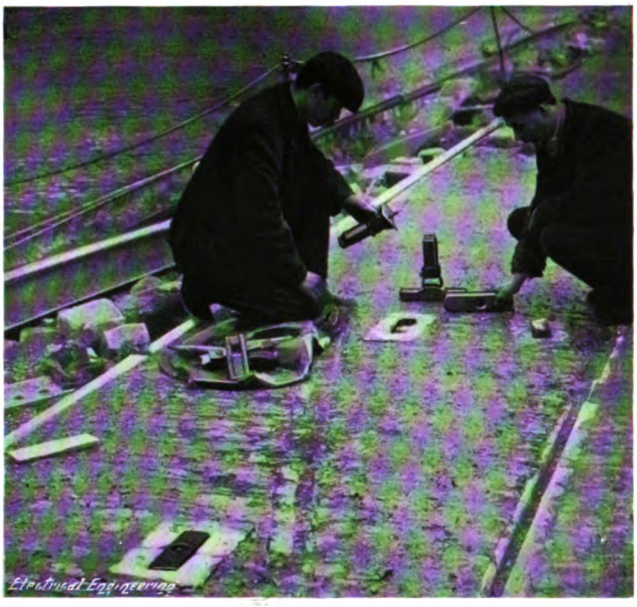

FIG. 8.—INSERTION OF STUDS.

Co., and the Western Electric Co. supplied the cables. It may be mentioned here that the London County Council will pay a royalty of £500 per mile to the G.B. Surface Contact Co., and have the option of retaining or rejecting the system at the end of one year. The street work was commenced last October, and has been complete for some time, but a service of cars was only started last week.

The G.B. equipment is being fitted to 48 double-bogie cars of the L.C.C. standard type, all of which will eventually be provided with the plough apparatus for through running over the Council's slot conduit lines. This through running, however, has not yet been commenced, as the combined equipments are not quite ready. A few cars have been equipped with the G.B. collecting gear without the plough in order to save time, and a service over this part of the lines is thus being maintained for the present. The presence of the plough fittings have, as already remarked, considerably shortened the length available for the collecting chain which has to be fitted at one end of the car owing to the necessity of a clear space right across the car for the sideways movement of the removable plough carrier. This, as we have seen, has entailed the studs being placed a good deal nearer together than at Lincoln, and, of course, an entirely new design of magnet and collector had to be got out

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which required some care in scheming in order not to interfere in any way with motors, brake equipment, and plough carrier.

A general diagram of connections of the car equipment is given in Fig. 10. The principal items are the magnet within which is the contact chain, about which more will be said hereafter, a small battery of accumulators by which it can be excited before making contact with a stud, and a live-stud detector with automatic switch. The battery is arranged so that the current through the motors assists the battery in energising the magnet, and when above a certain value recharges the battery. The live-stud detector simply consists of a short auxiliary collector at each end of the car in circuit with an automatic cut-out which breaks the motor circuit when a stud which has remained alive after the main collector has left it is passed over.

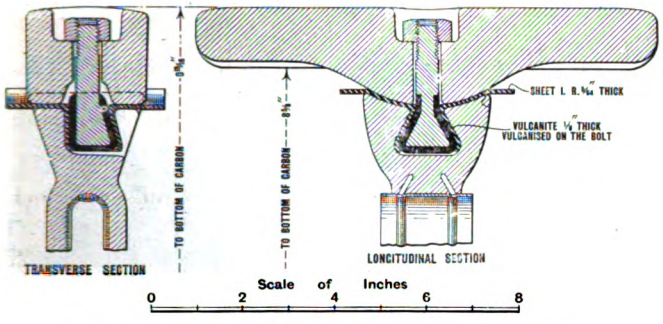

FIG. 9.—DETAILS OF HEAD OF RESISTANCE STUD.

The magnet has the field coils on horizontal yokes connecting the long pole-pieces ladder fashion. The pole containing the collecting chain is, of course, in the centre of the car, and the magnetic flux therefrom passes through the earth and through the studs and back to the other pole at the side of the car. The magnet is rigidly attached to the unsprung portion of the truck by insulating bolts, and is arranged with a clearance of about 2 in. above the roadway; the excitation required by the magnet is about 11 amperes at 18 volts.

The collecting chain consists of a series of special shaped iron links, each 5 in. long, strung on to and clamped with set-screws to a steel wire rope, the ends of which are secured to extensions of the magnet pole. A series of springs normally hold these links up, but when passing over a stud they are pulled down by exactly the same magnetic action that causes the switch-piece in the stud to descend into contact with the cable, in the manner shown in Fig. 11. The actual pull between the chain and the stud is adjusted at from 2 to 3 lb., and the tractive effect is negligible, as it does not exceed a few ounces. The general arrangement of the collector magnet is shown in Fig. 12.

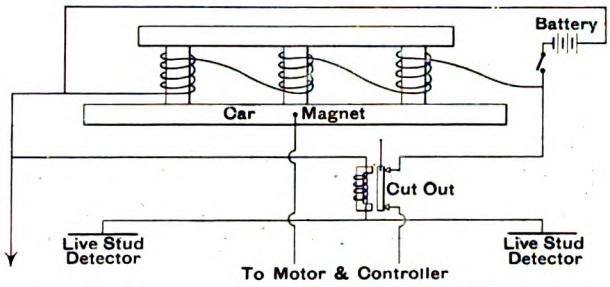

FIG. 10.—DIAGRAM OF CONNECTIONS OF CAR EQUIPMENT.

FIG. 11.—SKETCH SHOWING ARRANGEMENT OF CONTACT CHAIN.

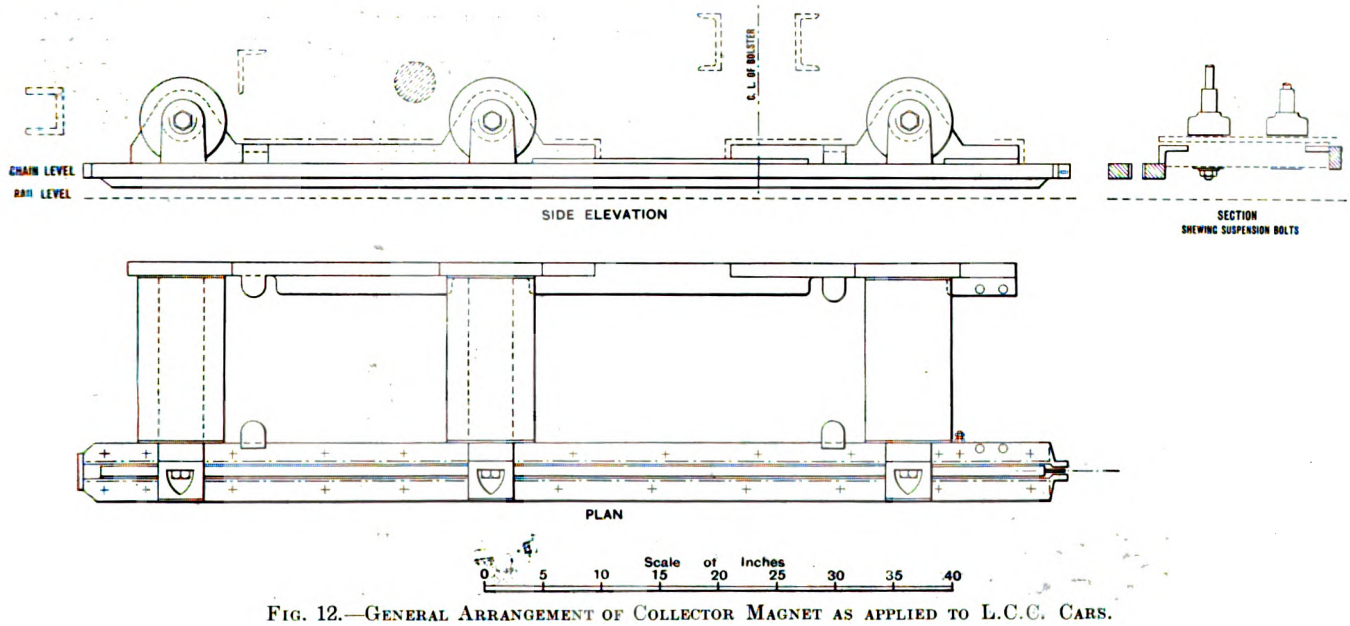

FIG. 12.—GENERAL ARRANGEMENT OF COLLECTOR MAGNET AS APPLIED TO L.C.C. CARS.

The permanent way and track work has been carried out to the designs of Mr. Maurice Fitzmaurice, C.M.G., Chief Engineer to the London County Council, and the electrical part of the equipment has been under the supervision of Mr. A. L. C. Fell, Chief Officer of Tramways to the Council, and Mr. J. Rider, Electrical Engineer to the Tramway Department.

Wireless Telegraphy.—H.M. Commercial Attaché at Yokohama (Mr. E. F. Crowe) reports that arrangements have been completed for wireless telegraphy at Choshi in Shimosa Province, near Cape Inuboe, the most easterly point in Japan, and that messages can be despatched to vessels within 120 nautical miles of the station. The charges are treble the ordinary land rates, or double if the telegram does not pass over the land wires. It is intended to establish public wireless stations later at Shiwomisaki in Kishu, Osezaki on the Goto Islands, and on Tsunojima in Choshu. The steamers on which the apparatus has been installed are those of the Nippon Yusen Kaisha and Toyo Kisen Kaisha, which sail to America.

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GERMAN SHIPBUILDING EXHIBITION

Exhibits of the Felten & Guilleaume-Lahmeyerwerke A.G.

AT the German Shipbuilding Exhibition now being held in Berlin, the Felten and Guilleaume-Lahmeyerwerke A.G., of Frankfurt, have several exhibits representing some interesting applications of electricity on board ship. One of the most striking of these is a model of the Adam system for coaling warships at sea. The principle of this system is shown diagrammatically in Fig. 1, in which the warship is assumed to be tugging the collier by means of a hawser. The endless cable, *d*, is carried round the cable sheave, *r*, which keeps it in motion, and also round the pulleys *e*, *f*, *g*, *h*, *i*, the tension pulley, *a*, and the pulleys fixed to the decks of the two ships. The cable

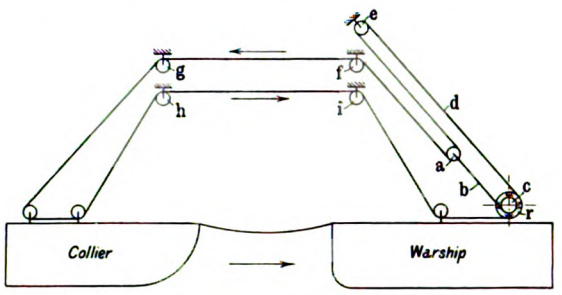

FIG. 1.—DIAGRAM OF THE ADAM COALING SYSTEM.

sheave *r* is mechanically coupled to the magnet system of the motor, and the cable is kept continuously moving in the direction indicated by the arrows. Both the field-magnet system and the armature of the motor are capable of rotation, as can be seen from an inspection of Fig. 2, which shows the motor with cable sheave and drum complete. The pinion on the right of the figure is connected to the magnet system, and drives the cable sheave, while the pinion on the left is connected to the armature and drives the drum *c*. To this drum is attached one end of the tension rope *b*, the other end being fixed to the tension pulley *a*. When the motor is switched on, the magnet system rotates, keeping the endless cable moving. The armature exerts a definite torque, and rotates in the opposite direction, winding in the tension rope *b* until the pull on this is equal to the torque of the armature. If the distance between the ships increases the pull on the tension rope overcomes the torque of the armature, and some of the rope is unwound. If, on the other hand, the ships approach one another, more of the rope is taken in, and so the endless cable is kept at a fairly constant tension. These actions are quite automatic, and the apparatus responds quickly to alterations in the distance between the ships. Where the cable leaves the ship, it passes through a fixed metal cone (coming out at the apex of the cone). A running noose made from a loop of stout cord is slipped over the cone and attached by means of a small iron hook to the full or empty sack, according to whether the cable is leaving the coaling vessel or the warship. The sack is pushed forward and the noose slips off the cone on to the cable. The weight of the sack draws the noose tight and the sack is carried along to the other ship. The cable is drawn so tight round the pulleys, that when the sacks pass the pulleys there is no chance of the cable being pulled off. At the receiving end, the cord supporting the sack is cut by two knife edges, just before the sack touches the deck. The whole apparatus takes up little room, and on account of the method of bringing the cable down to fixed pulleys on the far

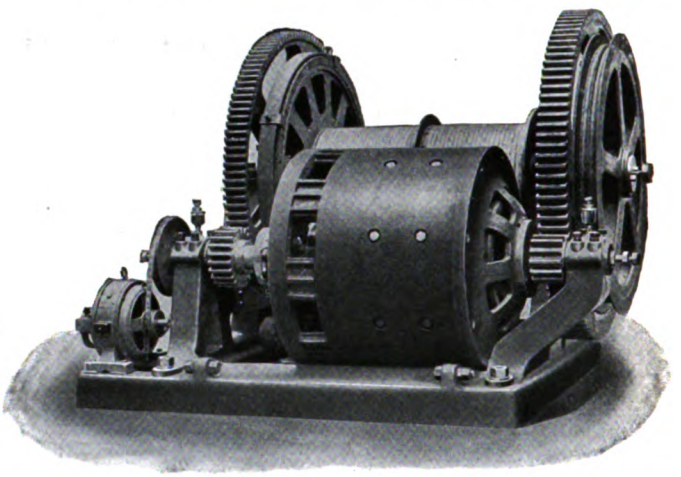

FIG. 2.—ADAM COALING WINCH.

sides of the masts, the tension on the masts themselves is not very great.

The turbo-generator illustrated in Fig. 3 is of especially compact and light construction for lighting and power supply on board ship. The turbine is a five pressure-stage Zoelly turbine, constructed by Escher Wyss & Co., of Zürich, and rotates at 3,600 revs. per min. An extra inlet valve is supplied, by means of which live steam can be admitted at the third pressure stage, and the continuous output increased to 25 per cent. Speed regulation is effected on the "servomotor" principle, by throttling the steam at the inlet valve. With this arrangement, on suddenly taking off the load, a speed variation of at most 4 per cent. is obtained. A further safety device is provided, which closes the inlet valve directly the speed exceeds the normal by 10 per cent. The continuous-current generator is a 220-volt 65-kw. machine. On account of the high peripheral speed, the commutator is constructed in two sections. Carbon brushes are used. Forced lubrication at a pressure of two atmospheres is provided, and the oil is cooled by circulating water in the tank under the bedplate.

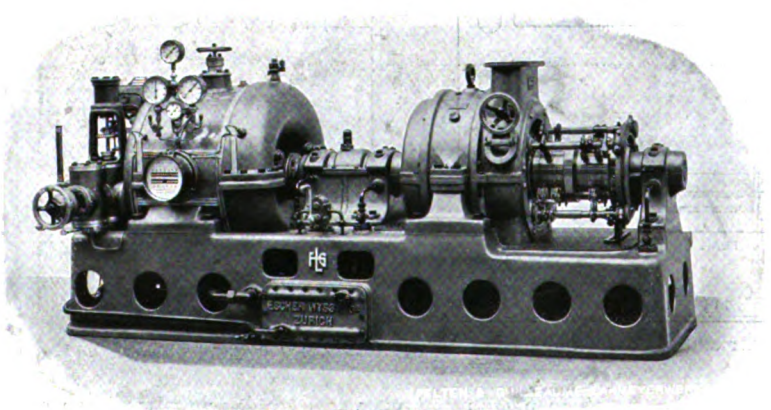

FIG. 3.—65-KW. ZOELLY TURBO-GENERATOR.

FIG. 4.—6 H.P. MOTOR-GENERATOR.

Another interesting exhibit is a motor generator especially designed for supplying searchlights. The generator will supply a constant current of from 150 to 200 amperes at from 0 to 60 volts, independent of the resistance of the external circuit. The

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motor is an ordinary shunt motor, but the generator, although a two-pole machine, is supplied with four sets of brushes; the brushes from which the current are taken for supplying the lamp are in the neutral zone, as usual, but the auxiliary brushes are at right angles to these, and each of the two field windings is connected across from a main brush set to an auxiliary brush set. The poles are divided in order that the auxiliary brushes shall not lie in a strong field. A winding connected across the mains produces a constant field in the armature axis, and another series winding producing a field in the same axis, carries the load current. The value of the constant current is altered by varying the number of turns in this last series compensating winding.

A compact construction for a motor generator for supplying alternating current to the wireless telegraph installation is illustrated in Fig. 4. The set consists of a 6-h.p. 1,500 r.p.m. shunt motor, and a 50-cycle single-phase generator developing 3·6 kw. with a power factor of 0·6. The generator voltage can be varied in 28 steps from 20 to 110 volts.

Ventilating fans, crane and hoist controllers, and various signalling systems are also exhibited, and examples of telephone, telegraph, and power cables are shown by the cable department.

THE KJELLIN AND RÖCHLING-RODENHAUSER ELECTRIC INDUCTION FURNACES

AT the last meeting of the Faraday Society, Mr. J. Härdén contributed an extremely interesting Paper upon the "Electric Induction Furnace," mainly in connection with the Röchling-Rodenhauser modification of the Kjellin furnace. In working with the original Kjellin furnace some disadvantages were experienced when dealing with large amounts of material, for instance, with charges of three tons or more. In such cases the section of the bath becomes very large, thus causing a low resistance and a consequent decrease in the power factor. If it is tried to increase the resistance by making a ring of wide diameter and small section, the distance from the primary becomes greater and the power factor is again lower. Consequently it was found necessary to employ a generator of very low periodicity for such furnaces, and this, of course, is not desirable. Furthermore, the processes of desulphurisation and dephosphorisation become very tedious, because it is difficult to keep the slag sufficiently liquid for such purposes. Nevertheless, this class of furnace will still hold its own for making special crucible steels, because for this purpose it is almost ideal.

In the case of crucible steel, it must be remembered, we rarely have to deal with more than one ton, or at the most one and a half tons at one time, and as it does not pay to use crude raw material no actual refining is required, but simply melting and "killing," and for this class of work plain induction furnaces can be used which will answer very well at 15 to 25 cycles per second. But for refining material smelted from inferior ores which still contain from 0·1 to 0·2 per cent. of sulphur, and 0·05 or more of phosphorus in quantities of from 5 to 7 tons, it was found necessary to modify the furnace. The modified furnace is a transformer furnace with two ring-shaped baths adjacent and communicating with one another, in case of a single-phase furnace, and three such baths in the case of a three-phase furnace. The hearth is square or rectangular, and is placed in the centre between the rings with doors both at the back and front. In exterior appearance it is very much like the Siemens open-hearth furnace, but the principal feature is the heavy secondary winding of copper cables wound round the primary and conaxial to it (one on each leg of the core), surrounded by the rings forming the charge. These copper secondaries which consist of only a few turns are connected to conducting plates—which one can hardly call electrodes, for reasons which we will give immediately—built into the furnace wall, two in front, and two at the back for single-phase furnaces. They consist of corrugated cast steel plates and a compound of magnesite and dolomite, and tar is applied firmly over the corrugation. When cold these plates do not conduct well, but as soon as the furnace is charged with molten raw material they function as a conductor of the "second class," and readily allow the passage of the current. About half of the power is transmitted to the charge by induction in the rings and the rest of the power through the side plates. As the copper

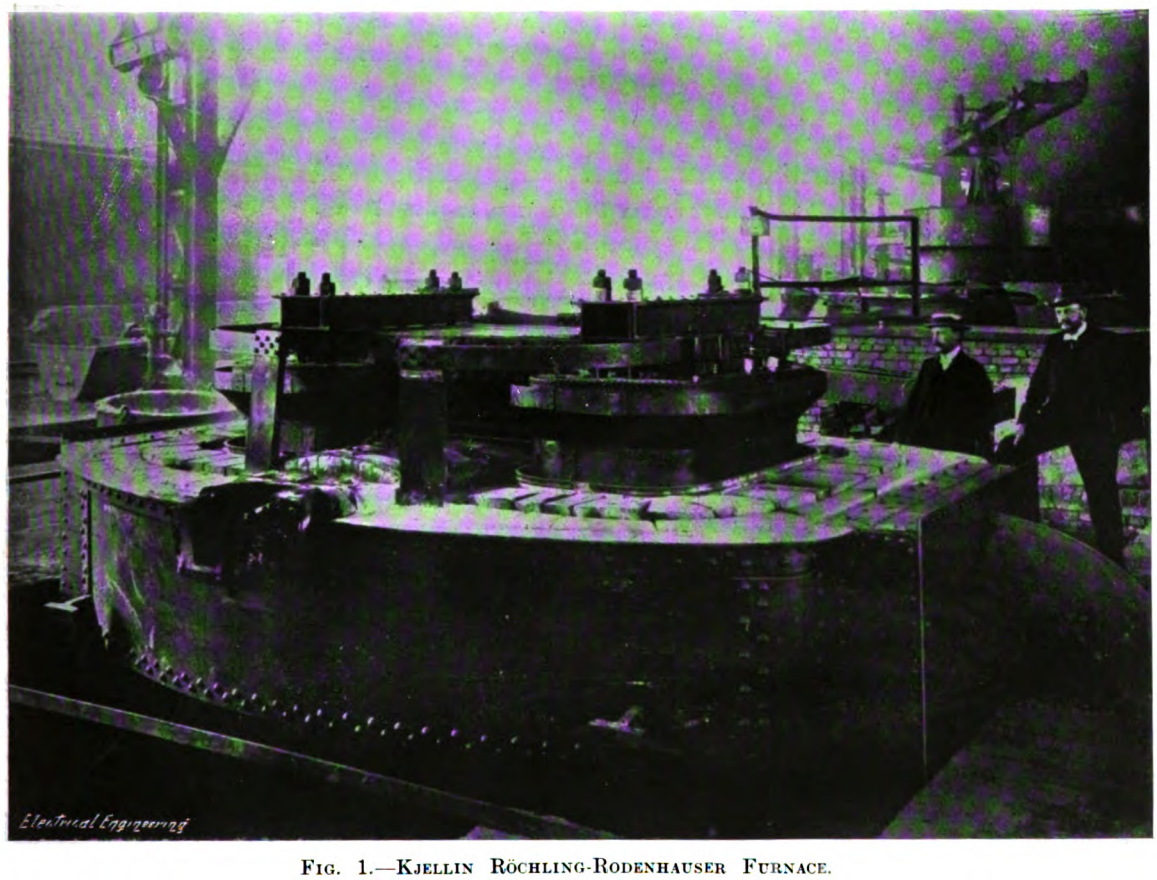

FIG. 1.—KJELLIN RÖCHLING-RODENHAUSER FURNACE.

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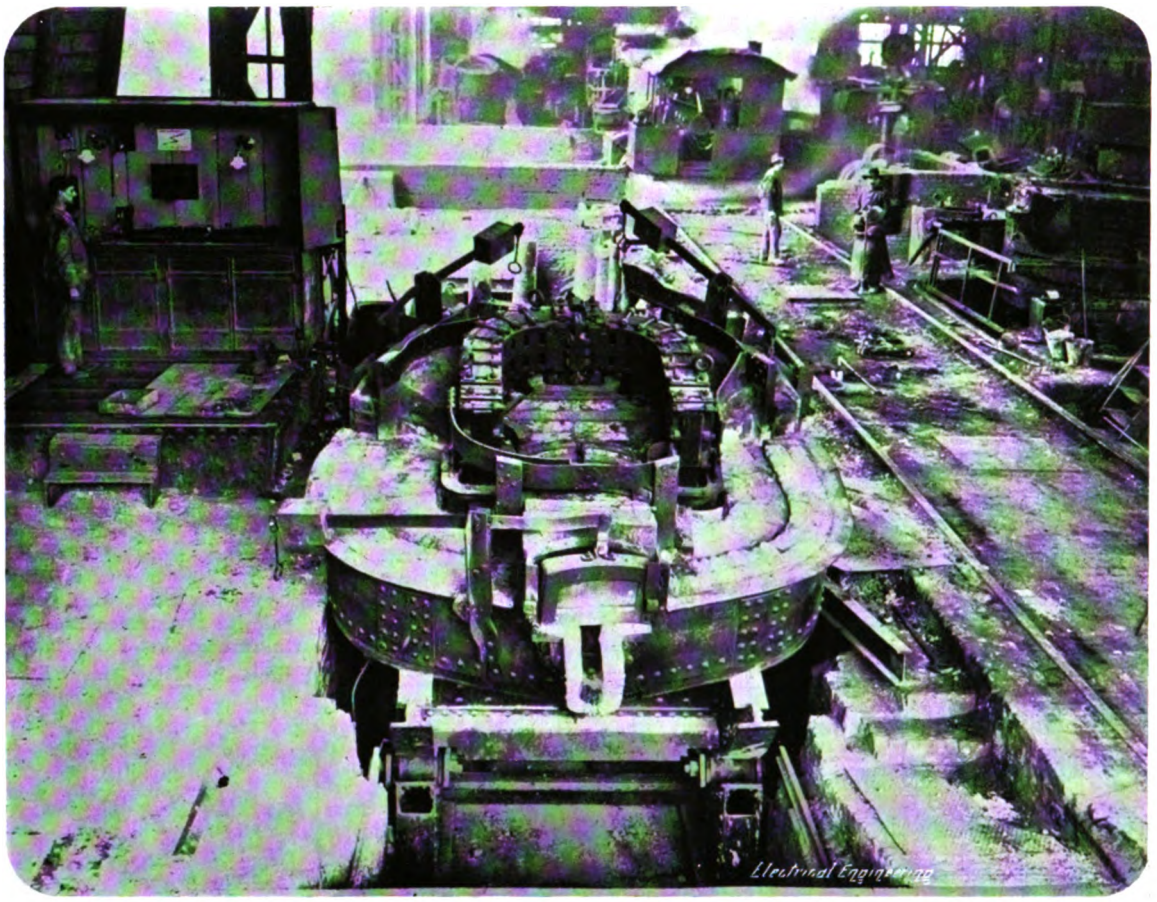

FIG. 2.—FURNACE PARTLY DISMANTLED, SHOWING RINGS.

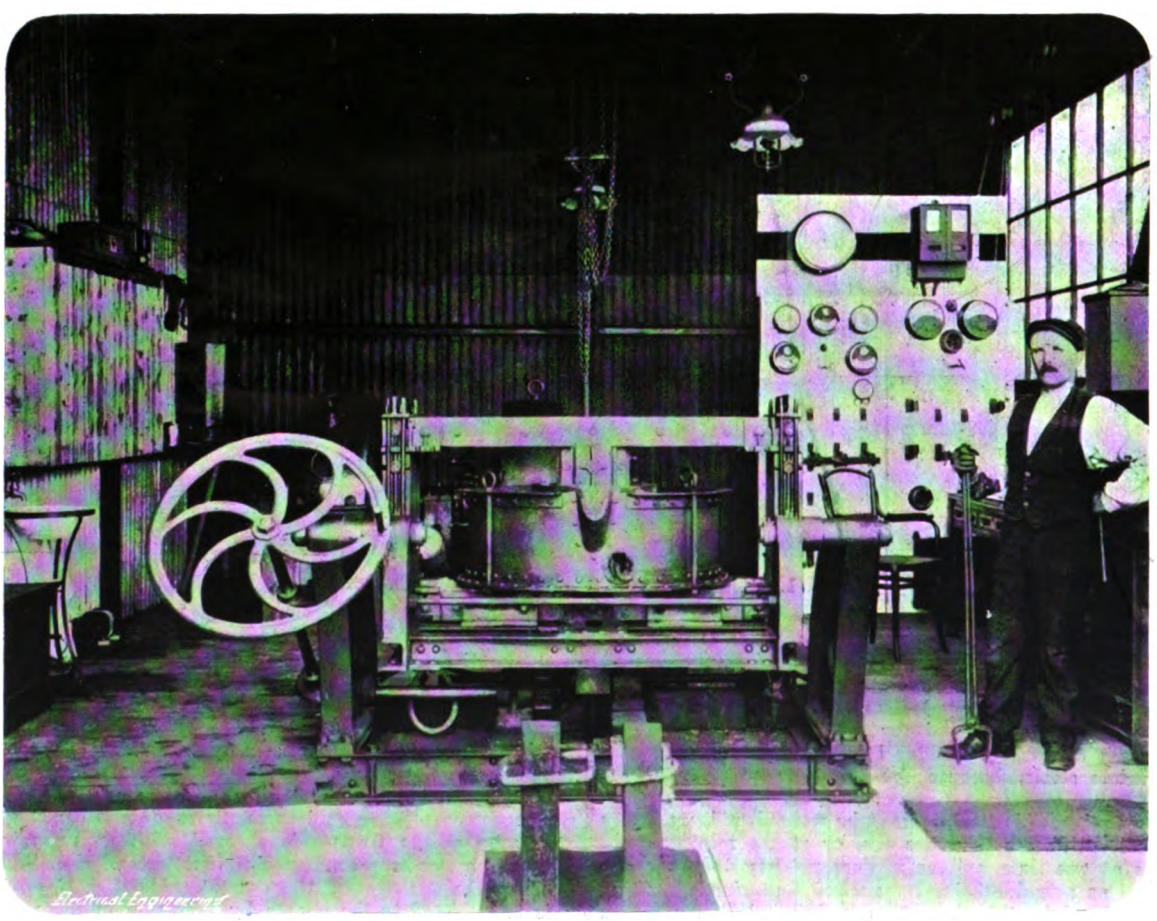

FIG. 3.—EXPERIMENTAL KJELLIN FURNACE AT BATTERSEA.

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secondary is placed very near to the primary, the leakage field is very much smaller, in fact, three furnaces for one to one and a half tons are now in operation with 50 periods at a power factor of 0·7 to 0·85; such a result could never be obtained with a plain induction furnace of a similar size, in spite of "bifilar" baths and other devices which have been tried. A still more important gain is in the metallurgical possibilities which can be obtained with the new design. For the carrying out of any refining processes in steel we must have a sufficiently liquid silica, and be able to handle the same. This is to a certain extent obtained in some "electrode furnaces," where an arc plays between carbon blocks and the slag blanket. Sometimes, however, this proves troublesome owing to the temperature being extremely high at the spot where the arcs are playing, and for some classes of steels this is a distinct disadvantage. If the carbons are dipped directly into the molten metal they are at once consumed, and the steel becomes contaminated.

With the combined furnace just described the conducting side plates are of quite a neutral nature, as they are practically not corroded. In one case, for example, where the furnace had been in use, day and night, for three months, the plates were so little corroded that the amount calculated per ton of steel could hardly be determined. Part of the power is induced in the rings, thus heating the charge, and the rest passes through the side plates only to such an extent as has been proved by experience to be necessary in order to obtain a sufficiently liquid slag. The ring-shaped part of the bath is covered with bricks, the height being slightly below the level of the charge in the centre bath, consequently no slag can enter into the rings, and as it is the slag which is injurious to the lining, the rings need hardly any repair during a long run, whereas the rectangular bath in the middle is easily accessbile and can be easily repaired.

It is evident from what we have stated that the steel side plates are not really a return to the old system of electrodes, because practically no consumption of these plates takes place. Before using the furnace the lining is first stamped in, the tar is burned out either by heating a cast steel ring or by pouring a small quantity of pig iron into the hearth. The pig iron is then teamed for treatment in the Bessemer converter, and a fresh charge is given which is tapped direct from the converter. It is found more economical to burn out the carbon and the silicon in the converter before refining from phosphorus and sulphur. Burned lime is added to form a suitable slag, the slag only containing about 6 per cent. magnesia, and, if necessary, a small quantity of fluorspar is added to act as a flux, and plate scale from the rolling-mill for decarbonisation. The slag takes up the phosphorus very readily, and it is then made more viscous by the application of cold lime and drawn off through the slag door by slightly tilting the furnace.

When the dephosphorising is finished the first slag is entirely removed, a fresh one consisting of lime alone is formed, and this, when the temperature is raised, acts as a desulphuriser. The oxygen is also driven out in this operation partly by the addition of small quantities of ferro-silicon and partly by calcium carbide, which is presumed to be formed *in situ*. Finally the maximum power is given in order to drive out the last trace of oxygen, and as soon as no more gas bubbles are seen to leave the charge a test piece is taken out and forged. If it happens to be too soft some coke powder is thrown in until the right properties are obtained. Generally speaking, the charge is finished in one and a quarter to two hours, but, if required, steel can without disadvantage be kept in the furnace for ten hours or more.

The final product is especially distinguished by its great strength, equality, and homogeneity. Rails have been made which showed a much higher bending and breaking point than ordinary Bessemer or Thomas rails, and these command in the market from 25s. to 45s. per ton more than ordinary rails owing to their greater durability.

It may be of interest to know that in this country Messrs. Vickers, Sons & Maxim have a 150 kw. Kjellin furnace, and they also built one of the same capacity for the American Electric Furnace Company, which is working upon the Canadian side of the Niagara Falls, and the Gröndal Kjellin Co., Ltd., have a 60-kw. experimental furnace near Battersea. In Germany a number of the Röchling furnaces are being installed and are giving great satisfaction. Messrs. John Brown & Co., Sheffield, and also Messrs. Wm. Jessop have each of them a Frick furnace. In France the Héroult electrode furnace is mainly used.

TESTS ON SOME LARGE CONTINUOUS-CURRENT MACHINES FOR THE WAR DEPARTMENT

BY the courtesy of Siemens Brothers Dynamo Works, Ltd., we are enabled to give particulars of tests made on some interesting machines which they have recently supplied to the War Department. Fig. 3 is a view of two large generators, which are of special interest as being amongst the largest machines yet built with commutating poles. They will be driven by triple expansion vertical type steam engines supplied by Messrs. Yates & Thom. The armatures will be bolted

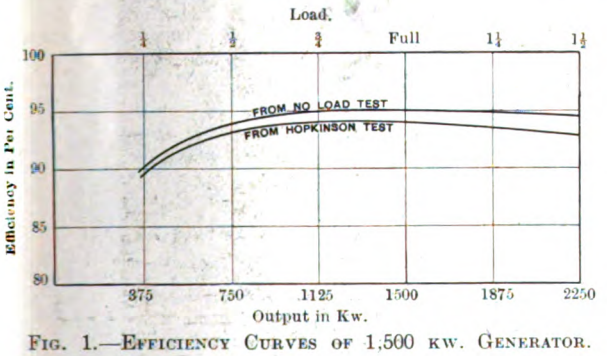

FIG. 1.—EFFICIENCY CURVES OF 1,500 KW. GENERATOR.

directly to the engine flywheels. There are 14 shunt-wound main poles, and an equal number of commutating poles, through the windings of which the whole load current of the machine passes in series. Each machine is designed to give 2,900 amperes continuously at from 500 to 530 volts, or 1,500 kw., when driven at 85 r.p.m. The specified temperature rise of the hottest available part after 12 hours' run on full load is not more than 70° F. (39° C.), and the efficiency not less than 93 per cent. by the Hopkinson test. The specified overload capacity is 25 per cent. for two hours. These specified figures were more than fulfilled on test, the temperatures coming out very low, and the efficiency 94 per cent., that is, 1 per cent. above guarantee.

The machines are constructed as follows:—The yoke is of cast steel, but the main poles are laminated throughout; both the latter and the commutating poles can be removed without

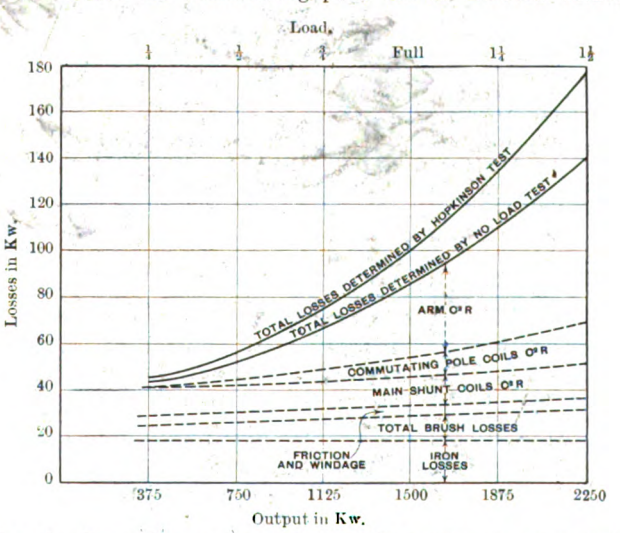

FIG. 2.—TOTAL LOSSES OF 1,500 KW. GENERATOR WITH VARYING LOAD.

dismantling the machine. The armature is of the slotted drum type, and is built up of soft iron laminations, with specially small hysteresis loss. It is mounted on a cast-iron spider, and is well provided with ventilating ducts. Former-wound and interchangable armature coils are employed, and are kept in

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place in the slots by wooden wedges through the whole of their length, the end connections being secured against displacement by centrifugal force by a special steel binding ring, easily removable. The insulation of the coils consists of layers of mica and presspahn, which are held together with shellac, and moulded while hot over the group of previously taped conductors. A suitable number of equalising rings of large section are provided. The commutator is of hard-drawn high-conductivity copper, and is insulated with mica. Each segment was carefully milled to the correct taper before being built in, and the whole subjected to a heavy pressure before being machined. The brushes are of carbon, the current density at full load being about 30 amperes per square inch.

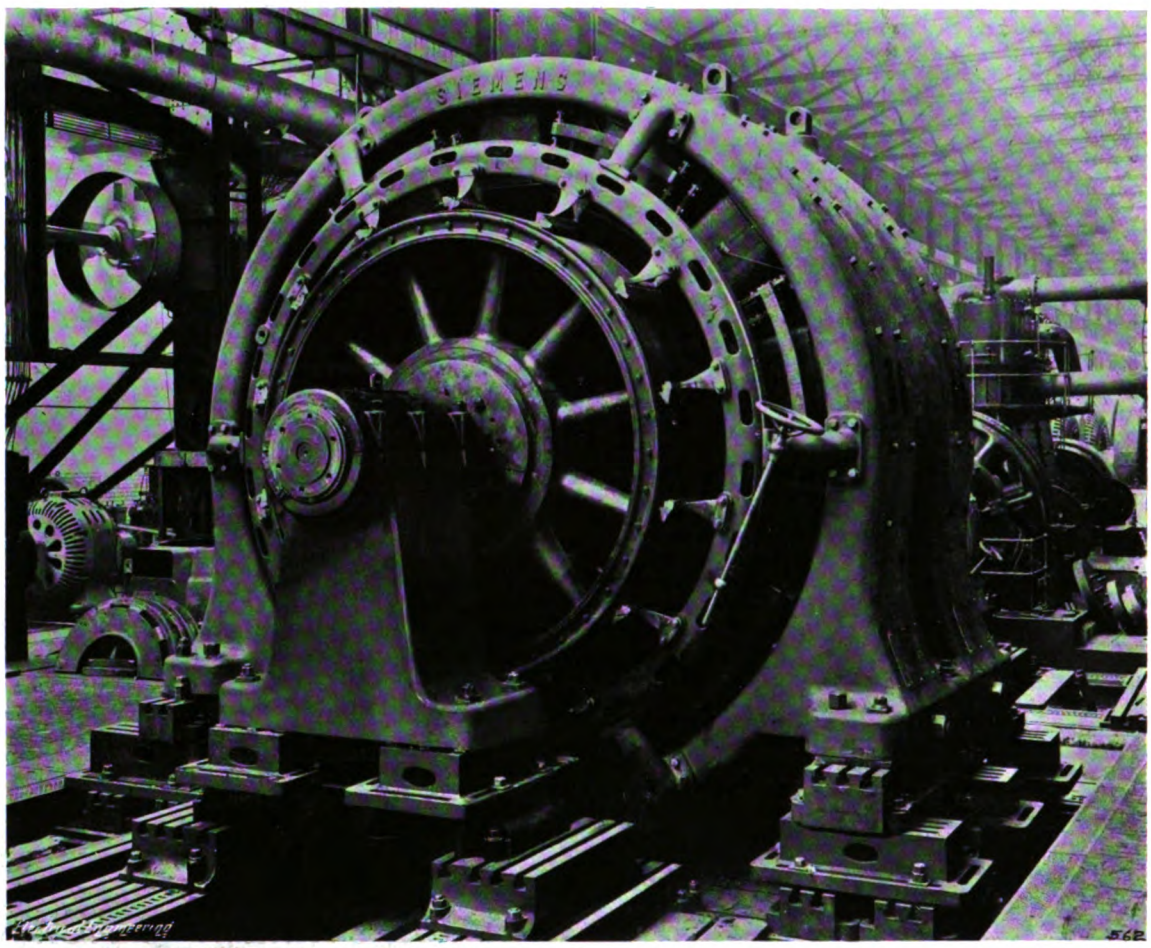

FIG. 3.—1,500 KW., 85 R.P.M., 530-VOLT CONTINUOUS-CURRENT GENERATOR WITH COMMUTATING POLES.

Before leaving the works the machines were subjected to severe tests, and the excellence of their performance may be gathered from the following:—For the 12 hours full-load run at 530 volts, 2,900 amperes, the machines were coupled up together, as shown in Fig. 3, for the parallel Hopkinson test, the losses being supplied electrically, and both fields excited from an external source. The run was made with the gene-

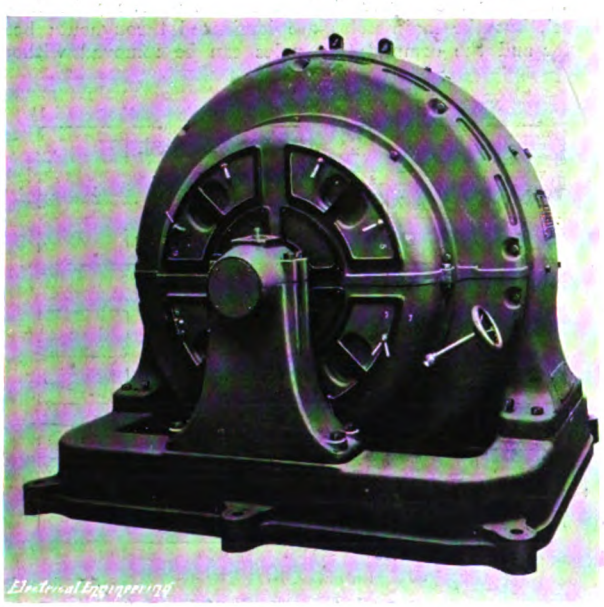

FIG. 4.—100 B.H.P., 100/600 R.P.M. CONTINUOUS-CURRENT MOTOR.

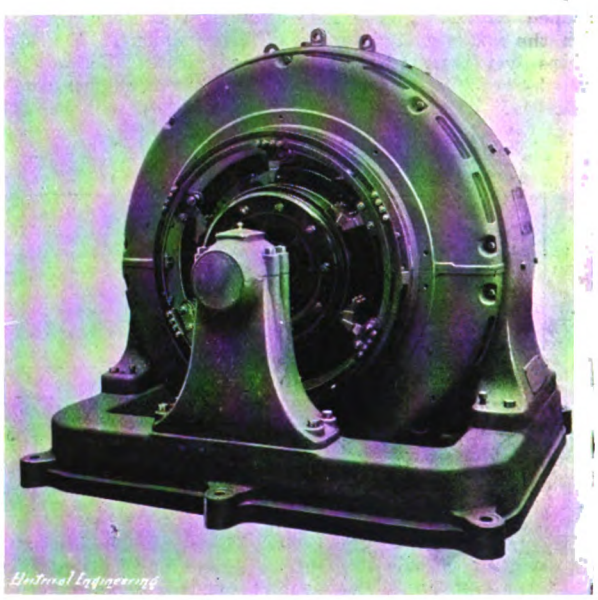

FIG. 5.—100 B.H.P., 100/600 R.P.M. CONTINUOUS-CURRENT MOTOR. (COMMUTATOR END.)

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rator giving the full rated output of 1,500 kw., corresponding to about 14 per cent. overload on the motor. At the end of 12 hours' continuous run at this output, during which time the commutation was sparkless, the following temperature rises were observed (by thermometer) :—

	Rise in degrees Centigrade above surrounding air.	
	Generator.	Motor.
Arm. core	29° C.	29° C.
Arm. end connections ...	23° C.	24° C.
Commutator	21° C.	18° C.
Shunt coils	31° C.	24·5° C.
Commutating pole coils..	28° C.	32·5° C.

In the efficiency test the machines were coupled up as before, and the following results were obtained :—

	Generator.		Motor.					
Speed. R.p.m.	Amps.	Field. Amps.	Amps.	Field. Amps	Volts common to both.	Amps. supplied externally.	Mean load. Kw.	Efficiency of each machine on mean load.
85·2	740	23·9	842	21·9	532	127	420	90·2%
85·0	1,450	24·8	1,595	20·8	528	172	805	93·4%
85·0	2,250	27·3	2,560	21·9	530	266	1,272	94·0%
85·0	2,970	29·1	3,360	22·8	530	380	1,675	93·8%
85 0	3,700	31·1	4,220	24·0	529	536	2,095	93·3%
85·3	4,500	33·4	5,320	24·9	529	767	2,570	92·2%

It will be noticed that besides being well above the guaranteed figures at full load, the efficiency remained high also at light loads. The maximum motor current of 5,320 amperes corresponds to an overload of 84 per cent., and there was only a trace of sparking. In all the other cases the commutation was sparkless.

A third test of 10 hours' duration was also carried out to determine the temperature rises on overload, the following results being obtained with a generator current of 3,500 amperes and a motor current of 4,000 amperes.

	Temperature rise.	
	Generator.	Motor.
Armature core	36·5° C.	32·5° C.
Commutator	21·5° C.	32·0° C.
Shunt coils	37·0° C.	29·5° C.
Commutating pole coils ...	41·5° C.	57·0° C.

Thus, on an overload of 39 per cent. on the motor for 10 hours, the only parts with a temperature rise higher than that specified for the normal load of 2,900 amperes were the commutating pole windings. The reason for the lower temperature rises on the motor is due to the fact that the cool air was delivered to the motor side of the combination, and the generator had the disadvantage of receiving air which had already passed the motor. In calculating the temperature rise, the mean air temperature was taken, and this, of course, handicapped the generator. The commutation was perfect throughout the test. It is well known that the sum of the no-load losses plus the additional C^2R losses due to the load do not make up the total power lost at full load, but the extent of this discrepancy is not generally recognised, and has led to much doubtful practice in specifying efficiencies. The serious nature of this error is well illustrated in Fig. 2, in which the upper curve represents the total losses as given by the Hopkinson test, and the lower curve the total losses as obtained from a no-load test. In the lower curve of Fig. 2, half the losses supplied from external sources are plotted against the mean load of the coupled machine, as found from the Hopkinson test. The discrepancy in the efficiency as obtained by these two methods is very considerable, as may be gathered from Fig. 1, and the following table :—

Load.	Efficiency by Hopkinson test.	Efficiency by no-load test.	Guaranteed efficiency.
50% overload	93%	94·5%	—
Full load	94%	95%	93%
Three-quarter load ...	94%	94·8%	—
Half-load	93%	93·8%	—
Quarter-load ...	89·5%	90·2%	—

In view of the fact that machines are sometimes required to give their full load current with a very weak field (for instance, for Siemens-Ilgner flywheel converters for colliery winding, where a current considerably in excess of full-load current may be required at practically zero volts), it was decided to test these machines also in this direction. The test was a short-circuit test, and it was observed that about 2 per cent. of the normal shunt current was required to produce full load armature current, and about 3 per cent. for 50 per cent. overload. With the very weak fields thus produced, a current of 4,500 amperes was taken from each machine in turn, and the commutation was quite sparkless, with fixed position of brushes. This current corresponds to an overload of 55 per cent.

Another machine supplied to the War Department, interesting on account of the fact that it is one of the largest, if not the largest motor, yet made with as wide a speed variation as 1 : 6, is shown in Figs. 4 and 5. It is designed to give 100 b.h.p. at a pressure of 500 volts, the speed ranging between 100 and 600 r.p.m. There are six main poles and an equal number of commutating poles. As will be gathered from the illustrations, the motor is of the ventilated type, the openings being covered with gauze. The speed variation is obtained by shunt control, and on test the motor was perfectly stable, and ran absolutely sparkless from no-load to 100 per cent. overload at all speeds. Sparking could not be detected even when the brushes were tilted on to their sparking edge, and a test more severe than this can scarcely be devised. After a five hours' run at full load and 350 r.p.m.—the mean speed of the motor—the temperature rise nowhere exceeded 37° F., and after six hours' full-load run at the highest and lowest speeds, the temperature rises were quite within normal limits. The efficiency of the machine at full load is some 88 per cent. between 200 and 400 r.p.m., but slightly lower at the extreme speeds. In view of the unusual nature and very special design of the motor, this efficiency must be regarded as very satisfactory.

SOME NEW SWITCHBOARD APPARATUS AND METERS

AT the present time practically all voltmeters, wattmeters, controlling apparatus, &c., in high tension systems are operated by potential transformers. Messrs. Ferranti, Ltd., of Holinwood, have given a good deal of attention to the design of this class of apparatus, particularly in the direction of obtaining reliability without undue increase in price. Fig. 1 represents

FIG. 1.—THREE-PHASE, 6,000-VOLT POTENTIAL TRANSFORMER WITH FUSES.

one of the latest products of this nature, of their transformer department, and is reproduced from a photograph of a 6,000-volt, three-phase, 150-volt ampere potential transformer, complete with primary high-tension fuses. This transformer is contained in a sheet-steel tank, oil immersed, and is designed to have a negligible drop, so that it can operate a number of instruments, wattmeters, synchronising gear, and so forth

Another recent product of the same department is the portable ampere-hour meter, illustrated in Fig. 2. The meter itself is of the well-known standard Ferranti type (Hamilton patent).

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It is contained in a polished mahogany case with leather carrying handle, and flap for protecting the front glass. It is provided with lock and key, and rubber supporting feet, and also with exterior terminals arranged with winged nuts for ease of making the connections. This portable meter should be very useful for testing house-service meters *in situ*, for testing meters about the works, and so forth.

Fig. 5 illustrates another interesting article made by the same works. It is a double reverse current relay for continuous currents, designed by Dr. C. C. Garrard. This relay is intended for protecting the continuous-current side of synchronous motor generator sets. These sets are started from the continuous-current side, with a current equal to, say, 25 per cent. of the normal full load current, the starting current being of course in the reverse direction to the normal. It is necessary for the machine to be protected against taking too large a starting current. With the machine, however, running as a generator, its circuit breaker should be opened if a reversal of very much smaller magnitude than the starting current occurs. The relay, therefore, is provided with two scales. The reverse current at which it operates is given by the sum of the two readings on the scales. Ordinarily, one scale is on zero, and the other scale set to, say, 10 per cent. of the full load current. In starting up from the continuous current side, the setting of the relay is increased by means of the second scale, the resultant setting being given by the sum of the two readings less 100 amperes. It is necessary to subtract this amount of 100 amperes from the sum of the two readings owing to the constant friction, which, of course, is allowed for in the calibration of each individual scale, but naturally comes in twice when the sum of the two scale readings is taken, therefore it has to be subtracted. This relay acts instantaneously on a reversal of current when the machine is running as a generator, or if a too large current is taken when starting up.

FIG. 2.—PORTABLE AMPERE HOUR-METER.

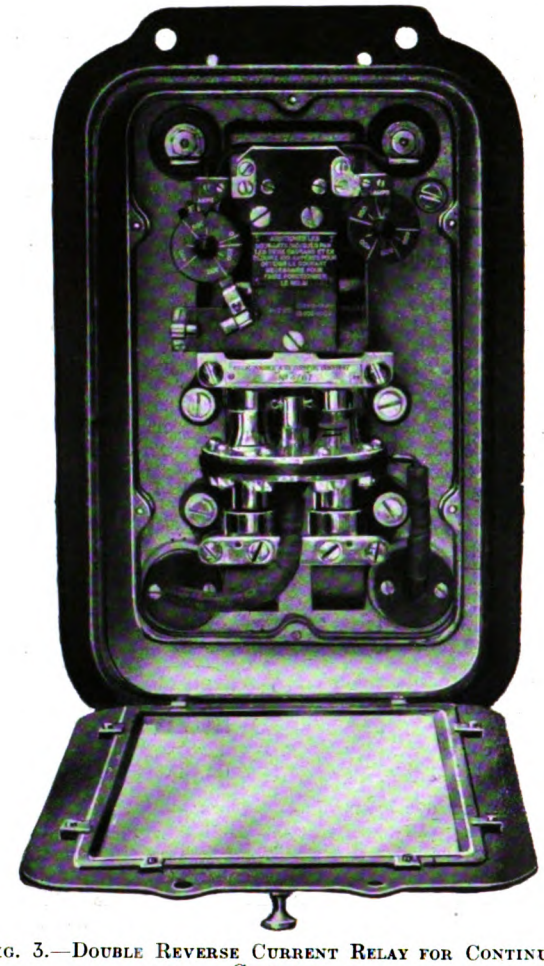

FIG. 3.—DOUBLE REVERSE CURRENT RELAY FOR CONTINUOUS CURRENTS.

Batti-Wallahs' Society.—On the occasion of the annual summer outing, the members of the P. & O. Batti-Wallahs' Society were again entertained at a garden party at Mr. L. M. Waterhouse's riverside residence, "Bindown," Hampton Wick. Mr. Waterhouse was busy during the afternoon taking parties of visitors up the river in his commodious motor launch, and other members were indulged in games and competitions on the lawn, or rowing. The Honorary Secretary, Mr. John F. Avila, informed us that the President has been kind enough to place at the disposal of the committee the sea-going sailing barge *Alde* for a week's cruise between Gravesend and Dover or Yarmouth. It is proposed to sail about Saturday, August 1st, and those members wishing to make one of the party are requested to send in their names immediately. It is suggested to put into convenient ports in the evenings. The cost of catering will be defrayed by those making the trip, and it is estimated that this will work out at about five shillings per head per day. Mention may be made of the fact that gentlemen engaged in the electrical profession are eligible for membership of this society as associates, and it is hoped by the committee that many will come forward under this clause.

The Institution Conversazione.—At the Conversazione of the Institution of Electrical Engineers, held on Thursday last at the Natural History Museum, South Kensington, there was a large gathering of members and friends. The following is a list of the principal members and guests who were present:—Mr. J. Ardron, C.B., Prof. W. E. Ayrton, F.R.S., Mrs. Hertha Ayrton, Sir John Wolfe Barry, K.C.B., Mr. W. G. Cavendish Bentinck, Colonel C. T. Bingham, Sir A. Carmichael Bruce, the Hon. W. M. Bruce, C.B., Prof. H. L. Callendar, F.R.S., Colonel E. T. Clifford, Lord Collins, P.C., Mr. E. Cunliffe-Owen, C.M.G., Dr. E. Divers, F.R.S., General Sir C. W. H. Douglas, K.C.B., Mr. W. Duddell, F.R.S., Mr. A. L. C. Fell, Sir George S. Gibb, Mr. F. Gill, Dr. R. T. Glazebrook, F.R.S., Mr. J. Hunter Gray, Mr. R. Kaye Gray, Mr. H. E. Harrison, Dr. H. S. Hele-Shaw, F.R.S., Capt. the Hon. Fitzroy Hemphill, Sir Walter J. Howell, K.C.B., Sir S. H. C. Hutchinson, Mr. W. Judd, Mr. J. E. Kingsbury, Sir Henry Mance, C.I.E., Sir Hiram Maxim, Mr. W. M. Mordey, Major W. A. J. O'Meara, C.M.G., R.E., Colonel J. C. Oughterson, the Hon. Sir Robert J. Parker, Mr. G. W. Partridge, Mr. W. H. Patchell, Sir Clifton and Lady Robinson, Brig.-General R. M. Ruck, R.E., Dr. Alexander Scott, F.R.S., Mr. J. F. C. Snell, Mr. C. E. Spagnoletti, Mr. C. P. Sparks, Major J. Stewart, R.E., Mr. G. Stoney, Dr. G. Johnstone Stoney, Sir Joseph Swan, F.R.S., Mr. A. A. C. Swinton, Prof. S. P. Thompson, F.R.S., Prof. W. A. Tilden, F.R.S., Mr. A. J. Walter, K.C., the Right Hon. Sir R. Vaughan Williams, P.C., Mr. C. H. Wordingham, and Mr. Israel Zangwill.

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THE COLLECTIVE EXHIBIT OF THE ELECTRIC SUPPLY COMPANIES OF LONDON AT THE FRANCO-BRITISH EXHIBITION

A LARGE number of visitors were invited to inspect the collective exhibit which has been arranged in the British Section of the machinery hall at the Franco-British Exhibition by the electric supply companies of London on Friday last. The circumstances which led up to organisation of the co-operative exhibit by the Supply Companies on account of a previous scheme for the representation of the British electrical industry at the exhibition having fallen through need not be recapitulated. The scheme only took definite shape a fortnight or so before the actual opening of the exhibition, so that the time for preparation of the exhibit was short; but both the companies, and more particularly Mr. F. J. Walker, who acted as hon. secretary to the conference as chief official of the London Electric Supply Companies, and the group of firms taking part in the display are to be congratulated on the results of their labours, which have led to the very complete miniature electrical exhibition which it was our pleasure to inspect last Friday. There are in all about 30 exhibitors taking part in the display, and considerations of space do not allow of our attempting to give here more than a general indication of the leading points of interest of some of the principal stands.

The nucleus of the collective display may be said to be the central reception-room, which is not only a comfortable haven of rest and refreshment to the tired visitor, but serves also as an information bureau. Literature relating to electric supply is available, and various views of generating stations adorn the walls. A limited number of exhibits are contained within the reception-room, in addition to the series of stands surrounding it.

THE SUNBEAM LAMP CO., of Gateshead-on-Tyne, have a show-case inside the reception room containing a collection of lamps and accessories of their manufacture. The manufacture of the Sunbeam carbon-filament lamp is demonstrated by a collection of samples of filaments and lamps in various stages of manufacture, but the most interesting objects shown are examples of the new Sunbeam metal lamp. Those in the case are 100-volt lamps, as that part of the case where they are installed had been previously wired for series, but in the reception room they are having fitted some of their 220 volt metal lamps. We have been unable to obtain very full particulars of these lamps, but we are informed that they will burn in any position on alternating or direct current. The case is wired on four circuits with a switch arrangement which lights up sections of the lamps alternatively, giving a very pleasing effect. The Sunbeam Lamp Co. is one of the oldest electric incandescent lamp manufacturers in the kingdom, having been established since 1887, and make every part of their lamps themselves, including the glass work for the bulbs. In addition to the 100-volt metal filament lamps inside the case already mentioned, a number of 220-volt 55-c.p. lamps with an efficiency of 1·35 watts per candle are to be seen hanging from brackets in the reception-room. We believe that we are correct in saying that these are the first British made 220-volt metal filament lamps to be exhibited. The low-volt lamps are running at an efficiency of about 1·2 watts, with a candle-power of 30. The filaments are strong, and likely to bear fair usage in transit, which is fully borne out by the lamps themselves, which arrived at the Exhibition without any special packing. We understand that the company are at present erecting a special factory for the production of these metal lamps, and will be able to meet the demands of the coming season, and are also prepared to guarantee the lamps against infringement, as they are working under license of the Westinghouse patents.

THE BIRMINGHAM GUILD OF HANDICRAFT have an effective show case inside the reception room, in which are shown numerous examples of their artistic electric light fittings. Several new designs of pendants, bracket, table lamps, &c., are exhibited, including a most handsome wall fitting in the centre of the case, in which the lamps are enclosed in an ornamental metal lantern with obscured windows, which has the appearance of being sunk into the wall. The accompanying illustration shows a very graceful form of table standard forming one of the series. Much of the charm and individuality of these fittings is due to the fact that they are almost entirely hand-made by skilled workers thoroughly trained both from the point of view of the artist and the metal worker.

TABLE STANDARD SHOWN BY THE BIRMINGHAM GUILD OF HANDICRAFT.

MESSRS. A. P. LUNDBERG & SON, LTD., have a show case in the reception room containing a large number of examples of their well-known accessories. Among these are switches of the tumbler and other patterns, including a variety of special switches for controlling groups of separate lamps from one or more points combined in some cases with wall plugs and a considerable variety of wall sockets and plugs of every description. A new form of plug which the firm have recently introduced is described and illustrated in another part of this issue.

THE REASON MANUFACTURING CO., of Brighton, exhibit a considerable variety of their manufactures in the reception room. Their well-known electrolytic meters and maximum demand indicators are well represented, in addition to various patterns of house fuse boxes and other accessories. A number of examples of the Reason enclosed arc lamp are shown both in the reception room and outside, and an interesting part of the exhibit is the large show case containing an extensive collection of potentiometers, resistances, and other electrical measuring and testing appliances.

A large electric punkah exhibited by Messrs. BERGTHEIL & YOUNG is fixed to the roof, and assists in keeping the room cool. This apparatus has been designed to imitate the motion produced by the native punkah puller, and is of very ingenious construction. The motor is fixed to the ceiling, and its shaft is vertical. At the bottom end of the shaft is a conical pinion. The punkah itself is carried on a light swinging frame, to which is attached a quadrant of leather or some similar material, at right angles to the punkah, and in such a position that it gears with the motor pinion. It is held against the pinion by a spiral spring, which pulls it to the centre, and as it leaves the pinion it is given a flick, which causes it to swing a considerable distance, and on the return journey to engage with the other side of the pinion.

A number of their specialities are exhibited by the LONDON DECORATIVE METAL WORKS, LTD., including examples of varied designs of switch covers, door furniture, and bell pushes, and in sets to match. The designs cover a large range of styles.

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Special attention should be drawn to the series of flush switch plates for groups of several switches.

MESSRS. VERITYS, LTD., of Aston, Birmingham, are also among the exhibitors in the reception room, and show electric fans, fittings, and accessories on one of the tables, as well as examples of their arrangement of tubular lamps in reflectors known as "Astonlite" strip, and intended for "concealed" lighting of shop windows, show cases, &c.

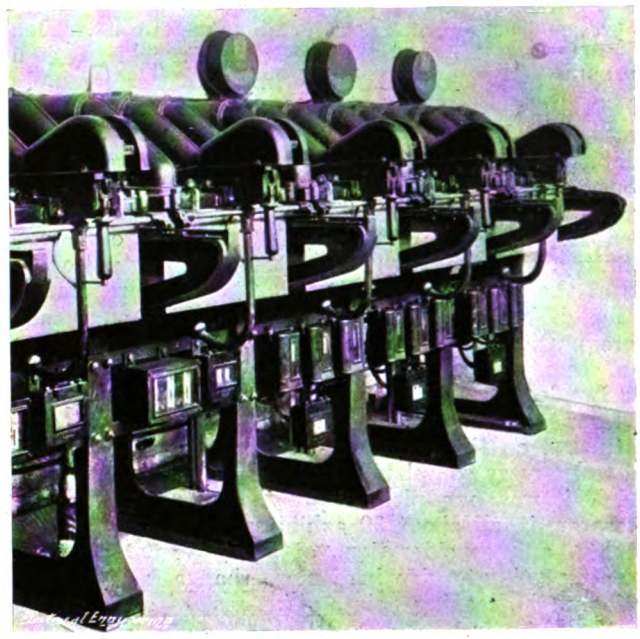
Among other attractions in the reception room is the illuminated fountain of Messrs. KEITH, BLACKMAN & CO., which is a model on a smaller scale of the large fountain combined with ventilating fans, which figured prominently in the centre of the Engineering and Machinery Exhibition at Olympia last year.

Another firm who exhibit artistic fittings is Messrs. GALSWORTHY & Co., of London, who have a small but attractive display in one corner of the reception room.

Two specially interesting stands of the outside group are those of Messrs. A. REYROLLE & Co., of Hebburn-on-Tyne. Attention should be drawn in particular to one of these, where examples of the firm's complete system of ironclad central station and sub-station switchgear are exhibited for the first time. Messrs. Reyrolle have been developing this system for some considerable time, and as a result of the careful attention they have given to the requirement of high tension working have struck out a line embodying many points of originality and interest. As shown in the accompanying illustrations, they have entirely abandoned the use of slate or marble panels and unenclosed conductors, and substituted a substantial construction with all conductors thoroughly encased. In the main the switchgear is built up on the solid system, and is entirely ironclad, the solid nature of the gear rendering it impervious to moisture, while its ironclad construction eliminates all possible danger of accidental contact with it. The high-tension feeder panel exhibited is of the standard type for pressures up to 10,000 volts, fitted with relays and releasing arrangements on the Merz-Price system (see ELECTRICAL ENGINEERING, Vol. III., page 763). The cables enter the ironclad trifurcating box underneath at the back, inside which are fitted the current transformers embedded in the compound with which the box is filled up. The actual oil switch is mounted on a carriage running on steel rails on brackets at the side, so that it can be withdrawn for examination complete with its operating gear, oil tank, &c., by drawing the carriage forward. This action breaks connections to the feeder and the bus bars by the simple withdrawal of knife contacts entirely isolating the switch. Further, on withdrawing the switch carriage, a pair of cast-iron doors

GROUP OF REYROLLE L.T. PANELS.

automatically come forward and close over the face of the chambers in which the live contacts are situated, and the reverse motion automatically folds them up and carries them into a special housing space. The doors can be locked so that access to the live conductors, under any conditions, is impossible. The contacts are purposely made stiff and of large surface, so that some force is necessary to withdraw them. A lever and ratchet arrangement is therefore provided for racking the carriage into and out of position. The handle working



GROUP OF REYROLLE H.T. PANELS.

this terminates in a plug forming part of the tripping circuit, so that it is impossible to draw the carriage forward until the switch is released. It is also impossible to close the switch unless the carriage is locked in place. The oil switch itself has several interesting features. The contacts carried on the fixed portion are mounted on springs, so that they have a certain degree of angular freedom ensuring their proper bedding down upon the wedge-shaped piece driven up between them by the moving part of the switch. They consist of a row—depending in number on the current to be carried—of small separate blocks about half an inch in width, and are arranged to be self-cleaning by having at least half an inch of sliding contact before the travel is completed. Auxiliary renewable sparking tips are fitted to both the fixed and moving portions, and a remarkably ingenious mechanical damping device is provided in the shape of a pair of hinged wings attached to the moving part, which have a sort of "parachute" action, and make the action of the switch gentle by preventing too rapid motion through the oil.

The tripping device is of the simplest construction and reliable in its action, being of the electro-magnet and armature hammer type, and can be supplied suitable for either battery or transformer trip. The automatic break is extremely rapid and certain in action, owing to there being no other moving elements than a lever pivoted on a pin. The handle gear is of the "free handle" type, and when glancing along a line of switches it is easy to see which switches "on" or "off." The switch itself is worked from the handle by a system of wire ropes. In designing this gear the object has been to evolve a line of standard units which may be combined to form panels, to meet all the requirements existing on high-tension networks. Thus, for example, the casings of the bus bars and the intake boxes can be mounted either way up so that the cables may enter from above or below, and the bus bars may be at the top or at the bottom. Again, the operating gear may be attached to the switch carriage as in the gear illustrated, or may be behind the wall. The system fulfils the important requirement of interchangeability, with the advantage that extensions or alterations to similar existing gear can be accomplished at the shortest notice, and without any break in the uniformity.

As already mentioned, the current transformers are contained in the intake chamber. They may be described as being of the ring type. The primary consists of the main cable simply threaded through the bore of a porcelain insulator in the centre of the transformer. When potential transformers are used they are contained within the switch tank immersed in the oil, so that they are completely isolated by withdrawal of the switch carriage.

The low-tension gear is similar in principle and is equally

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well enclosed and protected; the main points of difference in design are due to the heavier currents carried, and the less stringent requirements as to insulation. Oil break switches are, however, used, even at 440 volts. The accompanying illustrations show the appearance of a complete sub-station equipment, comprising high and low tension gear. An inspection of the apparatus shows not only the complete way in which questions affecting security of working have been studied, but reveals a number of points of detail to which attention has been paid. Amongst these may be mentioned the use of distinctive colours to all wires and connections to avoid possibility of confusion, and the provision of spring washers to every nut, to obviate the effects of vibration. It should be said that this form of gear has been applied already to some 30 or 40 sub-stations in the north of England, where over 200 panels are in use. Examples are also to be found in the Carville Power Station of the Newcastle Electric Supply Co.

In addition to this display of heavy switchgear, Messrs. Reyrolle & Co. have another stand, on which are shown a great variety of starters, resistances, fuses, and switchgear generally. Attention should be drawn particularly to the special resistance with which all the starters are fitted. This is composed of a number of units, in which the resistance material is a special variety of powdered graphite enclosed in an asbestos frame and clamped between metal plates. This resistance has an even more strongly negative temperature coefficient than solid carbon, with the result that even with a starter with only one resistance step an excellent graduation of the starting current is obtainable. In using starters fitted with this resistance all that is necessary in starting up the motor is to bring the lever or drum, as the case may be, to the starting position and to wait there until the motor starts, which it must eventually do as a result of the gradual and automatic increase in current due to the automatic decrease in resistance.

In addition to the various types of lever starters shown, examples are on view of the firm's drum type starter, which combines in one apparatus all the functions of a complete motor panel. Each starter is fitted with an interlocked double-pole switch, which is loose upon the main spindle; consequently, should an overload occur, either in the starting or running positions, the motor is at once isolated from the mains. A press button is provided for stopping, which trips both the drum and the main switch. These starters can also be fitted with a shunt regulator, in which case starting is effected during the first revolution, while the speed regulation is effected during the second by varying the shunt resistance. Other articles exhibited include low-tension fuses of the ventilated type, fitted with a double asbestos lining, which allows a continuous-current of air to circulate through every part of the apparatus and acts as a buffer against the explosive action of the fusing wire, high-tension fuses, wall plugs, fuse boxes, and oil switches. Other exhibits are telephone dividing boxes, large quick-break switches, small fuse boxes, house service fuse boxes, &c., &c.

THE EDISON & SWAN UNITED ELECTRIC LIGHT CO. occupy a prominent corner position on the outer ring of stands, but almost as much interest will centre round the examples of the new Royal Ediswan metal filament lamps, by which part of the lighting of the reception-room is effected and which make their public appearance for the first time. These particular lamps are of the 16-c.p. 50-volt size, arranged two in series on the 100-volt circuit. We are not at present able to give very full particulars as to these lamps beyond stating that they can be run in any position and are equally suitable for continuous- or alternating-current circuits. The company have also some of their white flame arc lamps, using pure carbons, in the reception room. On the stand itself are, of course, examples of incandescent lamps of every form and shape, and samples showing the various stages of manufacture. A large number of artistic fittings are shown, among which we should call particular attention to a group of table lamps and other fittings in Doulton ware, embodying some striking colour effects.

THE "COURT OF HONOUR" AT NIGHT, ILLUMINATED BY ROYAL EDISWAN LAMPS.

In addition to lamps and fittings, the exhibits comprise a variety of switchgear, including a new lever switch with a quick-make as well as a quick-break action. The Ediswan circuit-breaker is also on exhibition, together with the newest branch switch, named the "Phlatta," which is in use in the furnished flat forming part of the collective exhibit and other parts of the exhibition. A large show-case contains a complete range of measuring instruments, from the large central station type to the pocket cell tester, including the useful series of instruments for motor circuits, calibrated direct in horse-power. Examples are also to be seen of small auto-transformers for enabling small candle-power metal filament lamps to be used with high supply voltages. These are specially designed for small no-load loss and have a power factor of about 0·99 at three-quarters and full load. The Edison & Swan Electric Light Co. supplied the whole of the lamps used for the decorative exterior lighting of the buildings in the exhibition, and the fine effect produced is well shown by the photograph of the "Court of Honour" at night, which we are able to reproduce.

THE STEARN ELECTRIC LAMP CO., LTD., of 47 Victoria-street, Westminster, and Kew Gardens have an interesting exhibit of their English-made "Leuconium" metallic filament lamps, specially illustrating the use of these high-efficiency lamps, con-

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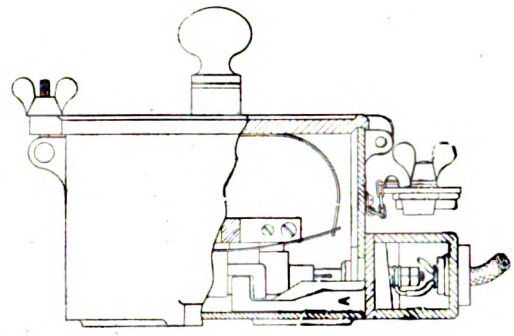
suming as they do only about 1¼ watts per English candle on a 220-volt circuit. The particular lamps shown are what they term their "Nevaout" series lamps, these being all fitted with a special automatic fuse in the cap of the lamp, and a substitutional carbon resistance in the bulb, so that, used in series, the failure of one lamp does not entail the extinguishing of the whole group as in ordinary series lighting, but with this device the circuit is automatically maintained through the carbon resistance until a new lamp is put in place of the broken one. The construction of these lamps was described in some detail in ELECTRICAL ENGINEERING, April 30th, page 651. The appearance of a 100-volt lamp made up of five units in series is shown in the figure.

The exhibit consists of a five-light electrolier, fitted with four lamps of 44 volts, the fifth point being occupied by a double tubular fitting, each tube being 22 volts, the total making the 220 volts used on the circuit. A three-light bracket is also shown, in which each point is for 74 volts, and in this case the two outer lamps are of bulb form, whilst the centre

FIVE-TUBE STEARN SERIES METAL FILAMENT LAMP WITH SUBSTITUTIONAL RESISTANCES.

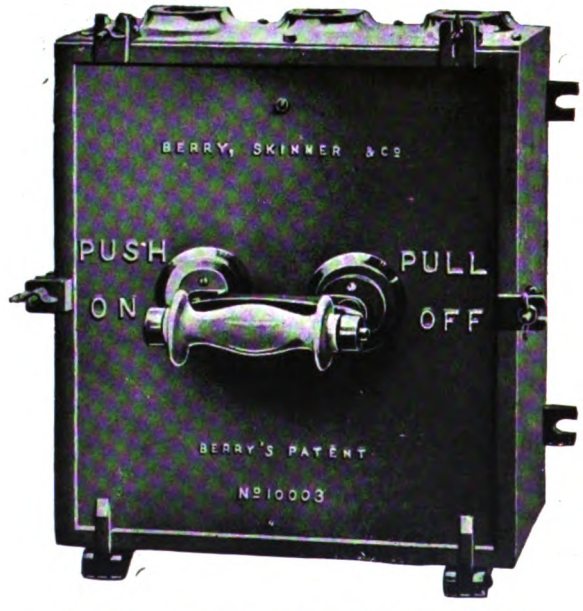
point is a three-tube cluster. Below this are two three-light brackets, with all six points wired in series, and consequently smaller c.p. at each point. There are two small standards illustrating the use of 55-volt lamps, four in series on 220 volts, one being fitted with ordinary bulb form lamps, the other with the special tubular form in clusters of three. This same system is shown by two single-point drop lights used direct on the 220 volts, the one consisting of a four-tube cluster fitting, each unit being 55 volts, and the other of a five-tube cluster fitting, each unit being 44 volts. These demonstrate the system for single points, and it is evident that not only is the loss by breakage of the filament reduced to the cost of one tube instead of a whole lamp, containing probably seven to ten filaments, but whereas with the single-light ordinary bulb form, if a filament breaks, the room is plunged in darkness, by this arrangement of automatic fuse the light is merely reduced by one-fifth in the one case and one-fourth in the other case. The Stearn Electric Lamp Co., Ltd., make a great point of the utility of this device for street lighting, and show a 10-tube fitting, fitted up in an ordinary street gas lantern.

MESSRS. BERRY, SKINNER & Co. exhibit a group of their enclosed switches of the push-on and pull-off type, which are used in very large numbers on the distribution boards throughout the exhibition. The construction of this apparatus is shown in the accompanying illustrations. The moving part of the switch is carried on a plunger terminating in the external knob or handle working through the lid, and a pair of springs are provided which produce a quick break and make effect by a sort of toggle action. The tubular fuses actually form part of the moving switch piece, so that the action of pulling off the switch is simply that of removing the fuses from their clips. They are made accessible for replacement by throwing back the lid, and, of course, the circuit cannot be made until the lid is closed again. A special form combined with a detachable plug for colliery work, in which interlocking arrangements are provided so that the plug cannot be removed or inserted unless the circuit is broken, is also shown. Another exhibit on the same stand is a complete electrically-driven ice-making plant on the carbonic acid system, suitable for country houses, hotels, &c., driven by a one horse-



SECTION OF SWITCH WITH INTERLOCKED PLUG.

power motor, and capable of producing 280 lb. of ice per day. Messrs. Berry, Skinner & Co. have also on exhibition examples of the Beck flame-arc lamp for direct or alternating current. The construction of this lamp is remarkably simple. The feed is entirely by gravity. Each carbon is constructed with a ridge the end of which rests on a copper abutment piece, and as it burns away permits the carbons to feed. The only mechanism is a simple striking device for allowing the carbons to come together at starting, and separating them through the action of a solenoid, which temporarily shifts a guide through which one of the carbons passes. A very high efficiency is claimed for this lamp. A special form of series resistance consisting of a metal wire enclosed in hydrogen can be used in place of the ordinary resistance when it is desired to run them on low-voltage circuits. On account of the temperature coefficient of this form of resistance, an equally good steadying effect can be produced on the



BERRY PATENT PUSH-ON AND PULL-OFF SWITCH.

arc without so great a voltage drop as is produced in the ordinary resistance. By means of this arrangement two lamps can easily be run in series on 100 volts.

Messrs. ELECTROMOTORS, Ltd., of Openshaw, Manchester, have a stand the object of which is to show a few examples of the methods of applying their well-known continuous-current motors to various classes of driving. At the back of the stand is a small motor-generator set, and in front of this are a group of motors fitted with various kinds of reduction gear, including ordinary "back" gear mounted on the motor frame, worm gear, &c. Flexible shaft drills are also shown, and another applica-

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tion of flexible shaft driving in the shape of an electrically-driven horse-clipper, which is stated to be able to clip a horse in thirty minutes. A small electric winch is exhibited, and electric fans of several patterns are in operation.

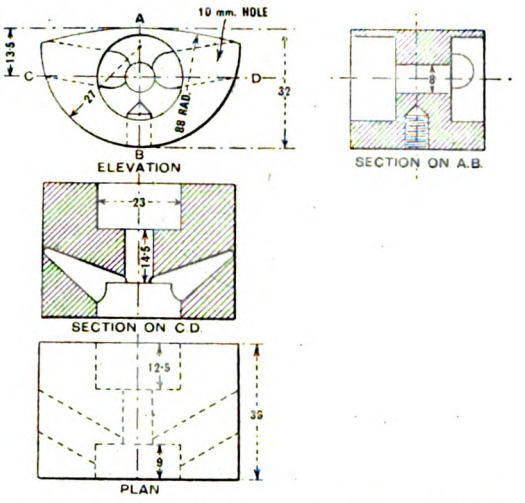
The ADAMS MANUFACTURING Co., of London and Bedford, have a display of a large variety of motor-controlling apparatus. An automatic float switch controlling a pump motor by a solenoid starter is shown in action. Other apparatus includes a lift controller consisting of a rope-operated reversing switch and a self-acting motor-starting rheostat suitable for dinner-lifts and similar work. A 20 h.p. self-acting motor-starting rheostat is also shown in operation actuated by two push-buttons, one for starting and one for stopping. The largest example of this kind of apparatus shown in operation on the stand is a 75 h.p. 500-volt self-acting starter. For this large horse-power the sliding type of contact is not used at all, but, instead, the motor circuit is opened and closed by a solenoid switch, which is fitted with carbon break and powerful magnetic blow-out, and the various steps of starting resistance are cut out in succession by a number of similar solenoid switches, all of which close in their turn, and at the proper interval, with a snap movement, and make circuit by pressing a laminated copper brush against hard-rolled metal surfaces. An interesting piece of apparatus is the Adams "Igranic" printing-press controller, which is designed for controlling large electrically-driven rotary printing presses of the type used for printing the large London daily newspapers. This is capable of regulating the speed of the press through a very wide range, the ratio in some cases being 40 or 50 to 1. All the speeds are obtained by use of only one handle and only one motor, and, moreover, we understand that each step represents a definite and positive speed. With this controller push buttons are supplied, which can be installed in convenient positions round the press, so that the press may be started, stopped, and "inched" from any of these positions. There are also two specimens of "Igranic" printing-press controllers for flat-bed presses. These are entirely ironclad, and are equipped with no-volt and overload automatic release, with magnetic blow-out and long range of speed control by variation of the shunt field. Both are entirely ironclad, and seem about as robust and reliable as the very arduous conditions of work in a printing works requires. Other items of the exhibit include a 30 h.p. 220-volt reversible crane controller of the face-plate type and various examples of ironclad field regulators, their drum or tramway type controllers, motor starters with no-volt and overload release, fan regulators, and many other types. An interesting new type of resistance with wires embedded in glass has been developed by the company.

Messrs. O. C. HAWKES, LTD., have a small stand, on which are displayed a number of examples of their well-known heaters of the convection type, in which they have specialized for some time. The heaters shown exemplify a wide range of styles of decoration. The advantage claimed for this form of heater against the luminous type are the more efficient circulation of the heated air and the consequent rapid rise in the temperature of the room as a whole, and the sterilising effect of bringing the air into more intimate contact with the heated conductor, and therefore to a higher temperature when it is passing through the stove.

The BRITISH THOMSON-HOUSTON Co. have a fine display representing the long series of heating and cooking appliances, which we have noticed in our columns from time to time, but perhaps the most interesting feature of the stand is the appearance of the B.T.-H. tungsten lamp, made at Rugby. We hope to give a full description of this new lamp in our columns at an early date.

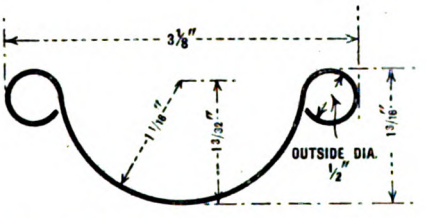
One of the largest stands is that of the DOWSING RADIANT HEAT Co., which is entirely devoted to electro-medical apparatus. Prominent among the exhibits is a bed for radiant heat treatment, in which the rheostat and connections, by which the radiator lamps in reflectors surrounding the bed are controlled, are conveniently mounted on the bed itself, so that the whole apparatus is self-contained. Several patterns of "solarium" or electric light bath-cabinet, for home and hospital use, are shown, including a portable folding form. It is claimed that this form of "bath" is much more healthy than the ordinary Turkish bath, as, although the body is subjected to a high temperature, the patient can breathe cool external air instead of inhaling harmful fumes. Some of these are specially arranged with screens before the lamps for special treatment by coloured light. A form of hydro-electric chair is also shown, in which the extremities of the limbs are immersed in glass vessels, so that current can be conveyed through the body more effectually and under better control than in the ordinary "electric bath," as the whole of the current measured passes through the body. A switchboard at the side is fully equipped with regulating, controlling, and converting apparatus enabling "continuous," "sinusoidal," or "Faradic" applications to be made. On the same stand is a display of Röntgen ray and high-frequency apparatus manufactured by Messrs. Harry W. Cox & Co., including coils with the newest form of mercury jet break, with the break occurring in coal-gas. Some powerful Röntgen-ray tubes are shown provided with special protection for the operators, and various accessories for Röntgen-ray work, including apparatus for localising bullets. Mention should also be made of the examples to be seen on the stand of the forms of luminous radiator with which Mr. Dowsing has been identified since the pioneering days of domestic electrical heating.

On the stand of the LINOLITE Co. are shown examples of lamps and fittings for their well-known "Tubolite" system of lighting by means of rows of tubular incandescent lamps placed end to end in specially designed aluminium reflectors. The two edges of the reflector are rolled up to form a beading on each side, and these carry the two wires. The angle of the reflector is such that the light is distributed over an angle of



PORCELAIN LAMP HOLDER FOR "TUBOLITE" STRIP.

140 degrees. The accompanying illustration shows the latest form of porcelain holder for the ends of the lamps. There are two standard sizes of strip, one for lamps of 12 c.p. each, and a large size for 32 c.p. lamps; the proportions of the



SECTION OF REFLECTOR FOR 32-C.P. "TUBOLITE."

reflector for the larger size are shown below. The various parts composing the equipment are shown in different stages of manufacture.

Messrs. R. WAYGOOD & Co. show a complete working model of an electric lift with their patent system of push button control, requiring no attendant.

A good display of arc lamps of various types, including enclosed and open lamps and special lamps for photographic purposes is made on the stand of the WESTMINSTER ENGINEERING Co.

The IMPERIAL LIGHTING Co. have an extensive exhibit exemplifying the applications of electricity to decorative and theatrical lighting and advertising signs, &c. Specimens are on view of several varieties of the firm's well-known "Fairyland Strip," which is in use for decorative exterior lighting throughout the exhibition. The accompanying illustration shows the arrangement of central pin and screw terminals adopted on the lamp caps, and the packing ring by which an absolutely watertight joint is maintained. A form of metal-backed strip is made to meet the requirements of some of the insurance authorities. Another special type is made with four wires running the whole length, so that two circuits can be carried along the whole length, and the lamps wired alternately on

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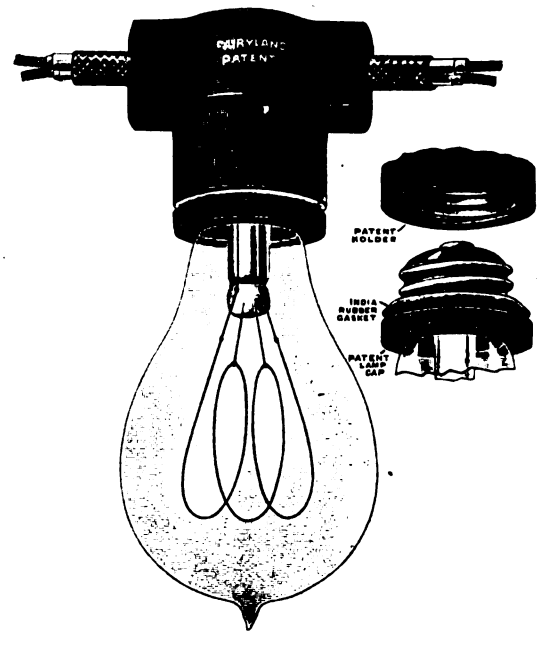
each for colour effects, &c. The component parts of the complete fireproof system for stage lighting which the company have developed are shown. All the wiring is asbestos covered and enclosed in metal troughs. In addition to sample lengths of footlights, battens, floats, &c., a special form of stage



DETAILS OF "FAIRYLAND" STRIP.

pocket is shown and also stage arc lamps and lanterns. Various forms of illuminated advertising signs are shown, and moving appliances driven by small electric motors for shop window purposes.

A number of stands are to be found in the further side of the passage way behind the furnished flat which also forms part of the collective exhibit. One of these, containing Messrs. Reyrolle & Co.'s switchgear, has already been referred to. The remainder, generally speaking, exemplify the applications of electrical power for various purposes. Thus we find a flat bed printing press exhibited by the BABCOCK PRINTING PRESS MANUFACTURING CO., equipped for electrical driving, and provided with the Adams Manufacturing Co.'s system of push-button control. There is also a fine display of wood working machinery shown by Messrs. F. W. REYNOLDS & Co. Electric organ blowing can be studied on the stand of the KINETIC-SWANTON CO., and BARLOW'S PATENT LIFT CO. have a working model of a lift for two floors on the ingenious principle amounting to a variable speed gear described in ELECTRICAL ENGINEERING, Vol. II., October 3rd, page 524, in connection with the Engineering and Machinery Exhibition at Olympia.

Perhaps the most attractive part of the collective electrical exhibit to the general public, and more particularly to the prospective consumer, is the complete miniature furnished flat which has been equipped with so much taste by Messrs. Waring & Gillow, and fitted up to demonstrate the various applications of electricity to domestic comfort, cleanliness, and luxury. The visitor enters a tasteful hall, and wanders successively through a series of miniature rooms forming dining-room, drawing-room, bedroom, nursery, and kitchen. All are lighted electrically in suitable style, provided with radiators for heating and fans for cooling, and a thousand and one small electrical accessories for adding to one's domestic comfort, particularly so in the luxurious bedroom, containing electric footwarmers, warming pans, curling-iron heaters, water boilers, &c. Attention should also be drawn to the very effective and reposeful lighting of the drawing-room by concealed lamps below the frieze.

The feature of the house is the kitchen, completely fitted with every variety of cooking appliance by Messrs. RASHLEIGH PHIPPS & Co., and demonstrated by a lady attendant. This complete electrical kitchen is designed to do away entirely with the use of coal fires or gas stoves, the whole of the usual operations connected with cooking, as also knife cleaning, plate cleaning, boot polishing, and ironing, being done electrically. The cooking-table, which replaces the usual kitchen range, consists of a number of circuits, each controlled by two switches, giving three degrees of heat, pilot lamps being arranged to show which circuits are in use, and special arrangements are made to do away with all loose flexible cords. Fuses for the various circuits, together with main switch and cut-outs, are mounted in two recesses above the switchboard, and an ammeter, showing the total amount of current in use at any time, is provided. In addition to the above-mentioned circuits, which are intended for use with frying-pans, saucepans, kettles, &c., there is provided an electrical oven on an entirely new principle (the first of its kind ever constructed), in which, on account of the high temperature obtainable in the new form of electrical element used, roasting and baking are performed with very much less expenditure of current than has hitherto been required. The various regulating switches and pilot lamps in this instance form a part of the oven, rendering it entirely self-contained and suitable for fixing in a kitchen quite apart from the other portion of the cooking-table. On the top of the oven is fitted a cooking hot-plate, a grill, and a toaster, all fitted with the new high-temperature elements as used in the oven. We may mention that this is the first occasion upon which an efficient and practical electrical toaster has been exhibited. A small boiler, fitted with tap, enabling a supply of hot water to be obtained at any moment, completes the outfit. A canopy is fitted over the cooking-table, which, by means of a small Blackman fan, provides for the efficient ventilation of the kitchen, and prevents any smell of cooking penetrating to other portions of the house. The space under the cooking-table is provided with a rack for holding saucepans, &c., when not in use. The utensils shown in the kitchen suitable for use with the above comprise stewpans, saucepans, frying-pans, omelette-pans, kettles, porringers, potato steamers, coffee-makers, hot-plates, steam cookers, brazing-pans, and fish-kettles. A spacious hot cupboard for warming plates and dishes, and keeping food hot, is also fitted, and electric irons of various shapes and sizes are shown in actual operation. Should the necessary space be available, it is intended also to show an electrical plate and dish washer. In connection with the demonstrations of electrical cooking, which will be given throughout the run of the Exhibition, the chief points which will strike the onlooker will be the ease of operation, the absolute cleanliness, the perfect control of heat, giving certainty of results, the entire absence of any obnoxious fumes, which are found so great a drawback to the use of gas stoves for cooking, and the complete freedom from the heat attending cooking by means of a coal range.

In addition to the above apparatus in the kitchen, various other domestic utensils of a similar character are shown in the various rooms as follows: A small hat-iron and a cigar-lighter in the hall; a hot-plate and a kettle in the dining-room; an afternoon tea-kettle and a foot-warmer in the drawing room; a bed-warmer, a bed foot-warmer, and a curling-tong heater, a particularly small and convenient form of hairdryer, a shaving pot, kettle, hot-water jug, and a form of immersion heater used for heating water directly in the washhand basin or jug in the bedroom; the nursery is equipped with a milk-bottle steriliser, a flat-iron, and a kettle, and electric radiators of various designs for warming rooms are also shown, besides electric glue-pots and medical sterilisers.

It should be noted that the kitchen arrangements, having been installed with a special view to giving a thoroughly complete demonstration of electrical cookery in all its branches, are far more extensive and elaborate than would be in any way necessary for a house of the size shown, the accommodation provided being ample for cooking for 30 persons.

The Traffic Problem in New York.—A Consular report states that, in spite of the vastly increased traffic facilities afforded by the new subways and tunnels, the congestion during certain hours is still very bad. The following schemes for further facilitating traffic are being either carried out or are projected:—(1) A municipal subway from City Hall, Manhattan, to the Long Island station at Brooklyn. A portion is already open, and the remainder will be in operation by June 1st. (2) A subway loop connecting the Manhattan terminals of the three bridges, to be finished in two years' time. (3) A subway across Manhattan Bridge to Fort Hamilton, with a two-track branch to Coney Island, the contract for which will be shortly advertised. (4) A route from Battery Park to the Harlem River, passing under the river with two branches, one to Woodlawn, the other to Pelham Park Bay. A cross town line in connection with this scheme is to be made from the Manhattan end of the Manhattan Bridge to the North River, in order to afford traffic facilities to Brooklyn passengers to all of the north and south lines in Manhattan. The estimated cost will be $70,000,000. An extension of the Brooklyn Union Elevated Railroad is also projected. The Hudson and Manhattan Railroad Company is also building its second tunnel under the Hudson River, from Manhattan to Jersey City. The report further states, with reference to the trade of New York, that the value of the electrical machinery exported from New York amounted to £1,149,000 during the year 1907, as against £948,000 for the previous year.

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THE TELEPHONE AND INFECTION

MR. F. J. ALLAN, Medical Officer of Health for the City of Westminster, has contributed to last week's *Lancet* a rather sensational article headed "The Public Telephone Call Office as a Factor in the Spread of Disease." He says:—

One can scarcely picture a more suitable place for harbouring organisms of all kinds than a dark telephone call-box with its stagnant air and dirty floor, the dust of which is brought in from the street and stirred up and inhaled by each fresh caller. There is, moreover, the risk that organisms of a pathogenic character may be left behind by persons suffering from such complaints as diphtheria, influenza, or consumption.

Dr. Allan goes farther than general statements, however, for he has obtained from Prof. Klein the results of his examination of six "swabs" taken from the mouthpieces of transmitters in public call offices. In five out of the six mouthpieces the results obtained were negative with regard to tubercle, but examination of the sixth revealed the presence of typical tubercle bacilli. This was proved by injecting two guinea pigs with this material; as after killing them and making a *post-mortem* examination 23 and 27 days afterwards respectively, it was found that tubercle bacilli were present.

Dr. Allan concludes:—

As these call-boxes are at present constructed and situated it is difficult to imagine how in the absence of regular disinfection and cleansing they can be anything but breeding grounds for germs. No doubt it is difficult to construct call-boxes which shall be efficiently ventilated and at the same time prevent outside sounds penetrating and conversation being overheard, but it ought not to be an insuperable difficulty. To keep the boxes bacterially clean presents no difficulty. Soap and water are always available, while the thorough spraying of the box and the instrument with an approved disinfectant solution once a day might be carried out with very little labour and at a trifling expense. I am given to understand that by arrangement with the Post Office the whole of the London Stock Exchange telephones, some 40 or 50 in number, are sprayed daily with a disinfectant.

It is hard to imagine that there must not be some cases in which infectious diseases are transmitted by telephone mouthpieces, but it is yet to be regretted that Prof. Klein and Dr. Allan have not pursued their researches further. If ten mouthpieces out of sixty had been found in a dangerous condition, the matter would have called for very prompt and serious remedies, but in this case it is to be noted that only one mouthpiece was found to be infected, although the proportion one in six is, of course, the same. That some method of cleansing and disinfecting, and, above all, of ventilating the call-boxes is desirable, cannot be disputed, but on the other hand there is no need for panic measures.

About three years ago some very similar tests were made by Dr. Collingridge, Medical Officer of the City of London, who selected a dozen mouthpieces from call offices and sent them in a similar manner to Prof. Klein for bacteriological examination. The mouthpieces were washed out, and exactly as in the above case, two guinea pigs were injected, one peritoneally, and the other subcutaneously, and the animals were examined, as in this case, about four weeks after the injection had been made, but no pathological symptoms of tubercle or diphtheria bacilli were found.

As regards subscribers' telephones in ordinary healthy situations which are accessible to fresh air, the daily dusting and wiping of the mouthpieces should be quite a sufficient precaution, as the conditions are entirely different from those obtained in several call offices open to the general public.

The question was raised in the House of Commons on Monday last, when the Postmaster-General was asked whether his attention had been drawn to Dr. Allan's report and as to what arrangements were made to disinfect telephones at the public call offices under the control of the Post Office. In reply, the Postmaster-General said that he had seen the report published in the *Lancet*, but pointed out that five out of the six telephones tested were found non-infectious, and that the sixth was at a railway station in exceptional circumstances. He then referred to the above tests made by Dr. Collingridge, and added that arrangements are made for regularly cleansing and disinfecting the telephones in public call offices, and suggestions for improved methods are under consideration.

ELECTROCHEMISTRY AND ELECTRO-METALLURGY

IN the *Centralblatt für Accumulatoren und Galvanotechnik* of June 20th E. Bäumer suggests the use of iron resistances for regulating the current when charging batteries of accumulators. It is well known how rapidly the electrical resistance of iron increases as the temperature is raised. There is always a difficulty in charging of accumulators, owing to the increase in the resistance of the cells, due to back E.M.F. as the charging proceeds. It therefore becomes necessary to regulate the resistance as the cells become charged up. In order to get over this difficulty and to cause the resistance to act automatically, that is to be gradually thrown out as the back E.M.F. of the cell increases, Bäumer uses iron wire of such a calibre that when the initial current is passed it is kept at a low red heat. As the cell E.M.F. increases the cell resistance increases, consequently the amount of current passing through the wire is less, therefore its temperature falls, and it now becomes a better conductor.

At the last meeting of the American Electrochemical Society Dr. Louis Kahlenberg returned to his attack on the ionic theory. He holds that the hypothesis of Hittorf and that of Arrhenius do not explain sufficiently electrolytic conductivity. Hittorf considered that electrolytes were salts. Arrhenius thinks that all solutions which show abnormal freezing points, boiling points, or abnormal vapour tensions, are electrolytes. But, says Kahlenberg, these generalisations are not correct. For example, an aqueous soap solution which boils practically at the same temperature as pure water is yet an excellent conductor. Consequently, "the vapour tension of solutions . . . and other physical properties so far as we know, do not afford any basis whatsoever of a correct view as to the nature of electrolytes as contrasted with non-electrolyes."

The fundamenal fact which we have to bear in mind is that the best conductors are metals and metallic alloys. Tin is a conductor, but chlorine is not, yet stannous chloride is a conductor, but stannic chloride is an insulator. But there is a difficulty: some substances which contain no metal are electrolytes when in solution, and others are not. Acetic acid is a non-conductor, so is water, but an aqueous solution of acetic acid will conduct the electric current. Dr. Kahlenberg thinks that much more intelligent experimental work must be carried out before we can hope for a real improvement of our theories of the interrelation of electricity and matter.

At the last meeting of the Faraday Society, Ad. Jouve contributed an interesting Paper upon "New Applications of Electrometallurgical Alloys." This Paper dealt mainly with the use of silicon alloys, particularly of ferro-silicon. This substance is manufactured containing percentages of silicon varying from 20 to 75 per cent., the most usual being 20 to 25, 50 to 55, and 70 to 75 per cent. Attention was drawn to the fact well known to analysts, that no methods of analysis for this substance, based upon the use of acids, with the exception of hydrofluoric acid, are employed for ferro-silicons, because ferro-silicon containing more than 20 per cent. of silicon is insoluble in acids. This protective property of silicon is being made use of in producing acid-resisting vessels. Ferro-silicons, however, are not the only substances which possess this property, almost any alloy of a metal with this metalloid will behave in the same way to a greater or less degree, according to the nature of the metal. Calcium silicide is, for example, unaffected by acid, whereas calcium itself acts vigorously upon water. The chief difficulty met with in preparing metallic silicates in the form of vessels is the brittle nature of the alloy; they contract on cooling, often breaking in the mould when hardly solid, and when still at a red heat. In manufacturing the apparatus the first process consists in obtaining a melted metal suitable for pouring into moulds. The most satisfactory method, and the one most generally employed, is to pour directly from the electric furnace into a mould lined with some refractory material. Once the liquid is obtained, metals for corrective purposes are added directly to the metal in the casting ladle, generally with addition of aluminium, which raises the temperature of the bath and increases its fluidity. As showing the resistance of these alloys, which are called "metillures," to acids, the following example is interesting. Nitric acid, even as a vapour, such as is obtained at the exit of a bisulphate retort, or when mixed with nitrous acid, does not affect them at all. A striking example of this is given by a pipe which has been submitted

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for nearly five years to the daily passage of 660 lbs. of nitric acid vapour at temperatures varying from 150° to 200°, without its loss in weight exceeding a few decigrammes in a total weight of about twenty kilogrammes. This loss occurred quite at the beginning of the period, and was probably due to a few impurities remaining on the inner surface of the pipe after fusion. Sulphuric acid has still less effect; the acids of strength from 20 to 25 per cent., known as *petites eaux*, may be concentrated in vessels of this kind by direct heating and continuous evaporation. Hydrochloric acid is analogous in its action, and use has been made of the pipes of the above material for carrying and condensing its gases. Acetic acid and the mixture produced by treating calcium acetate with sulphuric acid, are without effect on "metillures," even in the presence of air. The apparatus constructed up to the present time is extremely varied, both in form and dimensions, ranging from evaporating dishes, troughs, right-angled bends, elbows, worms, ventilators, &c., varying in weight from about 20 lb., and having a diameter of 1 ft., to those weighing over 1 ton, and measuring 7 ft. across, as well as pipes with a diameter of 8 ft., and weighing about ¾ of a ton. The points in connection with these new substances is that it is due to the great advance which has recently been made in electric furnace methods, that the possibility of preparing these alloys has been arrived at. Platinum, the most stable of our industrial metals, is becoming scarcer, whilst its price is increasing, and this makes its employment very expensive, consequently the advent of these new acid-proof materials should be of very great commercial importance.

ELECTRICAL SCIENCE

British and American

Secondary Radiation from β-Rays.—When the β-rays of radium are caused to fall on a plate of any substance, other rays known as "secondary" can be detected spreading out from the plate. That the β-rays are not merely reflected is seen from the experimental fact that the secondary rays possess qualities dependent upon the atomic weight of the substance of the plate if that substance be elementary, and upon the atomic weights of the elementary constituents of the plate if the plate consist of a chemical compound. Very many measurements have been made on these secondary rays from plates of different substances, and practically all under the same condition as regards the angle of incidence of the original rays on the plate, or as regards the angle of emergence of the secondary rays. In a Paper in the June *Proceedings* of the Royal Society, J. A. McClelland describes measurements of the intensity of the secondary radiation emitted at different angles from the plate for various angles of incidence of the β-rays. The radium was placed at the closed end of a thick lead tube, which was set horizontally with its open end pointing inwards along the radius of a circle round which it could be moved. At the centre of the circle the plate was placed with its plane vertical, and so that it could be rotated about its vertical centre-line. A fixed ionisation chamber, consisting of a metal tube with an insulated central wire, was set at a little distance from the plate, so that secondary radiation from the plate could enter the chamber by passing through a single sheet of tin-foil covering its end. By moving the plate relative to the radium any desired angle of incidence could be settled upon, and by then moving plate and radium together the secondary ray emission at various angles from the plate could be examined. The author obtains in this way a number of curves connecting secondary radiation and angle of emission from plate, for a series of values of the angle of incidence of the β-rays. For normal incidence the secondary radiation curve is almost a cosine curve; a result which follows from the theoretical consideration that the radiation from an element of volume at a depth in the plate traverses a thickness inversely proportional to the cosine of the angle of the rays from the normal. The secondary curves for other angles than perpendicular incidence have a maximum ordinate at a place suggesting direct reflection of β-rays. Consequently, as a rough method of analysing these curves, the author takes the difference between the ordinates for equal angles on opposite sides of the normal, as representing the merely reflected portion of the radiation. By measurements of the absorption coefficients of radiation coming off the plate at different angles, the author shows this mode of analysis to be justified, and thus reaches the important conclusion that, whatever the material of the plate, there is a practically invariable amount of radiation reflected at any particular angle. It follows from this that when the true secondary radiation from different substances, corrected for reflected rays, is considered, it is found to possess an intensity directly dependent on the atomic weight of the metal of the plate.

Royal Society Conversazione.—The second annual conversazione given by the Royal Society was held on Monday last in the rooms of the Society at Burlington House. Most of the exhibits were the same as those shown at the former conversazione in May, and described in ELECTRICAL ENGINEERING, Vol. III., p. 787. Of those on view for the first time, the following may be mentioned: A demonstration by Dr. J. A. Fleming, illustrating the transmission of signals by electromagnetic induction between oscillatory circuits; and a combined Kelvin siphon recorder and cable relay, shown by Dr. Alexander Muirhead, in which the silk fibre of the siphon recorder is replaced by a fine gold wire.

Continental

Sensitiveness of Detectors.—The usual way of discovering improvements in the sensitiveness of detectors is to look for an increase of loudness in the telephone. Such an increase involves an effort of memory, and implies a considerable liability to error. P. Jégou has therefore devised a more reliable null method, which he describes in the *Comptes Rendus* for June 15th. The usual telephone transformer is split up into its two components. The secondary coil is placed in circuit with the electrolytic or other detector to be studied, and the primary, to which the telephones are attached, moves along a scale in close proximity to the secondary. The necessary E.M.F. is taken off a potentiometer, and the current is sent through the detector and secondary coil. The primary is displaced along the scale until the sound becomes inaudible. In testing the sensitiveness of an electrolytic detector at various temperatures, the author found that at a temperature of 12° C. a displacement of 30 mm. sufficed for extinguishing the sound, whereas at 60°, the temperature of maximum sensitiveness, a displacement of 56 mm. was required.

Photoelectric Canal Rays.—H. Dember claims, in No. 7 of the *Annalen der Physik*, to have proved that ultra-violet light, falling upon a fresh zinc surface, does not merely liberate electrons, but also positive particles. The method adopted recalls Goldstein's expedient with the perforated cathode, which enabled him to discover the canal rays. The zinc plate is freshly polished, perforated, and mounted just outside a Faraday ice-pail containing a plate of old copper connecting with an electrometer. On the other side of the zinc plate is a loop of wire serving as an anode, and earthed through a galvanometer. The zinc plate is charged to a negative potential by means of a high-voltage accumulator. The whole apparatus is enclosed in glass casings, with a quartz window to admit the ultra-violet light. Then the electrometer always indicates a small positive charge, while the galvanometer simultaneously shows an electron current. The positive or canal-ray charge gives rise to a current not exceeding 4×10^{-11} ampere, which does not appear to be much above the limit of sensibility.

Microphone Records.—A study of some importance to telephone transmission is contributed by Devaux-Charbonnel to the *Comptes Rendus* for June 15th. An oscillograph was put in circuit with a microphone and a battery, and the curves traced by it were enlarged by projection. The French vowel sounds were chiefly studied. The vowel "ah" was found to consist of the first, second, fourth, and sixth harmonics, with amplitudes 1·0, 1·7, 3·0, and 4·8 respectively, and phase displacements of 0°, 90°, 90°, and −90° respectively. "Oh" consists of the 1st, 3rd, and 5th harmonics; "eh" of the 1st, 2nd, and 12th; French "u" of the 1st, 2nd, and 9th; and English "ee" of the 1st, 2nd, and 13th, with amplitudes in the last case of 1·0, 4·2, and 2·8, and phase displacements of 0°, 0°, and 90° respectively. The 12th and 13th harmonics in the above list appear to be damped. If a number of vowels are pronounced in succession, each vowel takes about five vibrations to attain its complete curve, and another five on terminating. Since one cannot easily pronounce more than ten syllables per second, each vowel has about ten clear vibrations to itself. These must be ensured before we can obtain clear transmission, and experience has shown the importance of clear vowels for the intelligibility of the message.

The Electrical Imports of Japan.—According to a recent Consular report relating to the trade of Japan, the value of the electrical machinery imported during the year 1907 was £259,500, as against £194,400 for the year 1906. The value of the insulated wire imported was £251,400 during 1907, as against £116,600 for the year 1906. Electric cars to the value of £57,000 were also imported, the corresponding figure for last year being £31,200.

Electrical Engineers in the Territorial Army.—The establishment of an Electric Light Corps in the county of Devon is being commenced. According to the *Western Morning News*, the Devon County Association took over the Mutley Barracks, Plymouth, as the headquarters of the Electric Light Corps, which is to be incorporated in the Devon Royal Engineers, under the Territorial Army scheme. It is proposed that the men shall receive their training at the forts around Plymouth, and their annual camp training will also take place at the forts. A complete company will consist of 230 non-commissioned officers and men.

Settlement of Buildings due to Underground Railways.—According to the *Morning Post*, a statement was made at the Bow Street Police Court, in connection with the failure of the owners of Holy Trinity Church, Kingsway, to make certain repairs to the ceiling, that the unsafe state of the structure was due to the settlement of the building consequent upon the construction of the London County Council's underground tramway and the tunnel of the Great Northern, Piccadilly, and Prompton Railway. Damages are claimed against both the County Council and the railway company.

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THE RADIO-TELEGRAPHIC CONVENTION

THE "Radio-telegraphic Convention," by which name the Convention between the European and other first-class Powers to regulate wireless telegraph traffic is known, came into force yesterday.

One of the main objects of the Convention is to ensure intercommunication between coast stations and ship stations without regard to the particular system of radio-telegraphy adopted by these stations. Particular stations can be exempted from this obligation, however. The service conditions drafted at Berlin provided for the use of standard wave lengths of 300 and 600 metres at all stations open for public service, the former being regarded as the normal for ship stations. For long distance stations, or stations used for other than public correspondence, wave lengths above 600 but not exceeding 1,600 metres may be used.

The Convention consists of twenty articles relating generally to the enforcement of the terms agreed, and the regulation of wireless telegraphic traffic, and there are also 42 service regulations. An important feature is the exemption of naval wireless stations from the terms of the Convention, with the exception of Articles 8 and 9, which lay down that stations are to be worked so as not to interfere with others, and that calls of distress from ships are to have absolute priority.

According to Article 22, the Convention is to remain in force for an indefinite period, or until the expiration of a year from the date of its denunciation. Denunciation only takes effect as regards the Government in whose name it is made, the Convention remaining in force as regards the other contracting parties.

The countries that have signified their intention of adhering to the terms of the Convention are the Argentine Republic, Austria, Belgium, Brazil, Bulgaria, Chili, Denmark, France, Germany, Great Britain, Greece, Hungary, Japan, Mexico, Monaco, the Netherlands, Norway, Persia, Portugal, Roumania, Russia, Spain, Sweden, Turkey, the United States of America, and Uruguay. The Italian delegate at Berlin in 1906 signed the Convention under the reservation that Italy could only ratify at the expiration of its contracts with Mr. Marconi and his company, or at an earlier date if the Italian Government is able to arrange accordingly by negotiations with the Marconi Company. The adhesion to the Convention of a Government by having colonies, possessions, or protectorates, does not imply the adhesion of these in the absence of a declaration of a Government to that effect. Although all the countries mentioned above have not yet actually ratified the Convention, this is only a question of procedure, and there is no reason to believe that any country has receded from the position taken up in 1906. So far as Great Britain is concerned, His Majesty's Government has ratified the Convention on its own behalf and on behalf of all the Colonies, including India, with the exception of Newfoundland and the Orange River Colony. Mention may also be made of the changed attitude of Marconi's Wireless Telegraph Co., since the Convention was under consideration of the House of Commons Committee last year. The company is now agreed with the British Government, although previously it was antagonistic to the views of the British delegates.

LOCAL NOTES

ABERDEEN: *Supply to Tramway Company.*—The Electricity Committee has again had under consideration the question of the renewal of the agreement with the Aberdeen Suburban Tramways Co. for the supply of electricity, and it has been resolved to ask the Directors of the company to confer with the committee, and meantime to state what objections they have to the terms of the present agreement.

Underground Telephone Wires.—The Postmaster-General has complained of the restrictions imposed in connection with the excavations for the underground telephone wires. The department has been informed that the contractors are prepared to finish very shortly now.

ACCRINGTON: *Tramways Accounts.*—The Tramways Committee have considered a report showing the net profit on the Corporation's electric tramways undertaking for the year ending March 31st to be £1,145. On the electricity undertaking the net profit for the year was £604.

ACTON: *Electrical Exhibition.*—The accounts in connection with the Electrical Exhibition held in January last, under the auspices of the electric lighting department, show a surplus of 18s. 7d.

New Electrical Machinery.—In reply to a question at the last Council meeting, Mr. J. M. Blair, the Electrical Engineer, stated that the motor generators which had been ordered to run direct at 10,000 volts had failed when delivered, and had been rewound by the makers to run at 1,000 volts. The contract price was £2,540 for the 10,000 volts machine, but they were not valued so highly at the lower pressure. To make up the difference and to make them suitable for the different conditions, the contractors had supplied four transformers valued at £550, free of cost. The working results had since justified the acceptance of the machinery.

AMBLE: *Electric Lighting.*—At the monthly meeting of the Urban District Council last week, the question of public lighting was discussed at length, and an offer from the local gas company was considered. Notice was given, however, by one of the councillors that at the August meeting he will bring up a scheme for the supply of electricity.

AUSTRALIA: *Prahran (Victoria).*—The local Electric Lighting and Traction Co. have approached the City Council with a view to making use of steam generated at the Council's refuse destructor works for the generation of electricity. An offer of the Electric Lighting Co., to pay the Council one halfpenny per unit for electricity generated by the surplus steam at the destructor, has been accepted upon a seven years' contract, subject to six months' notice on either side at the end of that time.

BARKING: *Proposed Transfer of Electricity Works.*—At the last meeting of the Urban District Council the Clerk reported that the amended terms for the transfer of the Council's electricity undertaking to the promoters of the London & District Electricity Supply Bill had been duly communicated to the engineers of the scheme, who had replied that the same would be considered after the Bill had passed through the Parliamentary Committee.

BELFAST: *Tramways.*—A special meeting of the Corporation was held on Friday last for the purpose of considering a report from a deputation which had recently visited a number of English cities to make inquiries as to the stages and fares in operation on their tramway systems. The report virtually showed that the existing penny stages in Belfast are excessive, and that they should not under any circumstances exceed two miles. The report also advised the introduction of a halfpenny half-mile fare. After some discussion the report was adopted. The halfpenny fare has been strongly advocated since the tramway was opened.

BERWICK: *Overhead Wires.*—The local Electric Supply Company have applied for powers to erect overhead wires in connection with supply to some factories. The lines will run on private property, and in order to get the consent of the Board of Trade, formal sanction of the local authority is necessary. A report is to be presented at the next meeting.

BIRMINGHAM: *Tramway Inspection.*—On Wednesday last week, by the invitation of Mr. H. Barrow, Chairman of the Tramways Committee, and the Lord Mayor, members of the Tramways Committee and other members of the City Council, in addition to representatives from Aston, Erdington and Handsworth, and King's Norton, made a tour of inspection of the chief depôts and works of the tramway undertaking. During the speeches at a tea which was given at the close of the tour, the Chairman of the Tramways Committee, referring to the running of first class cars, an experiment which is being carried on in Liverpool, said he regarded this as an undemocratic notion, and it would be interesting to see what happened with regard to the Liverpool experiment. It had been urged upon the Birmingham Committee that they should also try this plan, but he thought it would be preferable to have some cars like they had in Paris, in which a man could have his breakfast on his way to town.

BLACKROCK (IRELAND): *Central Ireland Power Bill.*—At a special meeting of the Council last week a resolution was adopted deciding not to lodge a petition against the Central Ireland Electrical Power Bill, provided that the clause for the installation of electric light within two years in the town be

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included on the terms agreed upon, but in the event of any change in the Bill, as now printed, by the Committee of the House of Lords, the necessary steps be taken to have the clause affecting Blackrock restored to the Bill when in the House of Commons, without expense to the Council.

BRADFORD: *Tramway Accounts.*—The report and balance sheet for the year ended March 31st, 1908, shows a total revenue from all sources of £243,148, an increase of £5,637 over the previous year. The receipts per car mile amounted to 10·591d., against 10·732d. for 1906-7. The number of passengers carried was 47,839,569, an increase of 1,110,592. The total expenditure, including interest and sinking fund, was £167,994, leaving a gross profit of £75,154, against £72,524 for the previous year. The traffic expenses were 2·312d. per car mile, against 2·891d. Although the assessment reduced the amount to be paid in rates by £400, the General Manager reports that he still considers the assessment an unfair one. The accident claims increased by £650, in consequence of the Church Bank disaster in July last year. The amount paid in compensation in respect of this accident was about £2,000. The repairs and maintenance were 1·479d. per car mile, against 1·457d. last year, an increase of about £300, largely accounted for by extra cost of maintenance and electrical equipment of the lines. The Tramway Manager calls attention to this matter in his report, which he says needs the serious consideration of the Committee. A gratifying feature of the repairs account was the decrease of nearly £800, caused through the use of improved methods at the car works. The whole of the surplus of £17,238 has been carried to the reserve and renewals account, which now stands at £52,229. In a comparison between the Bradford system and those of other towns of the United Kingdom, the manager points out that the cost of electric current is a great disadvantage. If they could obtain electricity as cheaply as in Leeds or Sheffield, the power account would be about £15,000 less, and the net profit would consequently have been increased to £52,238.

BURY: *Municipal Tramways Association.*—The Managers' section of the Municipal Tramways Association will hold a meeting in Bury on July 10th, when they will be entertained by the Tramways Committee.

Electric Lighting Tariffs.—The following reduction in the electric lighting tariffs have been approved by the Corporation; private lighting and short-hour users, from 4d. to 3¾d. per unit; shops, 3½ to 5¼d. per unit; hotels, public houses, clubs, and other long hour users, 3d. to 2¾d. per unit; for power purposes the initial charge of 2d. per unit for 1,000 units per quarter is reduced to 1¾d. per unit, whilst the charge of 1d. for the next 1,500 units per quarter remains unaltered. All additional consumption will be at the rate of ¾d., instead of 7/10d. as hitherto. For public lighting a reduction of 10s. per lamp per annum is to be made, and the charge to the Tramways Committee is reduced from 1·05d. to 1d. per unit.

CARDIFF: *Tramwaymen's Grievances.*—The Tramways Committee has again discussed the question of the formation of a conciliation board to deal with disputes and questions of hours, labour, and wages between the tramwaymen and the manager and committee. A deputation from the tramway employees has asked that the recent decision not to consent to the establishment of such a board should be rescinded. It has been ruled that the committee cannot further discuss the matter, although the Council has rescinded the resolution in question.

Workmen's Cars.—There has been some discussion recently as to the liability of the Tramways Committee, under their Acts of Parliament, to run certain workmen's cars. On the advice of the Tramway Manager, some workmen's cars have been discontinued, and a complaint has been lodged, presumably by a ratepayer, with the Board of Trade. In reply to a communication from the latter, Mr. Arthur Ellis, the Manager, and the Town Clerk, have prepared a report which has been forwarded to that department.

Tramway and Lighting Accounts.—Two reports have been prepared by the Cardiff City Treasurer dealing with the accounts of the electric lighting and tramways undertakings. From these it is seen that there is a deficiency of £5,714, owing to the fact that the net profit for the year which has been appropriated for depreciation fund amounted to £8,807, whereas the amount to be set aside for depreciation, as already approved by the City Council, is £14,522 per annum. Similarly, with regard to electric lighting accounts, there is a deficiency of £3,338, which is arrived at by adding £911, the revenue deficiency for the year, to the sum of £2,823, which it has been resolved should be set aside each year for depreciation. The reports in question have not yet come before the Council.

CHELTENHAM: *Alleged Slander.*—The Electrical Engineer to the Cheltenham Corporation, Mr. W. J. Bache, brought an action at the Gloucester Assizes last week against a member of the Town Council, Mr. T. R. Jones, for alleged slander. The alleged slander was contained in a speech by the Councillor, in which he referred to the cutting down of the wages of the workmen at the electricity works. The plaintiff considered the defendant meant by these words that he had been improperly using his position as Electrical Engineer to the Corporation, and had been cutting down the wages of the workmen below what was necessary for their reasonable maintenance so that he might effect economies at the works, and thereby induce the Town Council to give him an increase of salary. For the defence it was stated that the defendant had no malice against Mr. Bache, and did not wish to make any reflection upon him; the speech complained of was an attack upon the Committee, and not upon the official. The jury found for the defendant.

COATBRIDGE: *Electric Lighting.*—The Town Clerk has been instructed to write to certain consulting electrical engineers in Glasgow to inquire if they would be willing to act as electrical inspector, and upon what terms, under the Company's Electric Supply Order, 1890.

DUBLIN: *Quay Tramways.*—The Dublin United Tramways Co. has asked the Dublin Port and Docks Board to permit a tramway to be laid along the south quay for the purpose of conveying coal, &c. The matter has been referred to the engineer for report.

DUMBARTON: *Tramway Extensions.*—On Thursday the tramway lines from Dalmuir to Balloch were opened for traffic after Col. Von Donop had inspected the lines on behalf of the Board of Trade.

DUNDEE: *Competition by Power Co.*—It is stated that the company, with its headquarters in the west of Scotland, has issued a circular to power-users intimating its readiness to supply electricity in Dundee. The circular stated that the company is in possession of the necessary powers for laying wires along the railway tracks, and that working agreements with the railway company have been arrived at. It is intended that three-phase high-tension current shall be generated at some suitable spot in the west of Scotland. The Electricity Committee, which has some doubt as to the powers in question, have decided to further consider it at the next meeting of the Electricity Committee, and it is also mentioned that the subject is one which will engage attention at the Nottingham Convention of the Incorporated Municipal Electrical Association.

ERITH: *Electricity Undertaking Income Tax Assessment.*—The Clerk has been in correspondence with the Surveyor of Taxes and the Clerk to the Income Tax Commissioners with reference to the proposed assessment of the electricity undertaking, and as a result no income tax will be payable in respect of the year 1907.

EXETER: *Electric Lighting Accounts.*—After deducting interest and sinking fund, the net balance is £2,604, the largest obtained in any year since the Council acquired the undertaking from the company. Out of this the Electric Lighting Committee propose to liquidate a charge of £637 upon cables for connecting street lamps, &c., as it is in the nature of capital expenditure. It had originally been intended to spread the repayment of this sum over three years. The coal costs, despite the higher price, have been less than in the preceding year.

GLASGOW: *Tramways.*—The Tramways Committee have expressed their regret that the Clyde Bank Town Council has not consented to a physical junction between the lines of the Dumbarton Borough & County Tramways Co. and the Corporation Tramways at Dalmuir, as they are of opinion that it would have been to the public advantage.

GREECE: *Electric Tramways.*—It is expected that some of the most important lines in Piræus will be ready shortly. Fifteen coaches have already been received, and some 90 more are expected very soon, these having been ordered in Milan. The Tramways Company, although practically of Belgian origin, is now styled Societe Hellenique de Tramways d'Athene-Piree et Environs, and has head offices in Athens. The capital of the company is £714,286, divided into 200,000 shares of £3 10s. 6d.

ILFORD: *Electricity Accounts.*—Commenting upon the Accountant's abstract of accounts relating to the electricity undertaking, at the meeting of the Urban District Council, Councillor Philpot drew especial attention to the fact that the reserve fund now stood at £6,483. During the year £5,577 additional capital had been spent, making a total expended on the undertaking of £157,271. The business of the undertaking was still increasing, and there was a gross profit on the year's work of £9,670. However, instalments of interest and principal, interest on mortgage debt, and a repayment of £557 to the tramway department on account of machinery used for generation of electricity had taken an expenditure of £10,045, so that there was a deficit of £375. Councillor Philpot mentioned that the price of coal advanced during the year, and the undertaking had to pay more, and for twelve months the charge of 3½d. per unit to the ordinary consumer, instead of 4d., had been in force. The price for public lighting had been reduced to £3 15s. per lamp, and in nearly 400 cases the department had changed the 30 c.p. single lamp to a 50 c.p. double lamp, so that the lighting of the urban part of the district had been considerably improved.

ITALY: *Wireless Telegraphy.*—According to a British Consular report, a wireless telegraph station is to be set up at Palermo for communication with Naples and Cagliaria in Sardinia. A wireless station is already in operation between Messina and Calabria for railway purposes, and a Marconi station at Cozzo Spadaro in the Province of Syracuse is attached to the naval station there.

Telephones.—During the second half of 1907 the public telephone system of Italy passed into the possession of the State, which promised cheaper telephones and a better service—not yet realised. The direct service between Rome and Palermo is still very unsatisfactory. A thicker wire is to replace the present

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one. At the present moment the following towns in Sicily are in telephonic communication with Palermo and each other :—Acireale, Alcamo, Caltagirone, Caltanisetta, Castellamare, Golfo, Castrogiovanni, Catania, Cefalu, Girgenti, Leonforte, Messina, Mistretta; Nicosia, Noto, Porto Empedocle, Sciacca, Syracuse, Termini, Terranova, and Trapani.

JAPAN: *Electric Power Supply.*—A British Consular report makes some reference to the works of the Oshima Hydro Electric Power Co., at Hakodate, which are now under construction. The works are situated about 20 miles from Hakodate, near the outlet of Lake Onuma, from which the water is led in a flue some 6 ft. square and 3 miles long to a point where a fall of 220 ft. is obtained. The average flow of water is 140 square ft. per minute. The total horse-power available is 3,500 h.p., but at first only 1,500 h.p. is to be supplied. The cost per horse-power supplied is to range from 5 yen up to 15 yen (10s. to £1 10s.) per 24 hours, which will effect a saving of over 35 per cent. as against the present cost of horse-power using steam boilers. The capital of the company is £100,000. This concern has already taken over the electric lighting of Hakodate, and it is hoped will electrify the present horse tramway system.

LEEDS: *Tramway Extension.*—The Corporation are applying to the Board of Trade for an extension of the period for the construction of a number of tramway extensions in the city.

LITTLEBOROUGH: *Electricity Supply.*—The Rochdale Electricity Committee have now decided to give a supply in bulk to the Littleborough Urban District Council, subject to satisfactory arrangements of details of agreements. Three-phase alternating current will be supplied at 3,000 volts at a price of 3d. per unit for the first hundred hours per quarter, and 1d. per unit afterwards.

LONDON: *London County Council.*—At Tuesday's meeting of the Council the estimates sent in by the Highways Committee of £1,290,000 for capital expenditure for the year 1908-9 in the purchase of tramways undertakings, reconstruction for electrical traction and construction of authorised new tramways, including acquisition of sites for the erection of car-sheds and sub-stations, and the erection and equipment of the generating station at Greenwich were discussed at some length and finally approved.

City of London Tramways.—At the meeting of the Court of Common Council on Thursday, a petition was presented from ratepayers on the east side of Bishopsgate Street Without in opposition to the proposal to widen the thoroughfare in order to admit of the introduction of tramways.

North London Tramways.—Comment is made upon the fact that in the reconstruction of the London County Council Tramways to Finsbury Park, the track work stops short of the track of the Metropolitan Electric Tramways system, serving the outer northern districts by several feet. Hopes had existed that through running would have been arranged between the London County Council and the Metropolitan Electric Tramways, Ltd.

Fulham.—The accounts of the electricity undertaking for the year ended March 31st have closed with a surplus of £1,408, of which £1,000 is to be transferred to machinery maintenance and reserve account, and the balance is to be retained on revenue account. The gross expenditure for the year shows a reduction on the estimates, and the estimated receipts have been exceeded by £270. The total expenditure on public lighting is less by £460 than the estimates, notwithstanding a large amount of extra work carried out.

Marylebone.—A statutory declaration has been received from the secretary of the Reason Manufacturing Co., Ltd., that the amount of the profit accruing to Mr. A. Wright from transactions between the Council and the company up to March 31st last was £36 2s. This sum, according to arrangement, is to be deducted from Mr. Wright's account.

Poplar.—The Borough Council has applied to the London County Council for permission to lay electric lighting mains in certain main sewers. The Mains Drainage Committee recommend that its application be granted on payment of a nominal rent of £1 a year in respect of each way leave.

Stepney.—Relative to the contract which the Borough Council have entered into with Messrs. Willans & Robinson, Ltd., for the generating plant at the "Blyth's Wharf" power house, the specification required the contractor to tender alternatively for condensers of the "Contraflo" type and for condensers of the ordinary type, and stipulated that either type of condenser should be provided with a Parsons' vacuum augmenter, which would be required more particularly with the ordinary type. In tendering, Willans & Robinson, Ltd., offered to deduct from the amount (£28,140) of their tender £120 if the vacuum augmenters were omitted. The firm has now suggested that they should fit, without vacuum augmenters, condensers with a larger number of tubes than those tendered for. The Electricity Supply Committee has decided that subject to the contractors giving an undertaking to maintain their guaranteed steam consumptions and efficiencies as provided by the contract (notwithstanding the increase in the tube surface and size of air-pump), the suggestion should be agreed to, the £120 mentioned above not to be deducted.—The Committee has resolved that legal proceedings be commenced against the City of London Electric Lighting Co., Ltd., for restraining the company from continuing the supply of electrical energy for consumption within the Tower of London, which, it is contended, is outside the company's statutory area of supply and within the area of the Borough Council.

MANCHESTER: *Electricity Accounts.*—The accounts for the year ended March 31st, 1908, have been published. The revenue amounted to £384,602, and the working expenditure to £219,358. From the gross profit of £165,244 interest on mortgage debit sinking fund and instalment of loans repaid to works commissioners absorb £145,701, bringing a net surplus of £19,543. Out of this surplus the sum of £1,998 has been appropriated for extensions of works, for which borrowing powers cannot be obtained. £10,000 has been paid to the City fund in the aid of rates, and the balance of £7,545 has been carried to the reserve fund.

Telephone Junction Fee.—Heston Moor and Eccles have now been included in the Manchester central group of exchanges, and the 1d. junction fee for communication between these two places, which has been charged hitherto, is abolished. It is also intended to include Sale and Urmston in the same manner.

New Tramway Shed.—A new car-shed in Princess Road, Moss Side, capable of accommodating 250 cars, is now in the course of construction.

MIDDLESEX: *Tramways.*—The Council has confirmed a resolution previously passed that application be made to the Board of Trade for an order extending by £100,000 the borrowing powers of the Council as authorised by the Middlesex Light Railway Orders, 1903 and 1907. The County Council approved of the whole of the cost incurred by the Metropolitan Electric Tramways, Ltd., in promoting the Metropolitan Electric Tramways Act, 1905, amounting to £1,835, being charged by the company as part of the capital expenditure in connection with the Edmonton tramways. With reference to the dispute which has now been going on for the last five years between Messrs. Wm. Griffiths & Co., Ltd., and the County Council with respect to tramway contracts, the matter has now been amicably arranged by Messrs. Wm. Griffiths having agreed to accept £2,000 in full discharge of all claims in respect of the Great North Road lines. The original claim by Messrs. Griffiths was for £10,921 in respect of delays to which they alleged they were put.

RAVENSTHORPE: *Public Lighting.*—The Electrical Engineer has reported against the street lighting by electricity, and recommends that the Council should ratify their agreement with the gas company for the public lighting.

SWANSEA VALLEY: *Tramways.*—The first section of the Glamorgan County Council Tramways, which will connect Swansea with the Swansea Valley, will shortly be opened. The line will be operated by the Swansea Tramways and Improvements Co., in connection with their Swansea system. The Board of Trade inspection will take place in a few days.

TURKEY: *Electric Tramways.*—A proposal has been made by a Turkish contractor to construct an electric tramway about five miles long from the Monastir railway station through the town to the large village of Magarevo, but so far no satisfactory terms have been offered. The project has not yet been thoroughly worked out either from the technical or commercial point of view, and it is not certain whether the water supply from which it is supposed to obtain power is sufficiently constant.

WALTHAMSTOW: *Electricity Works.*—The excavations and the construction of the foundations for the new chimney shaft, boilers, &c., at the generating station, are to be carried out by direct labour. The Electrical Engineer has been instructed to substitute "Osram" lamps for 32 c.p. lamps on lamp-columns in such parts of the district as he thinks suitable.

WILLESDEN: *Tramway Speeds.*—The Board of Trade has refused to sanction an increase of speed for the next twelve months upon the Metropolitan Electric Tramways system in Willesden.

WIMBLEDON.—A letter has been received from the solicitor of the London & South Western Railway Co. notifying the Council that the company will not require a supply of electrical energy at their Wimbledon Park works after December 31st, 1908. Subject to protective conditions, the General Purposes Committee have given to the London United Tramways, Ltd., permission to lay a single line of tramway connecting the west track of the tramways in Hill Road with the south track of the tramways in Worple Road.

NEW COMPANY

BROWN & PARSONS.—This company was registered on June 25th with a capital of £1,000 in £1 shares, to acquire the business carried on at 63 The Parade, Leamington, as Brown & Parsons, and to carry on the business of electrical and mechanical engineers, manufacturers of electrical or other machinery, accessories and instruments, &c. The subscribers are :—R. N. Newton, H. Robinson, G. H. Salmon, Mrs. E. Brown, C. J. Passey, F. E. Brown, and H. B. Matthews. No initial public issue. The number of directors is not to be less than three nor more than five; the first are F. E. Brown (managing director), and two others to be appointed by the subscribers. Remuneration of F. E. Brown £150 per annum and 10 per cent. of the net profits after 10 per cent. is paid on the ordinary shares. Registered by S. Mandale, 41-2 Temple Street, Birmingham.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Miscellaneous

BRAUNTON.—A report has been submitted to the Parish Council outlining a scheme of electric lighting. No decision has been arrived at pending the obtaining of further information as to the merits of gas compared with electricity.

BURNLEY.—The Tramways Committee has decided to purchase five new cars.

WILLESDEN.—A telephone exchange is to be erected by H.M. Office of Works, Storey's Gate, S.W., at Willesden.

Generating Stations, Sub-stations, Mains, &c.

COVENTRY.—The increasing demand for electricity at Coventry both for lighting and power purposes has led to the Corporation making application to the Local Government Board for sanction to the borrowing of £35,000 for extensions to the distributing plant, including the laying of mains in the outlying district. Altogether about £25,000 of the total amount is required for this purpose, but it is not intended to spend all this sum at once, but only as the extent of the demand warrants it. On Friday last, Mr. E. H. Tulloch, on behalf of the L.G.B., held an inquiry into the application. There was no opposition. It was mentioned that £2,000 was required for motors, in which branch a very lucrative business is being done.

DENMARK.—H.M. Consul at Copenhagen (Mr. L. C. Liddell) reports that tenders are invited by the Copenhagen Lighting Department for the supply of electric cables, required during the period August, 1908, to August, 1909. Tenders, marked "Tilbud paa Kabler," and addressed to the "Direktorenfor Belysningsvaesenet, Raadhuset, Copenhagen," will be received up to noon on July 8th.

DUBLIN.—The Lighting Committee invite tenders for the supply of sub-station switchboard transformers and accessories. Full particulars from the City Electrical Engineer, Fleet Street, fee £1 1s., returnable, and tenders to the Chairman of the Lighting Committee, 3 Cork Hill, Dublin, by July 13th.

FARNWORTH.—The local District Council have applied to the Local Government Board for sanction to borrow £7,000 for purposes of electric lighting. An inquiry into their application has been fixed for July 7th, to be conducted by Mr. H. Shelford Bidwell.

FELIXSTOWE.—Tenders are invited for overhead lines and house services. Particulars from Mr. R. P. Wilson, 66 Victoria Street. Fee, two guineas (returnable). Tenders by July 15th (see an advertisement this week).

ILFORD.—The Education Committee has requested the Council's Electrical Engineer to prepare an estimate for the installation of electric light at the Cleveland Road Board School.

LONDON: *London County Council.*—The Council invite tenders for the manufacture and delivery of high-tension main switchgear and low-tension auxiliary switchgear for the Greenwich generating station. Particulars from the Clerk, fee £2, returnable, and tenders by July 7th.

The Council invited tenders for the supply and delivery of about 100,000 tons of washed singles for the Greenwich generating station. Delivery to be made between August 1st, 1908, and July, 1909. Particulars from the Clerk to the Council, and tenders by July 7th.

Hackney.—The Finance Committee of the Borough Council have submitted estimates for a number of extensions of mains, estimated to cost £251. The Electric Lighting Committee has resolved to invite tenders for painting and repairing work at the electricity and destructor works.

Islington.—A natural draught cooling tower is required by the Eden Grove works. Particulars from the Chief Engineer, and tenders to the Town Clerk by July 16th.

Marylebone.—Tenders are to be invited for the re-arrangement of Aybrook Street sub-station buildings for the purpose of properly concentrating the electrical distributing staff under healthier conditions. The L.C.C. is to be asked for a loan of £5,000 to carry out the work.

St. Pancras.—Additions are to be made to the low-tension switchboard at the King's Road generating station. Particulars from the Electricity Department, 37 Pratt Street, Camden Town, and tenders to the Town Clerk by July 13th.

MANCHESTER.—Mr. A. J. Drury held a Local Government Board inquiry, on Thursday, into the application by the Corporation for sanction to borrow £130,500 for extensions to the generating plant. The Deputy Town Clerk, in presenting the case for the loan, stated that the output during the last year was 31 per cent. higher than that during the previous year, and that since 1904 the number of consumers had increased from 5,171 to 7,519. The number of connections in the equipment of 8 c.p. lamps had increased from 6,007 to 1,238,000, and the output had increased from 6,292 kw. to 10,288 kw. The number of units sold had increased from 29,000,000 to 63,000,000, and the gross revenue amounted to £384,000 compared with £267,000. The new loan was for the provision of 12,000 kw. of new generating plant of which half would be installed during the winter of 1908-9, and the other half the following year. The proposed loan also includes the sum of £1,000 for feed-water heaters at Dickinson Street station, and £13,500 for an artesian well at Stuart Street station. The application was supported by the Property Owners' Association and the Manchester Retail Traders' Association.

ODESSA.—The Town Council invites tenders for the installation and working, as a concession, of an electric station, with a capacity of not less than 6,000. Tenders to the Town Uprava (Executive Committee of the Town Council) by 12 o'clock noon of the 1-14 September of the present year, 1908. A deposit of a thousand roubles must be made as security for their proposal. Detailed particulars of the concession and other information may be obtained of the Building Department of the Town Uprava on working days (i.e., days when members are in attendance), from 1 to 3 clock.

WIMBLEDON.—The Local Government Board has sanctioned the borrowing by the Borough Council of the following amounts for work in connection with the electricity undertaking:—£2,606 for new remote control switchboard, and gallery and stairway at electricity works, Durnsford Road; £1,240 for extensions of buildings and foundations for engine and boilers (after deducting £310, outstanding debt on old buildings); £7,575 for new 1,000-kw. turbo-alternator, with platforms, cables, &c.; £4,710 for two water-tube boilers and economisers.

Wiring

ANERLEY.—The Managers of the North Surrey District School are about to provide additional class rooms and central hall at the school. The plans have been prepared by Mr. Cecil A. Sharp, architect, 11 Old Queen Street, Queen Anne's Gate, S.W.

BLACKBURN.—The Town Council recommend the erection of a new sessions house and police station and large public hall on a site now in their possession, as suggested in scheme prepared by the architects.

BLACKHEATH.—The Managers of the St. John's Church of England School, Russell Place, have obtained a site on which they propose to build a new school. Plans are in course of preparation.

BRADFORD.—Tenders are invited for an electric light installation at the new Nurses' Home and Isolation Block of the City Hospital, Leeds Road. Full particulars from the City Architect, Whitaker Buildings, Brewery Street.

BRISTOL.—*Extension, &c., of Royal Infirmary.*—Architect not yet appointed. W. E. Budgett, secretary to hospital.

The Bristol Co-operative Society, Ltd., are about to build a bakery at Whitehall, St. George, at a cost of £40,000. Mr. T. H. Smith is the general secretary of the Society.

BRYNNA.—Mr. J. T. Jenkins, architect, Porth, Rhondda, has prepared plans for the erection of 30 houses, and the contract for the building has been let at £5,200 to Mr. T. W. Jones, Pontycymmer.

CARDIFF.—Messrs. J. Allen, Ltd., Cardiff, have secured the contract at £3,000 for erecting new bottling stores for the Anglo-Bavarian Brewery, Ltd. Mr. E. G. C. Down, 31 High Street, Cardiff, is the architect.

DENHAM, BUCKS.—Alterations and additions are to be made to Mr. C. N. Newton's country house, after the plans of Mr. Anthony Wilson, architect of 1 Hare Court, Temple, E.C. The cost will be about £2,000.

DARTFORD.—Tenders are shortly to be invited for the erection of a church. The vicar-designate is the Rev. F. V. Baker, Christ Church, Dartford.

EAST HAM.—Mr. F. Hamlett, builder, Barking Road, E., is about to erect twenty-one houses in Montpelier Gardens. The rebuilding of the Red Lion beer-house, in High Street South, will shortly be commenced.

FELTHAM.—Middlesex County Council has decided that the infants' department of the Council school be enlarged, and Mr. H. G. Crothall, Middlesex Guildhall, Westminster, architect to the Education Committee, has been authorised to prepare the necessary plans and specifications.

GILLINGHAM.—A theatre of varieties is proposed to be built almost in the centre of the town, and it is hoped that it will be possible to give the first performance early in 1909. Mr. W. J. Mackay is at the head of the scheme.

GRINDLEFORD.—Mr. E. R. Sutton, architect, Nottingham, has prepared plans for a new church. It is proposed to commence with a chancel and a temporary nave.

HAMPTON.—A new church, with a seating accommodation of approximately 600, is in course of erection. The cost of the completed design (prepared by Messrs. Greenaway & Newberry, architects, 21 Queen Anne's Gate, S.W.) is £7,000. Messrs. J. Dorey & Co., of Brentford, are the builders.

HOUNSLOW.—Mr. Charles Burton, architect, 65-66, Chancery Lane, W.C., has prepared plans for the erection of a music hall in High Street, and is submitting them to the local authorities for approval.

LITTLEOVER.—A south aisle and chancel are to be added to the Church of St. Peter at a cost of £2,000. The architects

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are Messrs. Naylor & Sayle, of Derby, and the contractors are Messrs. Joseph Parker & Son, of Derby.

LONDON, E.—Messrs. John Hall & Son are about to erect a steam motor garage, and additions to Sun Flour Mills, St. Leonard's Street, E.

Additions are to be carried out to St. Matthias' Schools, in Grundy Street. Messrs. Fred & T. Thorne, of 266 Manchester Road, E., are the builders.

N.—Messrs. W. V. Aldridge & Son, wholesale drysalters, of Islington Green, are to re-erect that portion of their premises recently destroyed by fire.

Plans have been prepared by Messrs. Greenaway & Newberry, 21 Queen Anne's Gate, S.W., of additions proposed to be made to St. John's Road Workhouse, Upper Holloway.

N.E.—Two factories are to be erected at Hackney, one in Foulden Road, by Mr. C. G. Smith, architect, 56 Cannon Street, E.C., and the other in Kingsland Road, by Mr. W. H. Cone, builder, 80 Alkam Road, Dalston.

N.W.—Messrs. Unwin, Parker & Unwin, architects, of Wildes Farm, North End, are about to develop several new roads at the Hampstead Garden Suburb. They have also prepared plans for the erection of 13 houses in Hampstead-Way.

Sanction has been granted, by the local authorities concerned, to Mr. R. Vernon Hart, builder, of Burgess Park, N.W., for the erection of houses in Golder's Green Road.

Eight houses are to be erected in Middleton Road, Hendon. Mr. E. Streather, builder, of Sanderstead Station, Croydon, is the contractor for the work.

The Improved Industrial Dwellings Co., Ltd., 33 Finsbury Square, E.C. (Mr. Arthur Moore, sec.), has decided to erect dwellings in Willifield Way, and Asmuns Hill, Hendon.

S.E.—The Governors of the Dulwich College Estates have concluded terms for the erection of two hundred houses in Woodwarde Road, and a number of other houses to be erected under current building agreements. Mr. W. G. King is the Secretary and General Manager of the Estates.

The Managers of Christ Church Church of England School, Bear Lane, Southwark, have decided to carry out alterations (including the erection of a hall) to their school. The plans have been forwarded to the Board of Education for approval.

Messrs. Norfolk & Prior, architects, Catford, have prepared plans for twelve houses on the west side of Muirkirk Road, and twenty-two houses on the south side of Ardoch Road, Lewisham.

Messrs. W. J. Scudamore & Sons, builders, of 13 Manor Lane, S.E., are about to erect five houses on the north side of Chalcroft Road, Lewisham, and five houses on the north-east side of the same road.

S.W.—Messrs. Elms & Jupp, architects, 25 Sackville Street, W., have prepared plans for the formation of a new street on the west side of Church Street, Fulham Road.

Alterations, &c., are to be carried out at the Chelsea fire station, for the L.C.C.

The Chelsea Guardians recommend that electric light be fixed in various parts of the infirmary.

Messrs. Chapple & Utting, builders, of 24 Wavertree Road, Streatham, are about to erect fourteen houses on the north side and six houses on the south side of Wavertree Road, S.W.

The proprietors of Clapham College, Nightingale Lane, Balham, have decided to extend their premises. Messrs. Holliday & Greenwood, Ltd., Loughborough Park, S.W., are the contractors.

Additions are to be made to the Clapham Public Library, North Side, Clapham Common, by Messrs. J. Garrett & Son, builders, 83 Balham Hill, S.W.

Mr. J. C. Radford, architect, of 223 Upper Richmond Road, Putney, has prepared plans for the erection of houses, record office, and pavilion on Bank of England sports ground, Priory Lane, Putney.

Three shops and houses are to be erected in Tooting High Street by Messrs. Style & Winch, Ltd., brewers, Electric Avenue, Brixton, S.W.

Messrs. Ashton Webb & E. Ingress Bell, of 19 Queen Anne's Gate, Westminster, have prepared plans of a new vicarage to be erected in Margravine Road, Fulham, to abut upon St. Alban's Terrace.

W.—Housebreaking operations are proceeding at 125-6-7 Piccadilly. On the sites there are to be erected buildings in accordance with the plans of Messrs. Mewès & Davis, architects, 6 Dean Street, Soho, W. The builders are Messrs. Higgs & Hill, South Lambeth Road.

A scheme is on foot for the re-erection of Princess's Theatre, Oxford Street. The Board of Directors consists of the following:—Mr. Joseph Lyons (chairman), Mr. Cecil Raleigh, Mr. Patterson, Lord Elcho, and Mr. Albert Gilmer, who will also act as business manager.

W.C.—Messrs. Barlow & Roberts, builders, 15 Red Cross Street, S.E., are negotiating for the acquirement of a site in Gate Street. The area is about 1,000 square feet, and will probably be utilised for building purposes.

MITCHAM.—A church, vicarage, and parochial hall, in connection with St. Barnabas', Mitcham, are to be erected at a cost of £12,000. It has been decided to commence with the parochial hall, which is to cost £3,200. The vicar of St. Barnabas' is the Rev. E. J. Baker.

MOUNTAIN ASH.—A mixed school is to be erected at Abercynon to accommodate 350 children. The plans have been drawn up by Mr. W. H. Williams, Town Hall, Mountain Ash.

ROTHERHAM.—Messrs. Owen and Dyson, Rother Ironworks, are to make some additions to their offices.

Alterations and additions to the Rotherham Grammar School are about to be put in hand by the Governors.

A new secondary school for girls at Rotherham is to be erected by the Local Education Committee (Mr. J. H. Mair, Secretary).

SALFORD.—The "White Horse Inn," Clarence Street, Broughton, is to be rebuilt.

SKEGNESS.—The Baptists propose to erect a new church, and have acquired a site. Sir Joseph Bright, J.P., of Nottingham, is taking a prominent part in the movement.

SOUTHALL.—A new school is to be erected by the Middlesex County Council to accommodate about 800 children. Mr. H. G. Crothall, Middlesex Guildhall, Westminster, Architect to the Education Committee, is to prepare plans, and tenders are to be obtained for the work.

STOCKTON-ON-TEES.—The Post Office is to be enlarged by H.M. Office of Works, Storey's Gate, S.W.

TOTTENHAM.—Building operations in this district are fairly brisk. Mr. G. W. Rowley, builder, 278 Philip Lane, Tottenham, N., who has recently put up a large number of houses, has decided to erect a further forty-seven residences in Rosebery Avenue, and sixteen in Gorleston Road.

Mr. G. W. B. Bolton, architect, of 11 and 12 Finsbury Square, E.C., has prepared plans for a block of flats in High Road. Owing to technical reasons the plans have not yet been passed.

Additions are to be made to St. Ignatius' College, High Road, South Tottenham, and to St. Mary's Priory, St. Anne's Road.

TWICKENHAM.—Electric lighting is to be installed at the Town Hall, the contractors being the Twickenham and Teddington Electric Light Co., Richmond.

The District Council has agreed to install electric light in the Town Hall, and has passed a scheme submitted by the Twickenham and Teddington Electric Light Co. There was considerable discussion at the last meeting of the Council on a recommendation of the Highways Committee to light the new isolation hospital with electricity. It was proposed by the committee to take the current required from the Council's sewage works, and, with this object, to spend a sum not exceeding £1,000 on doubling the generating plant at the works. The recommendation was carried.

WAKEFIELD.—The Wakefield & District Small-Pox Isolation Hospital Committee have obtained sanction to borrow between £10,000 and £11,000 for the erection of an isolation hospital at Carr Gate.

WALLINGTON.—The Wallington Congregationalists are raising money for the erection of a new church. A site has been obtained, and it is hoped that building operations will be shortly commenced. Communications may be addressed to Rev. G. Mannington.

WALTHAMSTOW.—Mr. H. Brodey, architect, 259 High Street, Walthamstow, is about to erect seven houses in Pentire Road. He has also prepared plans for the conversion of stables into flats in Randolph Road. These are still under the consideration of the local authorities.

WORTHING.—A site has been obtained on the sea front for the erection of a convalescent home in connection with the Royal Surrey County Hospital. Mr. Shepherd some few months ago gave about £10,000 for the building and endowment. The erection will be commenced when a sum of about £500, the balance of the purchase money of the site, is raised by subscription. Mr. E. Gibson is honorary secretary.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Queensland Postmaster-General's Department has accepted the following tenders:—British Insulated & Helsby Cables, Melbourne, lead-covered cable at £490, £240, £140, and £115 per mile respectively for 208 pair, 78 pair, 39 pair, and 26 pair cable; Western Electric Co., Sydney, 3,492 yards of 104 pair lead-covered cable at £464 19s. total; W. T. Henley's Telegraph Works Co., Ltd., Melbourne, 52 pair lead-covered cable at £176 per mile; C. E. Burnay, Brisbane, 13 pair lead-covered cable at £74 per mile

The Electric Lighting & Traction Co. of Australia have placed an order with Messrs. Bellis & Morcom, of Birmingham, for two 1,100-h.p. engines coupled to 750-kw. Brush D.C. generators, in addition to a surface condensing plant with motor-driven air and circulating pumps.

AUSTRALIA.—The tender of Messrs. Siemens Bros., London, for the manufacture and laying of two new cables between Victoria and Tasmania, has been accepted by the Federal Government at £47,955. The Postmaster-General of Australia

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has accepted the tender of the Western Electric Co., Sydney, for the supply and delivery of 20 miles of telephone cable, at £490 per mile (a total of £9,800), and 150,000 paper sleeves.

BOLTON.—The Electricity Committee has accepted the tender of the British Insulated & Helsby Cables Co., of Prescott, for 12 months' supply of cable; that of the British Westinghouse Electric & Manufacturing Co. for the supply of a combination booster; and that of Mr. H. Critchley for painting the interior and exterior of the electricity offices.

DARTFORD.—The Council has accepted the following tenders for annual supplies to the electricity department:—House service cable, jointing material, and accessories, Johnson & Phillips, Ltd., £159; general stores, S. W. Gibson & Co., £67 10s.; 2,500 to 3,000 tons South Hetton rough small coal, Beadle Bros., Ltd., 14s. 6d. per ton; 2,000 to 2,500 tons of coke breeze, E. J. & W. Goldsmith, Ltd., 8s. 6d. per ton.

LONDON: *Hackney.*—The Electric Lighting Committee has decided to accept the tender of W. G. Beaumont & Sons, Priory Works, Priory Street, Bromley-by-Bow, at £121 11s. 10d., for the painting of arc lamp posts and switch pillars. This was the lowest of eight tenders received.

MIDDLESEX.—The County Council received the following tenders for the construction of the tramways along Friern Barnett Road from the Orange Tree Inn, Friern Barnet, to New Southgate Station, and from the Orange Tree Inn, Friern Barnet, along Woodhouse Road to Great North Road, Finchley:—

	£	s.	d.
Adams, Thomas	32,668	1	8
Dick, Kerr & Co. (accepted)	31,431	7	10
Fasey, A., & Son	37,161	14	0
Ford Clift	31,431	7	10
Holloway & Co.	35,063	15	11
Law & Co.	35,855	13	10
Mowlem & Co.	33,704	12	6
Wall, C., Ltd	36,364	17	1
Wimpey & Co.	34,048	17	0

The estimate of the County Engineer for the work was £33,524 15s. 9d.

SOUTH AFRICA: *East London.*—The tender of Messrs. W. Bain & Co., of Coatbridge and Johannesburg, has been accepted for the structural steel work at £5,101, in connection with the new power station which the East London Council is erecting. The same firm's tender for a coal transporter at a cost of £2,805 has also been accepted.

STOCKHOLM.—The Oerlikon Co. have received an order for two 6,000 kw. turbo-generators. The sets will generate at 6,000-6,500 volts 25 cycles, and will give their full output at a power factor of 0·85 at a speed of 750 r.p.m.

UNDERGROUND RAILWAYS CO. OF LONDON, LTD.—An order for a large number of signs with the word "Underground" has been placed with Messrs. O. C. Hawkes, Ltd., of Birmingham, by the Underground Electric Railways Co. of London, Ltd. Some of these signs, which are for erection outside the stations of the Underground Electric Railways Co., will be made with three faces, so that the word can be read from the front and from either side, whilst others are to be V shape. It is calculated that about 70,000 sq. ft. of plate glass will be utilised. Messrs. O. C. Hawkes, Ltd., will carry out the complete contract, including the ornamental ironwork and electrical equipment.

WIMBLEDON.—The Electric Lighting Committee of the Borough Council has decided to accept the following tenders:—Supply of coal for electricity works for year ending June 30th, 1909, Charrington, Sells, Dale & Co., "Mapperley small nuts," 15s. 9d. per ton; supply of arc lamp globes for year ending March 31st, 1909, Edward J. Shaw & Co.

COMPANIES' MEETINGS AND REPORTS

ANGLO-ARGENTINE TRAMWAYS CO.—At an extraordinary meeting on Tuesday, resolutions were carried approving a provisional agreement with the Compagnie Générale de Tramways de Buenos Ayres, for the acquisition by the company of 24,007 six per cent. preference shares, and 20,007 ordinary shares, both of £5 each, and constituting all the issued share capital of the Buenos Ayres Electric Tramways Company (1901), and the entire undertaking of the Belgian Argentine Tramways Company; and authorising the division of the £5,000,000 new ordinary shares into £2,500,000 five per cent. cumulative third preference shares, and £2,500,000 ordinary shares, the payment for the above properties and the Buenos Ayres and Belgrano Tramways Company's undertakings to be effected as to one-half in third preference shares and as to one-half in ordinary shares.

BUENOS AIRES GRAND NATIONAL TRAMWAYS.—At the meeting on Tuesday the report and accounts, given in our last issue, were adopted. Mr. Irving Courtenay, in presenting the accounts, said he thought the shareholders would consider them satisfactory under the transition circumstances. Having gone through the accounts he gave warning against exaggerated expectations for the future. The traffic upon the system as a whole continued to show an increase month by month as compared with the previous year, but a new and active competition upon the part of a rival line was affecting several of their services. It was too soon to form a definite idea of what the effect would be upon the current financial year, but he feared it would tend to postpone the time when they would be in a position to pay a dividend upon the ordinary shares. They were working in harmony with the consultation of the various tramways in Buenos Aires, a consultation which, since he had studied the tramways situation on the spot, he had always been of the opinion was bound to come.

GLOBE TELEGRAPH & TRUST.—At the ordinary general meeting held on Tuesday, Lord Tweeddale stated that the receipts for the year, after deducting expenses, amounted to £210,295, of which £131,770 had already been absorbed in dividends. A final dividend on the ordinary shares of 5s. 9d. per share was recommended, making a total of 5¾ per cent. for the year. £27,206 are to be carried forward. The report was adopted.

INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS CO.—At the half-yearly meeting held yesterday, Major Darwin, in bringing forward the recommendation for a 2½ per cent. interim dividend, referred to the symptoms now being shown of a permanent lowering of the prices of raw material. At an extraordinary general meeting which followed, a resolution was passed under which the directors were empowered to issue fresh capital.

INDIAN ELECTRIC SUPPLY.—The report for 1907 shows that up to June 30th, 1907, the capital expenditure amounted to £122,402, and that the revenue account was opened on July 1st. The working in India for the half year of 1907 resulted in a loss of £2,043, which was increased to £6,681. After meeting London expenses and interest on construction debenture stock. Further capital will have to be raised to pay off the indebtedness incurred, and to provide for extensions of the mains. Arrangements have been made for the financial requirements of the company until the end of 1908.

JOHNSON, LUNDELL ELECTRIC TRACTION.—The accounts for the 21 months to May 30th show a balance at debit of profit and loss account of £558,555. The report stated that funds are being conserved in order to keep the patents alive until a more favourable time, and arrangements are being made to give effect to the offer of the principle promoters to make good to the shareholders the profit made by them in the promotion. The meeting was on Tuesday adjourned to enable these arrangements to be completed.

J. G. WHITE.—At the ninth ordinary meeting held on Monday, the report, abstracted on page 982 of our last issue, was adopted. Mr. J. G. White, who presided, called attention to the satisfactory way in which difficulties arising from severe competition and stringency in the money market had been met. He was pleased to say that business in hand was sufficient to ensure thoroughly satisfactory profits for the current year, and negotiations for other important business were progressing favourably.

COMPANY MORTGAGES, &c.

BOURNEMOUTH & POOLE ELECTRICITY SUPPLY CO.—Particulars have been filed pursuant to Section 14 (4) of the Company's Act, 1900, of a series of debentures for securing an amount not exceeding half the subscribed capital for the time being, of the company, created by resolutions dated March 5th, 1900, July 16th, 1903, and May 21st, 1908. The present subscribed capital of the company is £375,000. The property charged under the new debenture is the company's undertaking and property present and future. There are no trustees.

LA CAPITAL TRACTION & ELECTRIC LIGHTING CO. (BUENOS AIRES).—A trust deed was registered on May 20th, supplementary to two trust deeds, dated December 21st, 1900, and November 11th, 1907, securing £800,000 debentures. The property chargeable is the company's undertaking and assets present and future, and the trustees are W. Trotter, Basildon House, and R. Fleming, 2 Princes Street, E.C.

LANCASHIRE DYNAMO & MOTOR CO.—£500 5 per cent. first mortgage debentures, part of series created to secure £75,000 charged on two plots of land in Trafford Park, Manchester, with the premises and machinery thereon, and the company's other assets and undertaking, except new capital, were issued on June 3rd. There has previously been issued of the same series £68,000. The trustees are E. F. Sheppard, 55 King Street, Manchester, and A. Tongue, 86 King Street, Manchester.

APPOINTMENTS AND PERSONAL NOTES

The Bury Electricity Committee have decided to increase the salaries of the works and mains superintendents from £150 per annum to £180 per annum in each case.

Mr. W. T. Maccall, of the Woolwich Polytechnic, has been appointed head of the electrical engineering department at the Halifax Municipal Technical School at a salary of £200 per annum.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival quoted on Tuesday night, was £58 15s. to £59 5s. per ton.

AGENCY.—Messrs. Pooley & Austin, of 25 Victoria Street, S.W., inform us that they have been appointed sole agents in London and the Home Counties for Messrs. Engineering Instruments, Ltd., manufacturers of totally enclosed motor control gear for direct and alternating current.

CHANGE OF ADDRESS.—Messrs. Arc Lamps, Ltd., have now removed from Camden Town to their recently completed factory at St. Albans. They wish to notify their clients that in order to facilitate the securing of spares, Messrs. Frampton & Paine, of 29 Old Queen Street, Westminster, their sole selling agents for London and the South of England, hold a stock of carbons, globes, and other spare parts.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—At the London Bankruptcy Court, on Thursday, Thomas Clement Hodgkinson, trading as "The Electro-Neurotone," at 186 Goldhawk Road, Shepherd's Bush, applied for his discharge. The Official Receiver in his report said the receiving order was made on May 2nd, 1906, and at the first meeting of creditors debtor returned his liabilities at £541, and assets at £235. Proofs were lodged, however, for £1,698, and a dividend of 1s. 9d. in the £, was paid. The only offence against the Bankruptcy Acts reported was that the assets were not equal to 10s. in the £. No creditors opposed the discharge. The Registrar said the only alternative to two years' suspension the law allowed was that the debtor should consent to judgment being entered against him for a certain sum. He would grant an adjournment in order that the debtor might consider whether he would pay £20 in order to bring the dividend up to 2s. The matter was accordingly adjourned.

A meeting of the Totnes Electricity Supply Co., Ltd., will be held in room No. 425, Salisbury House, London Wall, on July 30th, at 11.15 a.m., to hear the liquidator's account of the winding up.

A meeting of the Chelmsford Electric Lighting Co. will be held in room 425, Salisbury House, London Wall, on July 30th, at 11.15 a.m., to hear the liquidator's account of the winding up.

A meeting of the "Z" Electric Lamp Syndicate, Ltd., will be held at Orient House, New Broad Street, London, on July 28th, for the purpose of hearing the liquidators account of the winding up.

T. A. Evans, carrying on business under the name of T. Arthur Evans & Co., electrical and mechanical engineers and contractors at Swansea, has been adjudicated as a bankrupt.

PARLIAMENTARY INTELLIGENCE

CENTRAL IRELAND ELECTRIC POWER BILL.—The Dublin Corporation and the Dublin and Alliance Gas Co. have petitioned against the Central Ireland Electric Power Bill.

LIVERPOOL CORPORATION BILL.—This Bill was under consideration of the Police and Sanitary Committee of the House of Commons last week, and has been sent forward for third reading. Part 3 proposes the construction of tramways in the district of the Litherland Urban District Council, and the sum of £2,900, repayable in 30 years, is to be borrowed. The period for construction is five years.

METROPOLITAN DISTRICT RAILWAY.—In answer to a question in the House of Commons on Thursday, Sir H. Keighley stated that the Board of Trade were informed that the Metropolitan District Railway Co. were preparing to change the pneumatic method of operating the sliding doors on their trains to hand operation.

PAISLEY AND DISTRICT TRAMWAYS ORDER CONFIRMATION BILL was read a second time in the House of Lords on Tuesday, and the Ayr Corporation Tramways Order Confirmation Bill was read a third time.

TRAMCAR ACCIDENTS.—In reply to a question in the House of Commons last week, Mr. Churchill stated that the number of accidents reported to the Board of Trade as having occurred through persons being knocked down or run over by tramcars in the year were as follows:—Number of accidents, 1,329; killed, 105; injured, 1,003; uninjured, 221.

WEST LONDON, BARNES, AND RICHMOND TRAMWAYS BILL.—The promoters of the West London, Barnes, and Richmond Tramways Bill have intimated their intention not to proceed with the measure this session. The Bill proposed the incorporation of a company with a capital of £240,000 in £1 shares to construct a network of lines in Richmond, Mortlake, Barnes, and Putney. The first directors of the company were to be T. W. Reynolds, A. H. Sanderson, F. E. Savory, and R. P. Sellon. The term of purchase was to be 60 years instead of 61, and provision was made for agreements to be entered into with the County of London Electric Supply Co. and the Richmond (Surrey) Electric Supply Co. Fifteen separate lines were described in the Bill.

The Blackburn Corporation and the London United Tramways Bills were read a third time in the House of Commons on Tuesday.

PROGRESS OF ELECTRICAL BILLS.—The North East Railway Co. Bill was read a third time in the House of Commons on Thursday.

The Lanarkshire Tramways Order Confirmation Bill was read a third time, and passed in the House of Commons on Wednesday.

UNOPPOSED BILLS.—The Macclesfield and District (Abandonment) Bill was ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Wednesday last week. The Tramways Company, having been transferred to the Urban District Council, now seeks to relieve itself of the obligation to construct the lines, and at the same time seeks authority to transfer the Macclesfield Electric Lighting Order, 1901, to the Macclesfield Electric Light & Power Co., and to wind up the company.

The Bristol Tramways Bill has also been ordered to be reported for third reading by the Unopposed Committee of the House of Commons. This Bill seeks an extension of time for three years for tramways authorised in 1904.

MISCELLANEOUS CITY NOTES

BRUSH ELECTRICAL ENGINEERING CO.—An extraordinary general meeting is to be held on Tuesday next for considering resolutions regarding the consolidation of the non-cumulative 7 per cent. preference and ordinary shares, so that every three shares of 6s. 8d. shall form one fully-paid share of £1, and that the unissued shares shall be sub-divided so as to be also of £1 each.

HARPER ELECTRIC PIANO CO.—A dividend of 10 per cent. per annum on the preference shares is recommended for the half-year ended June 1st.

O. C. HAWKES, LTD.—A dividend of 5 per cent. per annum has been declared upon the preference shares for the half-year ended June 30th, also an interim dividend of 5 per cent. per annum upon the ordinary shares for the same period.

INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS CO.—An interim dividend of 5s. per share, free of tax, is recommended upon the ordinary shares.

NOTTING HILL ELECTRIC LIGHTING CO.—The directors announce an interim dividend of 6 per cent. per annum, and a bonus of 1 per cent., making together 8s. per share on the preference shares, and 6 per cent. per annum upon the ordinary shares for the half-year ended June 30th.

VICTORIA FALLS POWER CO.—Mr. A. E. Hadley, who is known in connection with the Rosario Electric Co., has joined the Board.

APPOINTMENT VACANT.

BOROUGH POLYTECHNIC INSTITUTE,
103, BOROUGH ROAD, LONDON, S.E.

ELECTRIC WIRING INSTRUCTOR.

FOREMAN WIREMAN REQUIRED, qualified to give instruction in Electric Wiring (Elementary and Advanced) to City and Guilds of London Institute Technological Classes, on one or two evenings a week. Particulars of the appointment can be obtained by sending stamped addressed envelope to the Principal. All applications must be sent in by 11th July. Only selected candidates will be written to.

C. T. MILLIS,
Principal.

TENDERS INVITED.

FELIXSTOWE URBAN DISTRICT COUNCIL.

ELECTRIC LIGHTING.

THE URBAN DISTRICT COUNCIL OF FELIXSTOWE AND WALTON are prepared to receive tenders for the following:—

OVERHEAD LINES AND SERVICES.

Specifications, General Conditions, and Forms of Tender may be obtained on and after Saturday, 4th July, 1908, at the offices of the Consulting Engineer, Mr. Reginald P. Wilson, 66, Victoria Street, Westminster, on payment of a sum of two guineas.

This sum is required as a deposit, and will, after the Council shall have entered into a contract upon the tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bona fide* tender and shall not have withdrawn the same. In any other case the deposit will be forfeited.

The tenders must be sent in on the Official Form, and all instructions contained therein must be complied with.

Tenders, endorsed "Overhead Lines and Services," must be addressed to the Clerk, Felixstowe and Walton Urban District Council, and must be delivered at the Town Hall, Felixstowe, not later than 12 noon on Wednesday, 15th July, 1908.

The Council do not bind themselves to accept the lowest or any tender.

F. B. JENNINGS,
Clerk to the Council.

Town Hall, Felixstowe.
30th June, 1908.

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PROPOSED NEW HOME FOR THE INSTITUTION OF ELECTRICAL ENGINEERS

THERE was a very good attendance at the special general meeting of members, associate members and associates of the Institution, which was held on Tuesday afternoon in the lecture theatre of the Medical Examination Hall to consider the following resolution:—

"That the purchase of the lease of the site and building known as the 'The Medical Examination Hall,' situate on the Victoria Embankment, now the property of the Royal College of Physicians of London and the Royal College of Surgeons of England, for the sum of £50,000, be sanctioned and approved, and that the Council be authorised to sell such of the investments of the Institution, and to make such other financial arrangements (including the disposal of the site in Tothill Street now owned by the Institution) as the Council may consider necessary for the above purpose."

The President, Col. CROMPTON, introduced the subject with a few preliminary words, and called upon the Hon. Treasurer, Mr. R. Hammond, to give a statement as to how the financial side of the question would be dealt with.

Mr. HAMMOND said that the capital requirements were as follows: For the purchase of the building, £50,000; and for the estimated cost of enlarging the theatre, six months' rent of the old premises, removal, painting, new furniture and bookshelves, £6,000; making a total of £56,000. The capital resources were as follows: Trustee investments, less the life compositions fund (possibly not deemed to be available for investment in the building), £17,701; deducting from this the sum of £862 transferred to the Kelvin Lecture Fund since the last accounts were made up, a sum of £16,839 is available, the realisable value of which may be taken as £15,000. To this last figure the following may be added: Value of investments made in current year, £4,000; estimated additional amount available by June 1st, 1909 (the date on which the £50,000 is payable), out of the usual increment, £4,000; and book value of the Tothill Street site, £19,260. This brings the total up to £42,260, leaving a sum of about £16,000 to be raised by a loan. Mr. Hammond then went into the probable income and expenditure in the year 1909, showing that whereas the probable expenditure amounted to over £13,500, the estimated income was only just over £13,000, leaving a slight deficit. He pointed out, however, that this deficit would almost certainly be converted into an increment by the further subletting of the upper floors of the building, as in the probable income he had included only the small sum of £650 for the rooms already let. He also pointed out that the Tothill Street site would, according to the best authorities, realise a larger sum than the book value.

The PRESIDENT then moved the resolution.

Mr. W. M. MORDEY (President-elect), in seconding the resolution, said that he was sure that if the building were purchased, it would be to the lasting good of the Institution. After mentioning the debt of gratitude owing to the Institution of Civil Engineers for the liberal use of their hall, he pointed out that the Institution was quite large enough to deserve a home of its own, not only for the purpose of holding meetings, but also for encouraging social intercourse among the members. The number of members was now over 6,000, as compared with the 8,500 members of the Institution of Civil Engineers. The idea of purchasing a building was no new thing, he said; since 1893, when the building fund was first started, the matter had been before the Council. The Tothill Street site was purchased in 1904 because it was the best they could find at the time, and land in Westminster was getting scarce. That site was by no means suitable, being far too small, but the purchase had not been unwise, as the site had paid a fair interest, and had increased in value. Five weeks ago the question of purchasing this building was first put before the Council, and the competition of an important public body and an option to purchase at a definite price within a few days from now, had compelled the Council to act quickly. Mr. Mordey then pointed out the suitability of the building, adding that the lecture theatre, which was rather small, could be made one of the finest halls in London by roofing in the quadrangle. The architect to the Institution had given an excellent report on the general condition of the building. The Council, he said, were unanimous in recommending the purchase of the building, and the contract was ready for signature.

Sir JOSEPH SWAN, Mr. G. WARD (Hon. Secretary for New York), and Mr. E. BARTON (Hon. Secretary for Australia) supported the resolution.

Major CARDEW opposed the passing of the resolution, which he said had been rushed through. He did not think the meeting of some 200 members could be taken as representative, but proposed that a statement should be submitted to members and voting invited. He criticised Mr. Hammond's figures with reference to the probable expenditure in the new building, and expressed dissatisfaction with the building itself.

Mr. MARTIN ROBERTS moved an amendment that the matter be referred back to the Council for further consideration. The building, he said, was too large and altogether unsuitable.

Mr. W. B. ESSON seconded the amendment, pointing out what a serious matter it was to borrow so much money and still expect a deficit at the end of the year. He proposed that the Institution should enlarge the present offices and hire a lecture theatre for the meetings rather than purchase the building under consideration.

Mr. SYDNEY SHARP and Mr. LEON GASTER also spoke.

Mr. ALEX. SIEMENS then rose to oppose the amendment, and pointed out that the Council had already very carefully considered the matter. The new building was none too large; the present building occupied by the Institution of Civil Engineers was not large enough, and the new building would have 20,000 sq. ft. of ground space, which was the same as that of the building under consideration. The enlargement of the lecture theatre was an easy matter, and should be taken on at once. He thought that there would be no difficulty in letting those parts of the building not required by the Institution, and mentioned that the Society of Arts, the Institution of Naval Architects, and the Iron and Steel Institute were all on the look-out for new accommodation.

A few questions were put to Mr. Hammond concerning the Tothill Street site and the lease of the new building, and after these had been answered, the PRESIDENT, in putting the amendment, explained the reason of the rush, and emphasised the fact that if the amendment was passed the building would be irretrievably lost, as the option to purchase expired in a few days.

The amendment was lost, and the original motion was then put to the meeting and carried unanimously.

NEW PUBLICATIONS

"Electric Bells, and all about them." By S. R. Bottone. Seventh edition. (London: Whittaker & Co.) 2s.

"Industrial Electrical Measuring Instruments." By Kenelm Edgcumbe. (London: Archibald Constable & Co.) 8s.

"Field Telephones for Army Use." By Lieut. E. J. Stevens. (London: Crosby, Lockwood & Son.) Price 2s.

New Electric Railway in the Alps.—According to the *Times*, an electric railway from Martigny to Châtelard was opened yesterday. The Paris, Lyons & Mediterranean Railway Co. have also just completed a short line connecting their own system with the above Swiss line. The new line enables tourists to proceed from Fayet, St. Gervais, and Chamonix to Martigny and St. Maurice in Switzerland, returning by Evian, Thonon, and Geneva.

Telegraph Traffic.—Communication to the United States of America and Canada over the cable of the Direct United States Cable Co., which was broken during the recent trawler troubles off the Irish coast, has been restored. The Government of British Guiana have passed a resolution urging his Majesty's Government, in view of repeated failure of telegraphic communication, to support the extension of the British cable system from Bermuda to Barbados, Trinidad, and British Guiana, especially as the suggested establishment of a wireless system between Trinidad and Demerara does not appear to be making any headway.

The Electrical Industry and Port of London Bill.—On Tuesday the Joint Committee of the Houses of Lord and Commons, considering the Port of London Bill, heard evidence from Mr. Alexander Siemens, a director of the firm of Messrs. Siemens Bros. & Co., Ltd. He supported the case put forward by the London Waterside Manufacturers' Association, which is representative of all the waterside manufacturers in the Port of London. Mr. Siemens, who is a member of the Council of the Association, informed the Committee that the rateable value of his premises by the waterside was between £9,000 and £10,000. He was emphatically of opinion that the waterside manufacturers ought to have the certainty of some representation on the Port authority. The latter body ought to have such knowledge as only the manufacturers could give them when fixing rates, &c. Mr. Siemens endorsed evidence that the rateable value of the waterside manufactories represented by the Association was nearly half-a-million, and the industries gave employment to about 70,000 people. Cheap transport was essential to the large manufacturing industries. It was of great importance to the welfare of London that the waterside industries should be represented on the new Port authority. The Association was satisfied with the present condition of affairs. At present they were able to hold their own with foreign competitors because they had a free port. Many materials were bought by waterside manufacturers from merchants in London, who, paying the dues, would therefore get the vote for representation instead of the waterside manufacturers. Their interests ought to be protected against foreign competition. Mr. Siemens emphasised the danger of manufacturers and industry being driven away if heavy and ill-considered charges were imposed.

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LONDON ELECTRIC POWER BILLS

London (Westminster & Kensington) Electric Supply Bill.

THURSDAY, JUNE 25TH. (TWENTY-EIGHTH DAY.)

LORD CROMER'S Committee of the House of Lords met on Thursday for the consideration of the London (Westminster & Kensington) Electric Supply Companies' Bill, which provides that the Kensington & Knightsbridge, St. James and Pall Mall, Notting Hill, Westminster and Central Supply Companies may enter into, and carry into effect, agreements providing for the supply of electrical energy in bulk. An agreement has been come to with the Westminster City Council with regard to the compulsory purchase of the bulk supply mains. The Bill provides that any mains laid down under the provisions of this Act outside the area of supply, shall be marked in a distinctive manner so as to distinguish them from other mains or work, and shall not be liable to purchase by the local authority in whose district they are laid, but that they shall be deemed part of the undertaking of the company, and shall be purchasable as if they had been within the district of the local authority entitled to purchase. The Bill also contains the now well-known "standby" clause. A further clause provides that from the passing of the Act the maximum charge for power supply within the areas of the respective companies shall be £6 15s. per annum per kilowatt of maximum demand plus ·33d. per unit. Any consumer requiring more than 20 kw. may be required to enter into a contract for seven years, but no portion of such electrical energy is to be used for lighting purposes. It is further provided in the Bill that the companies may supply railway, tramways, tramroads, canals, navigations, docks, or waterworks, situated partly within and partly without the area of supply, provided such supply shall only be used for the purpose of haulage or traction, or for lighting vehicles of bodies drawn by such haulage or traction. The only other important clause in the Bill relates to the certification of meters, and is for the purpose of removing an anomaly in the general form of provisional order which, as it reads, practically implies that a meter can only be certified *in situ* and not in an electrical inspector's laboratory, such as that of the City of London Electrical Inspector or the London County Council Electrical Inspector. The new clause puts it quite clearly that a meter will be regarded as certified if it is certified by an electrical inspector, and is fixed in a manner approved by the Board of Trade. Presumably, therefore, the practice will continue as at present, viz., that the Board of Trade approves a type of meter and the manner of fixing it, which is published as an official notice in the *London Gazette*, and at any meter certified by an electrical inspector and fixed in that manner will be regarded as a certified meter. The clause also specifies that a meter shall be certified to be a correct meter if it will register within the limits of error that are allowed by the Board of Trade for meters of the class to which the meter in question belongs.

MR. SEYMOUR BUSHE, K.C., who appeared for the promoters together with the Hon. Sidney Holland and Mr. Kennedy, said that a great deal of the purport and object of the Bill was covered by the principle of the decision given on the London Electric Supply Bill the previous day. The Bill enabled certain electric supply companies to link up with one another, and although in view of the previous proceedings it might seem a small matter, yet he could assure the Committee that the promotors attached much importance to it, and felt that it would be a valuable instrument, in their opinion, for the purpose of discharging their duty to the public. All the areas of the companies mentioned were within the districts of one or other of two local authorities—namely, Kensington and Westminster; the Westminster and St. James's Companies were wholly within Westminster; the Notting Hill Company's area was partly in the borough of Kensington, and partly in the City of Westminster, whilst the Kensington and Knightsbridge Company was wholly within Kensington. The principle embodied in the Bill had already been conceded by Parliament, in that the four companies had been permitted to form themselves in two groups of two each which were supplied respectively from generating stations outside the area of supply—namely, at Wood Lane and Marylebone respectively. He also wished to point out that the Board of Trade had for a considerable time been endeavouring to initiate legislation for the purpose of doing away with the restrictions as to association under which electric lighting companies now suffered, and what the Bill asked was to allow the companies named to form themselves into one group for this purpose.

The CHAIRMAN said that, as the schedule of the London Electric Supply Bill included the names of the companies promoting the present Bill, it seemed to him that they therefore got all they wanted in the other Bill.

Mr. BUSHE said that the names of his companies were included in the London Electric Supply Bill against their wish, but they were not promoters of that Bill, and would have no voice in any decision as to whether it will be proceeded with. The promoters of that Bill had on one occasion stated that the Joint Committee formed an important portion of their scheme, and as powers to create a Joint Committee had been struck out of it, it was not inconceivable that the Bill would be dropped. Therefore, the fate of his companies depended upon the action of the other promoters, and placed them in a position which they did not desire. If both Bills were passed, it would not prevent all the companies combining together later on; indeed, it was highly probable that all the companies might come together, but that depended on many things.

Mr. J. H. HORDERN (Manager of the Westminster Electric Supply Corporation) was called in support of the Bill, and Mr. Freeman, K.C., for the London County Council, cross-examined to the effect that the Bill only gave all that was given in the London Electric Supply Bill.

Mr. HORDERN agreed that this might be so, but pointed out that his shareholders had not sanctioned the promotion of that Bill, and, therefore, they had no voice in the policy of it. It was conceivable that the other companies would strike the names of the present promoters out of that Bill, and, further, they did not wish to be involved in the fate of the other Bill, whatever that might be.

Mr. FREEMAN, addressing the Committee on behalf of the London County Council, urged that it was entirely contrary to Parliamentary precedence to pass two Bills giving identically the same powers, although he had no objection to the Bill on its merits.

After deliberation the Chairman announced that the Committee were of opinion that the Bill might proceed on the understanding that the clauses in it must be identical with the clauses of the London Electric Supply Bill when these came to be considered.

The Committee sat during the week to consider clauses of this Bill, together with the London and District Electric Power ("Parshall-Hammond") Bill and the London Electric Supply ("Eight-Company") Bill.

Tramway Authorities and Mutual Insurance.—A conference of municipal and other tramway authorities was held in London on Friday last, says the *Yorkshire Post*, to consider proposals put forward by the Corporation of Halifax for establishing a mutual scheme of insurance against "third party" risks. The matter was fully discussed, and a committee was appointed to formulate a scheme, which will be submitted to the authorities represented at the next meeting. The committee was constituted as follows:—Councillors C. F. Spencer and D. Hanson, Halifax Corporation; Mr. Geo. Troudman, Birkenhead Corporation; the Hon. Arthur Stanley, Lancashire United Tramways; Councillor C. E. Perry, Exeter Corporation; Mr. E. Hatton, Newcastle Corporation; Alderman Winter, Rotherham Corporation; Mr. F. Schofield, Leyton Urban District Council; Mr. H. E. Blain, West Ham; Mr. Robert Hilton, Swindon Corporation; Mr. Cecil Barber, Bournemouth Corporation; and Alderman Lindsey, Salford Corporation. Mr. H. Ashling, Deputy Town Clerk of Halifax, was appointed secretary to the conference.

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A NEW AUTOMATIC TRANSFORMER SWITCH

AN automatic switch for use in connection with small house transformers for metal filament lamps was described on page 789 of our issue of May 21st, 1908. Mr. W. J. Davy, the inventor of the particular switch there described, has given further attention to the matter, and has developed an automatic switch which is extremely simple in its operation, and which is particularly adapted for use with an auto-transformer. The operation of the switch can be best understood by referring to Fig. 1, which gives a diagram of the connections employed. In this diagram, *A* is the low-pressure section of the auto-transformer, which transforms down from the mains pressure of 250 volts to the lighting pressure of 25 volts; *S* is the single-pole switch which connects the transformer to the mains; and *C* and *D* are magnetising coils wound in opposite directions on the core of an electro-magnet which, when magnetised, closes the switch *S*. Under ordinary conditions the switch *S* is open, as shown, and no current flows in any of the circuits. If, however, one of the lamps (*L*) is switched on, a small current flows through the coil *C*, the lamp, and the high-pressure portion (*B*) of the auto-transformer. This current, though not sufficient to cause the filament of the lamp to become incandescent, is sufficient to magnetise the electro-magnet mentioned above. The switch *S* is therefore closed, the transformer connected to the mains, and the lamp lit. Immediately the transformer is connected, a larger current flows through the magnetising coil *C*, and as the load increased, the iron loss and the inductive drop due to this electro-magnet would increase to a serious extent, were it not for the neutralising action of the coil *D*, which, as stated before, is wound on the core in an opposite sense. The coil *D* only partly neutralises the effect of coil *C*, and consequently coil *C* will always have a slight magnetising effect on the core of the electromagnet, and the switch *S* will remain closed so long as lamps are switched on at *L*. When the last lamp is switched off, the switch *S* is opened, as the magnetising action of the no-load current of the transformer, flowing through the coil *D*, is not strong enough to keep the switch closed. Thus directly the last lamp is switched off the transformer is switched off the mains, and no-load losses, during the periods when the lamps are not in use, do not occur. Another source of continual loss under ordinary conditions is the shunt current of the meter. In Fig. 1, *E* represents the series coil, and *F* the shunt coil of the meter, and the latter is connected so that when the main switch *S* is opened, the meter shunt circuit is broken, and thus no continual loss occurs. The use of such a switch will save, therefore, not only the transformer no-load losses, but the meter shunt losses during periods of inactivity as well.

The construction of the combined transformer and switch is illustrated in Figs. 2, 3, and 4. In Figs. 2 and 3, *H* is the core

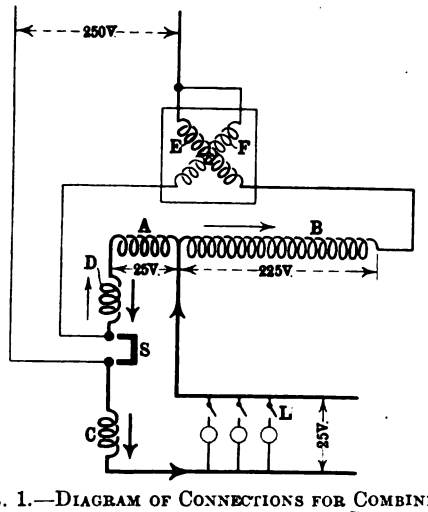

FIG. 1.—DIAGRAM OF CONNECTIONS FOR COMBINED AUTO-TRANSFORMER AND AUTOMATIC SWITCH.

of the auto-transformer, and *G* is the winding. The armature *D*, attached to the lever *B*, is shown drawn down into the gap of the electro-magnet *A*. The two magnetising coils are shown diagrammatically at *L* and *K* in Fig. 3. The lever *B* is pivoted at *C*, and supports at one end the weight *W*, and at the other end the connecting link *E*, which, with the two mercury cups (*F*), forms the main switch.

A small movement of the armature *D* gives a large movement of the switch link *E*. The weight *W* must be so adjusted that when one lamp is switched on, the pull on the armature *D* is sufficient to draw it down, and thus close the mercury switch. The shape of the armature and gap of the electromagnet can be seen in Fig. 4. Although this combined transformer and switch is not yet on the market, two or three are already installed, and are proving very satisfactory. The transformer can be installed in a consumer's house without any alteration whatever to the wiring, and the same candle-power lamps as

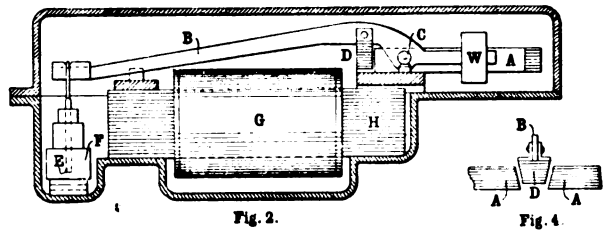

FIG. 2. FIG. 4.

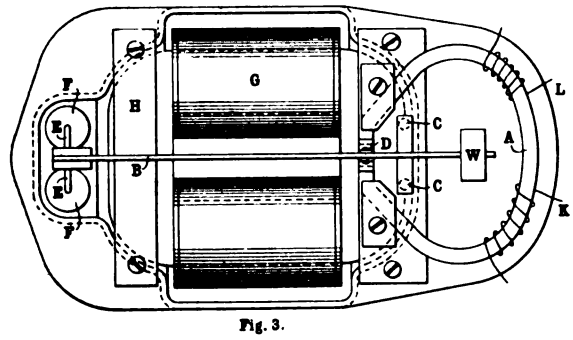

FIG. 3.

ELEVATION AND PLAN OF COMBINED TRANSFORMER AND AUTOMATIC SWITCH.

hitherto employed may be used. Thus the 10 and 16 c.p. carbon filament lamps usually employed in private houses may be replaced by 25-volt metal filament lamps of the same candle-power; whereas with high pressures, the metal filament lamps would have to be 32 to 50-c.p. lamps. The filaments of the low pressure lamps are also much stronger than the high pressure metal filaments, and the low-pressure lamps may consequently be burnt safely at any angle.

Franco-British Exhibition.—A slight inaccuracy which appeared in our description of the stand of the Société Gramme in the French section of the Machinery Hall at the Franco-British Exhibition has been pointed out to us by Messrs. T. L. Scott & Co., Ltd., who are the London agents for this firm. The exhibit which we specially mentioned of a complete generating set, comprising gas suction plant, engine, and dynamo, is not an exhibit of the Société Gramme, but is shown by E. Bardot, of Paris. The set in the exhibition is specially constructed for running on wood charcoal.

Auto-mixte Railway Cars for the L.B. & S.C.R.—Two petrol-electric railway cars are under construction for the London, Brighton, and South Coast Railway, embodying what is known as the Auto-mixte, or Pieper system of control, in which an ordinary petrol engine is coupled to a shunt-wound machine, which can act either as a generator or a motor, according to circumstances, as it is also connected through a clutch and suitable reduction gear to the rear wheels. When the car is at rest, or when the full power of the engine is not needed for propulsion, the dynamo is employed to charge a battery, but when extra torque is required for starting or hill-climbing, the battery drives the dynamo as a motor to assist the engine. According to the *Railway Times*, the trial motor-cars which will shortly be running on the Brighton railway are being fitted with petrol engines of 120 h.p. capacity by the Daimler Co. The dynamo-electric machine is rated at 50 h.p. as a motor. There are 48 accumulator cells. The cells are arranged in four sets, twelve cells per set. There are four stops on the controller: (1) Four sets of cells in parallel across the armature, and four field coils in parallel; (2) the cells are arranged in two sets, two in series, the two sets in parallel; the field coils being arranged in the same way; (3) the sets are arranged in series with a rheostat in series with the armature, the field coils being now in series across all the cells in series; (4) the cells in full series across the armature, the field coils also in full series. By this means a very large starting torque is obtained—the current taken from the cells when the car is fully loaded being about 1,000 amperes on the first stop, and about 600 amperes on the second. A high acceleration will thus be obtained.

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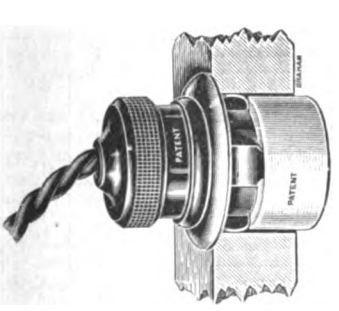
CENSUS OF PRODUCTION ACT, 1906

ACCORDING to this Act, a census of production in the United Kingdom is to be taken this year, and subsequently at intervals to be determined by the Board of Trade. The taking of the census is in the hands of the Board of Trade, which is to issue a report on the matter. Forms are being sent out to manufacturers, mine-owners, builders, and other engineering concerns, and these are to be filled in and returned to the Board of Trade, Census of Production Office, at 68 Victoria Street, S.W. We have received a copy of the form which is being sent out to manufacturers and others in the electrical engineering trades. This form has been prepared after consultation with the Cable Makers' Association, and with important firms representing the different branches of the electrical industry. All information given in fulfilment of the obligations imposed by the "Census of Production Act" will be treated as strictly confidential. The main object of the Act is to ascertain the total production of the United Kingdom, and the information supplied will, therefore, be used solely in the compilation of general statistical results, and no particulars with respect to any individual establishment or firm will be in any way disclosed. Any person improperly disclosing such information or publishing information so disclosed is liable to imprisonment for two years, with or without hard labour, or to a fine. The form is divided into two parts, (*a*) compulsory information, and (*b*) voluntary information. The first part contains the following questions: (1) nature of trade or business, (2) year of return, (3) output in year of return. The output stated in answer to question (3) should be the total value of the goods made in the year of return, irrespective of whether part of these remain in stock, or whether all are sold. Factored goods, which are simply re-sold without any further work being done on them, are not to be included as output, but goods made from assembled parts are to be returned at their value as finished products. The goods manufactured must be put under one or more of the headings provided in the schedule, and figures for "Contract Work in the United Kingdom," "Repairs and Maintenance Work for Customers," and "Constructional and Repair Work on own Buildings and Plant," must also be included. The object of question (4) is to determine the net value of the production in the United Kingdom in the year of return. For this purpose, the estimated aggregate cost of purchased materials and stores used in the year of return must be given. The estimated amount payable to other firms for work given out to them must be given in answer to question (5), in order to prevent duplication in the case of work given out to other firms. The number of persons employed on four defined days is the subject of question (6). These are divided into two classes under the headings of wage-earners and salaried persons. The number of calendar days on which the establishment was open for production in the year of return, and the average percentage of wage-earners at work on Sundays are required in answer to question (7). The last question in the compulsory part relates to the capacity of steam, gas, or other power plant in the works, and in the case of an electric power supply from without, the amount of electricity supplied in the year of return must be stated. In the second part of the form, the following questions are put under the heading of voluntary information: (1) The estimated value of the selling output in the year 1906. (2) quantity of copper used in the year of return in the manufacture of cables, and (3) the fuel consumed in the year of return.

A NEW TYPE OF WALL CONNECTION

IN a description of the electrical installation at the new Public Offices at Whitehall, given on page 917 of our issue of June 18th, mention was made of a new type of wall-plug socket which is not screwed on to a wood block sunk in the

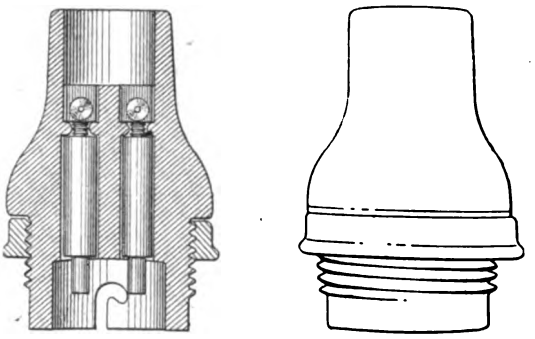


"CLINCHER" WALL SOCKET AND PLUG.

wall, but which is either sprung into a brass ring attached to a block or is simply sprung into a hole bored in the skirting board. We have since received some further particulars of this type of wall connection from the makers, Messrs. A. P. Lundberg & Sons, of 477 Liverpool Road, Islington. The fitting in question is known as the "Clincher" connection (Patent No. 11,430 of 1906), and is made in two sizes: the "Dot," or 2·5 amp. size, and the "Universal," or 5 amp. size. The former is illustrated in the figure, which shows the socket sprung into a hole bored into a wooden floor or skirting board. In order to keep the diameter down, the usual type of porcelain centre has been retained. The use of fixing screws is obviated, and a very neat appearance is produced. This fitting is intended for use in floors, skirting boards, furniture, panelling, desks, &c., and lends itself well to any special finishing when it is required to match existing fittings. The polished brass ring is provided with four spring arms formed out of the same piece of metal, as the figure shows. A hole is bored in the skirting board just large enough to take the porcelain centre, and after wiring up, all that is necessary to fix the socket is to force it into position, when the spring arms grip it securely.

A NEW PORCELAIN LAMPHOLDER

THE accompanying illustration represents a new form of lampholder which is being introduced, under the Knowles patents, by Messrs. L. E. Wilson & Co., of Manchester, which is specially suitable for use in the presence of acid fumes, and



KNOWLES' PATENT PORCELAIN LAMP-HOLDER.

it is incorrodible, being constructed entirely of a single piece of porcelain without any joint through which fumes or vapours could gain access to the interior of the holder. The plungers, with their containing tubes, are cut out of solid brass rod, accurately turned and bored, and are tapped to receive the adaptors or sweating terminals to which the conducting wires are soldered. The sweating terminals consist of square-headed brass screws having taper necks. The screwed portions are one-eighth inch in diameter, and are pointed at the ends. The heads of the screws are bored out to receive the conducting wires which are soldered in. Small countersunk holes are drilled in the sides of the square heads to facilitate the soldering. The sealing chamber at the upper end of the holder is filled with compound which effectually protects the terminals from moisture or chemical action. After the lamp is inserted, the joint round the neck may be made good by a lapping of asbestos yarn held in place by prepared tape.

It will readily be seen that the construction gives excellent insulation, not only between the plungers, but also at the lamp opening, as the usual brass tube is entirely superseded by porcelain. The usual bayonet slots are done away with, and grooves are moulded in the thickness of the porcelain to receive the pins of the lamp socket, thus hermetically sealing the usual openings by which fumes would otherwise penetrate to the interior of the holder. The plungers, which are of substantial construction, are renewable, and may be exchanged in a few seconds without disturbing the sweating terminals by merely unscrewing them with a forked screwdriver, and screwing new ones in their places.

Fire at the Savoy Theatre.—According to the *Times*, a slight fire broke out at the Savoy Theatre shortly before midnight on Saturday last. The outbreak, which occurred in the electrician's room, was detected by the fireman attached to the theatre, and in a short time the fire was put out. The switch-gear in the electrician's room was practically destroyed, and the room itself was seriously damaged. No other part of the building was affected, however, and the working of the theatre will not be interfered with in any way.

X-ray Dermatitis.—Mr. Hall Edwards, of Birmingham, who was recently granted a Civil List pension of £120 per annum in recognition of his services in the development of medical radiography, has been obliged to undergo a further operation. The operation, which was performed on Sunday last, involved the removal of the fingers of the right hand. The left arm was amputated below the elbow in February last. Mr. Hall Edwards has for some time been engaged on a work on Dermatitis, which is now nearly complete.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1906	1907	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	7%	10¼—11	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10⅝	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10⅝	−⅛
Do. 4½% Debenture, Red.	Stock	4½	4½%	100—103 xd	−2
Bromley (Kent) E.L.& Power Co., Ltd.	5	5⅛	5⅛%	4⅛—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co., Ltd.	5	10	10%	7—8	+⅜
Do. 7% Cum. Pref.	5	7	7%	6¾—7¾	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	5%	3¾—4¼	+⅛
Do. 4½% Cum. Pref.	5	4½	2½%	4¼—4⅝	
Do. 4% Deb. Red	Stock	4	4%	95—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3¾—4¼ xd	−⅛
Chelsea Electric Supply Co., Ltd.	5	4½	4½%	3—3½	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	−2
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125 xd	−2
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103 xd	−2
City of Durham E. P. Dis. Co.	5	4	2%	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ltd.	10	5	5%	7⅜—8¼	+⅛
Do. 6% Cum. Pref.	10	6	6%	10⅜—10⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108 xd	−2
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	98—101	
Edmunson's Electricity Corp., Ltd.	5	4	1/6*	⅛—⅜	
Do. 6% Cum. Pref.	5	3½	—	¾—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	63—73	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4⅜—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	+1
Hove Electric Lighting Co., Ltd.	5	9	8½%	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	10%	8—9	+1
Do. 4% Deb. Red	Stock	4	4%	96—99	
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	4	2½%	⅞—1⅜	
Do. 6% Pref.	5	6	6%	4⅜—4⅞	+⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	8—92	
Metropolitan Elec. Supply Co., Ltd.	5	6	6½%	5⅛—5	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅝—4⅞ xd	−⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109 xd	−2
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89 xd	−1
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	96—99	
Newcastle & Dist. E. L. Co., £9 paid	10	5	4%	7⅞—8¼	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97 xd	−2
Newcastle-upon-Tyne Elec. Supply.	5	8	8%	5⅜—6	
Do. £2 Pm.	5	8	8%	5⅜—6	
Do. 5% Pref. (fully paid)	5	5	5%	5¼—5½	
Do. 10/- Pm.	5	5	5%	5⅛—5⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7½	7½	12—13 xd	+½
Oxford Electric Co., Ltd.	5	7	7%	5¾—6⅛	
Do. 4% Deb. Red.	Stock	4	4%	94—96	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	7⅛—8¼	
Do. 7% Non-Cum. Pref.	5	7	7%	6⅜—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½%	83—88 xd	−2
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	nil	—	⅛—¼	
Do. 4% Deb. Red	Stock	4	4%	70—74	
South London Elec. Sup. Corp. Ltd.	5	3	4%	2⅜—2⅞	+⅛
South Metropolitan E. L. & P. Co.	1	2½	1/-	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5%	1—2	
Do. 5% Cum. Pref.	5	5	5%	1⅞—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	87—91	
Westminster Elec. Sup. Corp., Ltd.	5	12	10%	7⅜—8⅜	+⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5¼ xd	−⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	90—92	
Central London	Stock	4	3%	75—78	+1
Do. 4% Preferred	Stock	4	4%	91—92	
Do. Deferred	Stock	4	2%	56—59	
Do. 4% Debentures	Stock	4	4%	103—105	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	82—85	
City and South London Cons.	Stock	2⅝	4⅛%	39—41	
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	5%	114—116	
Do. 5% Perp. Pref. 1896	Stock	5	5%	112—115	
Do. 5% Perp. Pref. 1901	Stock	5	5%	110—113	
Great Northern & City Pref. "A"	10	4	11½%	3—1¼	
Gt. Northern, Piccadilly & Brompton	10	4	4%	6—6½	
Do. 4% Perp. Deb.	Stock	4	4%	87—91 xd	−2
Mersey Cons.	Stock	nil	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	nil	—	3—6	
Metropolitan Cons.	Stock	1	1%	39—40	−1½
Do. 3½% Preference	Stock	3½	3½%	86—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	75—78	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	nil	—	12—13	−1
Do. 6% Perp. Deb.	Stock	6	6%	117—122 xd	−3
Do. 4% Deb.	Stock	4	4%	71—76 xd	−2
Do. Perp. Extension Pref. (5%)	Stock	nil	—	23—28	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3	3½%	44—48	
Underground Elec. Railways Co. of London 5% Profit Sig. Sec. Notes	Various	5	5%	39—43	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104 xd	−2
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	5	1/-	⅛—¼	
Do. 5% Cum. Pref.	1	5	5%	⅝—⅞ xd	
Do. 4½% Deb. Red.	Stock	4½	4½%	85—91	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91—94 xd	−2
British Electric Traction Co., Ltd.	10	—	—	1⅜—1⅝	
Do. 6% Cum. Pref.	10	6	6%*	4¼—4¼ xd	−⅛
Do. 5% Perp. Deb.	Stock	5	5%	94—97	
Do. 4½% 2nd Deb.	Stock	4½	4½%	75—77	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4⅜	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1906	1907	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	6%*	12½—13¼	
Do. 6% Pref.	10	6	6%	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	93—96	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	1¼	—	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61 xd	−2
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	88—91 xd	−3
London Street Tramways Co.	4	4/9	4/6	⅛—⅛	
London United Trs., Ld., Cm. Pf.	10	5	5%	7—8 xd	−¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	79—84 xd	−2
Metropolitan Elec. Trams, Ltd., Def.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	1¼—1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96 xd	−2
National Elec. Construction Co. Ltd.	1	10	2/-	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	nil	—	¼—¾	
North Metropolitan Trams Co.	£4 10s.	1/-	1/-*	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	4%	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅛—⅜	
Do. 4½% Deb. Red	Stock	4½	4½%*	93—96	
Provincial Tramways Co. Ltd.	10	3½	4%	4⅝—5⅛ xd	−⅛
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼ xd	−¼
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	—	6%	¾—1	
Do. 4% Deb. Red.	Stock	—	4%	75—79 xd	−2
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	76—81	
Yorkshire (West Riding) Elec. Trams	5	nil	—	⅛—1⅜	
Do. 6% Cum. Pref.	5	nil	—	3⅛—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85 xd	−2
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3⅝	15/-*	59—62	
Do. 6% Pref. Crd.	Stock	6	30/-*	103½—104½	−½
Do. Def. Ord.	Stock	1¾	1%	16—16½	−½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	83—86 xd	−1
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4/-*	13⅜—14⅝	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100½—102½	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	101—103	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	7/6	12⅜—13½	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100½—102½	
Eastern Telegraph Co.	Stock	5⅜	7%	133—136	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	100⅜—102½	
G. N. Tel. Co. (Copenhagen)	10	20	20%	27½—29½	−½
Indo-European Telegraph Co. Ltd.	25	13	65/-	54—57	
Marconi Wireless Telegraph Co. Ltd.	1	nil	—	⅞—1	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	5½	6%	114—115	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—12½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—12½	
Do. 5% 3rd Pref.	5	5	5%	5¼—5⅝	
Do. 3½% Deb. Red	Stock	3½	3½%	98—100 xd	−1½
Do. 4% Deb. Red.	Stock	4	4%	100—102½ xd	−2
Western Telegraph Co., Ltd.	10	7	7%	13⅜—13¾ xd	
Do. 4% Deb.	Stock	4	4%	99½—101½ xd	−2
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	nil	—	⅜—⅝	
Do. 6% Cum. Pref.	1	6	6%	⅛—⅜	−1/16
Babcock & Wilcox, Ord.	1	20	1/7½*	3⅛—3⅜	
Do. 6% Pref.	1	6	7½d	1⅛—1⅜	
British Insulated & Helsby Cables, Ld.	5	10	10% & bonus	5⅜—6¼	
Do. 6% Cum. Pref.	5	6	6%	5⅜—6¼	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	100—103 xd	−2
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	—	4½%	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	nil	—	⅞—1⅛	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48 xd	−2
Brush Electrical Engineering Co.	2	nil	—	0—½	
Do. 6% Pref.	2	nil	—	⅜—⅞	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	53—58 xd	−2
Callender's Cable and Const. Co., Ld.	5	15	15/-	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜ xd	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—107 xd	−1
Consolidated Electrical Co., Ltd.	1	3	3½%	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅜—1⅝	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	92—95	
Dick, Kerr & Co., Ltd.	1	10	10%	1½—1⅝	
Do. 6% Cum. Pref.	1	6	6%	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	−2
Edison & Swan United "A," £3 paid	5	4½	2/6	½—¾	
Do. do. (fully paid)	5	4½	4/2	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	76—79 xd	−2
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	½—¾	
Do. 7% Cum. Pref.	2	7	—	1½—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	63—66	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7½—8 xd	−¼
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	87—90	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	15%	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	104—106	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	15	17½%	31—33	+½
Do. 4% Deb. Bds. Red	100	4	4%	102—104	
Willans & Robinson, Ord. Shres	1	nil	5%	¾—1⅛	
Do. 6% Cum. Pref.	5	nil	6%	3½—3⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4%	4%	70—74	

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BRITISH ELECTRIC TRACTION CO.'S MEETING

AT the annual meeting on Thursday, the report and accounts given in our last issue were adopted. Sir Charles Rivers Wilson, the chairman of the company, who presided, said that, in the directors' opinion, the fall in the market value of the company's shares and debentures during the year was much greater than the circumstances of the company called for, and an unwarranted impression seemed to prevail that the general position of the company was not satisfactory. The subscribed share and debenture capital of the company was £4,949,969, the amount due to creditors was only £12,570, and the debenture interest accrued was £46,623, so that, apart from the reserve for depreciation and the balance at net revenue account, the total on the debit side of the balance-sheet was £5,009,165. To meet this there were assets amounting to £5,658,653, and of this large amount the intangible items, like expenditure on Acts of Parliament and other rights and powers which might or might not be realised, and goodwill represented only £18,528, so that there was a surplus of assets of about £631,000, and the important question for the shareholders was whether the depreciation of the securities held by the company was greater or less than the surplus. The difficulties of making an accurate valuation of the numerous investments and undertakings controlled by the company were so great that the directors were unable to attempt it. There could, however, be no doubt that the estimated depreciation of the company's debentures and shares had been exaggerated. The net profit amounted to £203,194, and after deducting debenture interest and bringing forward the balance from last year, there remained £118,824. The directors had had a good deal of discussion as to how this balance should be applied, and had decided that £35,000 should be added to the general reserve, raising this to £602,420, that £35,000 should be carried forward, and £48,431 applied to the payment of a dividend on the preference shares equal to 3 per cent. for the year. They regretted the dividend was not larger, but the important thing was to reassure the shareholders that the directors were not paying dividends at the expense of the future stability of the company. They held a quarter of a million consols, £50,000 in cash, and close on £400,000 in debenture stocks of electrical companies, besides several millions of other securities. Very few companies in England could show an equally strong position.

The subsidiary undertakings were well established, and were not over-capitalised. In the course of a few remarks upon the legislative and municipal conditions of Great Britain in their relation to the electrical industry, Sir Charles Rivers Wilson stated that electrical enterprises in this country had been greatly influenced by political considerations. Electric traction was not generally adopted in this country for nearly ten years after electrical tramways had been demonstrated to be sound commercial undertakings in America and on the Continent, because it was impossible to embark capital under the terms of the original Tramways Act. The work of the British Electric Traction Co. had aroused the jealousy of local authorities, who were urged by an agitation in favour of municipal socialism to enter upon the business themselves, and where they could not do business themselves, they thwarted and harassed private enterprise. Parliament had yielded to the clamour in favour of municipal trading, and added to this was the constant demand by the public for increased facilities and reduced fares. Hence the difficulty of making profits. At the same time he emphasised the point that the company was in a position to undertake new business, and had ample resources for initiating new enterprises. Mr. H. O. Arnold-Forster, M.P., seconded the resolution for the adoption of the report and accounts. Sir Charles Rivers Wilson and Sir Charles Fremantle were re-elected directors.

The Electrical Standardising, Testing, and Training Institution.—An examination for a "Maxwell" entrance scholarship, value one hundred guineas, will be held at Faraday House on Wednesday, July 22nd, and the following day. Notice of intention to compete should reach Mr. H. Foulds, secretary, Faraday House, 62 Southampton Row, not later than July 12th. Further particulars may be obtained from Mr. Foulds on application.

Running Powers on Eccles Corporation Tramway Lines.—We learn from the *Manchester Guardian* that on Thursday last, in the Chancery Division of the High Court, Mr. Hughes, K.C., for the Eccles Corporation, moved for an injunction restraining the South Lancashire Tramways Company from running trams over lines belonging to the Corporation. Counsel said there was an arrangement between the Eccles Corporation and the Salford Corporation, under which the latter worked the tramway service in Eccles. The present dispute arose over a claim by the South Lancashire Tramways Company, under a licence from the Salford Corporation, to run their trams over a portion of the lines without the consent of the Eccles Corporation, whose case was that the Salford Corporation were not entitled to sublet the lines. Mr. Justice Eady said he did not see how he could determine the construction of the agreements on a motion and in the absence of the Salford Corporation, and he ordered that the motion should stand over until the trial of the action, but granted leave to appeal against that decision.

CATALOGUES AND PAMPHLETS RECEIVED

ACCUMULATORS.—A pamphlet from the Hart Accumulator Co., Ltd., of Stratford, London, gives particulars of batteries for use in house and other installations where 25-volt metal filament lamps are employed. The listed sizes of batteries, each consisting of 13 cells, range from 8 to 960 ampere-hour capacity on a 10-hour discharge rate.

ALUMINIUM.—We have received two pamphlets from the British Aluminium Company, Ltd., of 109 Queen Victoria Street, E.C. One of these contains a comparison between copper and aluminium for electrical conductors, and the other is a reprint of the articles on "Aluminium: Its Present and Future Uses," which appeared recently in the *Times*. A chapter in this booklet deals with aluminium as a substitute for copper for electrical purposes.

AUTO-TRANSFORMERS.—A pamphlet from the British Electric Transformer Co., of Hayes, Middlesex, gives particulars of two types of the Berry transformers for use with metal filament lamps. Each type can be obtained as a two-winding transformer, an auto-transformer, or as a balancing auto-transformer; the differences between the two types illustrated in the pamphlet being in the building up and arrangement of the core.

BOILER MOUNTINGS.—A very handsomely executed catalogue of various specialities in the way of boiler fittings has been issued by Messrs. James Baldwin & Co., of Keighley. Attention is particularly called to the "Betall" stop valve, with simply arranged renewable valve and seating, Baldwin patent combination safety valve of high steam and low water, a water hammer safety spring stop valve, and other boiler mountings.

ELECTRIC LIGHTING, HEATING, AND COOKING.—The new catalogue issued by Simplex Conduits, Ltd., covers a very large range of lighting, heating, and cooking appliances, including a number of novelties recently introduced, although the extent of the operations of the firm are, of course, considerably wider than can be comprised in a single list. Attention should be particularly called to the list of prices of V.I.R. wires and cables of qualities similar to "Association" and "Non-Association" classes of material, and a specially low-priced "Competition" quality to fill the demand for a cheap but really good cable. A large number of patterns of installation switches and other accessories, carbon and metal filament lamps are listed. A special feature of the catalogue is the section devoted to heating and cooking apparatus. This includes heaters of the radiation and convection types, and a very complete series of kettles, hot-water jugs, flat irons, and other domestic appliances. The fittings section is admirably printed, and contains many new artistic designs. The final pages deal with Simplex electric fans.

ELECTRICAL SUPPLIES.—We have received a collection of price sheets from the E.M.F. Manufacturing Co., dealing with arc-lamp carbons, a new type of automatic sign switch, lamp holders, and series adaptors, special reflectors for metal filament lamps, high and low voltage metal filament lamps, dry cells, fans, and small power motors.

IGNITION ACCESSORIES.—An illustrated price-sheet from H. Miller, Ltd., of Hazelnouch (France) deals with several patterns of pocket and other voltmeters for ignition batteries, and sparking plugs, with and without external spark-gaps.

MARYLEBONE ELECTRICITY SUPPLY.—An excellently printed souvenir of the St. Marylebone Electricity Supply Undertaking has been sent us. This contains a well-illustrated description of the generating station, mains, and sub-stations, and also some information relating to the recent development of the undertaking. The rates of supply, publicity, and canvassing work, and the administration are also dealt with. A series of attractive leaflets, dealing with metal filament lamps, electric heating, and cooking apparatus, flame arc lighting, electric power, and electric signs, have also been published by the Electricity Department of the Borough.

TELEGRAPH, TELEPHONE, AND TRANSMISSION LINE POLES.—We have received from Richard Wade, Sons & Co., Ltd., of Hull, a revised copy of their catalogue of wooden poles containing the results of tests on poles for all purposes. This has been considerably enlarged, and should be in the hands of all engineers interested in overhead construction. Excellent photographs of overhead work carried out for various companies are included, together with full particulars of the usual construction adopted. Messrs. Wade are sending this book free of charge to regular customers only, the price per copy to others being 10s. 6d.

The Electrical Contractors' Association (Incorporated).—At the annual meeting of this association, Mr. E. C. Wallis, of Leeds, was elected president for the ensuing year. The outgoing president is Mr. A. Rashleigh Phipps. During the past year nearly 100 new firms have applied for, and have been elected, to membership. New branches have been formed in Dundee, Aberdeen, Leicester, Birmingham, and Cheltenham. The financial position has been considerably improved, and the Law and Parliamentary Committee have been successful in getting clauses amended in several Corporation Bills. The Central Board will shortly consider the question of the registration and examination of workmen, and the formation of other branches of the association throughout the kingdom.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published June 25th, 1908

A full list of these was published in our last issue. The following are abstracts of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

10,072, **Series-parallel Control.** BRITISH THOMSON-HOUSTON Co. (*General Electric Co.*). A method of altering the connections of series-wound motors from series to parallel, without opening the motor-circuit, and without unbalancing the load on the two motors. The motors are provided with divided field windings as sometimes employed for securing an intermediate speed. The halves of each motor field winding are connected in parallel in the series connection. To change to parallel connection, each motor is shunted by a resistance; a half-field winding of each motor is then disconnected, and the series connection broken, leaving each motor connected in series with a resistance to the source of power. The disconnected half-fields are then placed as shunts across the resistances, which are afterwards cut out, leaving the two motors in parallel, and both half-fields of each motor in series with their respective motors. Five claims, twenty figures.

20,119, **Wireless Telegraph Transmitter.** G. MARCONI AND MARCONI'S WIRELESS TELEGRAPH Co. According to this invention, each of the plates of the condenser in the oscillating circuit is respectively connected to one of a pair of revolving discs of metal, situated at such a distance apart as not to allow a discharge to pass when the condenser is charged, and the gap between the discs is partially bridged at regular intervals by pieces of metal which may be pegs or projections attached to a third disc, which rotates between the two discs above mentioned. The two latter discs are rotated at a sufficient speed to prevent pitting or burning of their surfaces. The third disc is rotated at the speed necessary to obtain the desired frequency of discharge. The apparatus is capable of emitting oscillations in regular groups so as to produce a readily recognisable note in a telephonic receiver, which makes it easy to differentiate between signals emanating from the transmitting stations, and noises caused by atmospheric electrical disturbances. Four claims, one figure. (Sets have been installed at Clifden and Glace Bay Wireless Stations—see ELECTRICAL ENGINEERING, Vol. III., p. 430.)

24,753, **Connections for Aluminium Electrolytic Rectifier.** SIEMENS BROTHERS & Co. (*Siemens & Halske Aktien-gesellschaft.*). This invention consists in the use of two cells or two groups of cells connected oppositely to one another. One cell is connected in the main circuit, and the other is connected as a shunt across the load. The first cell permits currents in the positive direction to pass through it and the load; the second cell, being connected in the opposite way, does not let current pass through it, but is charged up, acting as a condenser, and discharges through the load during the negative half-wave period when there would be otherwise no current flowing through the load. One claim, one figure.

27,379, **Wireless Telephony.** AMALGAMATED RADIO-TELEGRAPH Co. (*G. Siebt*). To effect wireless telephony, changes in either the amplitude or the periodicity of the electrical oscillations, corresponding to the air vibrations generated by speaking, must be produced. For this purpose a microphone is inserted directly into the antenna or into a circuit coupled with the antenna. For the maximum effect, the damping action of the microphone resistance should be equal to the damping action of the other resistances in the antenna, *i.e.*, these resistances should be equal. If this is not the case, a capacity and an inductance in series should be placed in parallel with the microphone, when this has too low a resistance; or, if the microphone resistance is too high, a capacity or an inductance should be connected in parallel with it. Three claims.

1908 Patents

5,610, **Supports for Metal Filaments.** ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT. An improved anchor for keeping suspended-stirrup-form filaments in tension without interfering with the linear expansion or contraction of the filament. The anchor has a stationary and a movable member, the former being sealed into the glass pedestal or the bulb. The filament passes through the movable member, which is so hinged to the fixed member that linear but not lateral movement of the filament is possible. There is no spring; the weight of the movable part holds the filament straight, the weight being proportioned to the diameter of the filament. Two claims, five figures.

6,050, **Process for Hardening Tantalum.** SIEMENS & HALSKE AKTIEN-GESELLSCHAFT. As a hardening agent, partially oxidised tantalum can be used. This is first tested as to its hardening power by adding it in different proportions to pure soft tantalum, melting the mixture and then testing the hardness, capacity for being worked, brittleness and like properties of each sample. It is then easy to produce any desired degree of hardening by adding, before fusion, a certain amount of the hardening agent to the soft tantalum to be hardened. The proportion of oxygen in the hardening agent determines the degree of hardening, but there is no known process for determining the amount of oxygen in partially oxidised tantalum. One claim.

7,910, **Thermo-electric Pyrometers.** SIEMENS BROTHERS & Co. (*Siemens & Halske Aktien-gesellschaft*). When pyrometers are used continuously for measuring the temperature of a bath of molten metal or metal salt, the wires are apt to be quickly destroyed by vapour from the molten mass, owing to the permeability of the casing enclosing them. To avoid this, the wires, which are embedded in porcelain or corundum, are surrounded with a metal tube, and this tube is provided with an electrolytically deposited coating of nickel or other suitable metal. To protect this coating from the action of the molten metal, a further casing, preferably of iron, is provided. A renewable metal sleeve should be fixed to the casing at the part which extends through the surface of the bath. This resists the action of the slag for a long time, and can be renewed when destroyed. Two claims, one figure. (Further information relating to pyrometers will be found in ELECTRICAL ENGINEERING, Vol. III., p. 778.)

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Summaries of the more important of these patents will appear in our next issue.

1907 Patents

5,314, BLOXAM (*Soc. Generale per la Cianamide*). Manufacture of nitrogen compounds from carbides.
12,937, FELTEN & GUILLEAME LAHMEYERWERKE ACT.-GES. Compensated alternate current series motors.
13,129, GROB. Lighting and heating of vehicles.
13,147, BROCKIE. Enclosed arc lamps.
13,190, HARRISON & HIRST. Electrodes for arc lamps.
13,432, SCHATTNER. Fusible cut-outs.
13,712, PARSONS & LAW. Regulation of dynamos.
13,821, JENTZSCH. Coin-controlled telephones.
14,567, ECKSTEIN, HEAP & MELLIS. Switches.
15,366, AMBERTON & SCHATTNER. Electric regulators.
15,367, BRITISH THOMSON-HOUSTON Co. (*General Electric Co.*). Manufacture of metal filaments.
17,300, BUCKTON. Combined plug, socket, and switch.
18,044, FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. Single-phase shunt machines.
18,187, BAILEY. Means for signalling the approach of tramcars at cross roads.
18,936, LECOEUR. Manufacture of cellulose filaments.
20,824, IRWIN. Electric oscillographs.
26,084, MEYERLING. Continuous-current meter.
26,973, ANDERSON. Sparking plugs.
28,220, THOMAS. Starting means for vapour-electric devices.

1908 Patents

207, KUZEL. Process for the production of alloys.
325, SANDERS & GREENBERG. Induction coils.
4,286, TARDIEU. Suspension device for microphones.
4,433, SIEMENS-SCHUCKERT WERKE GES. Starting and working of three-phase motors from a single-phase supply.
4,692, SIEMENS-SCHUCKERT WERKE GES. Brush-holders.
4,831, LEVY. Automatic tramway and railway switches.
5,698, SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*). Electrical block apparatus for railways.
5,783, HOWELL. Incandescent electric lamps.
6,757, VON PINDTERSHOFEN. Electric cables.
7,125, Firm of ROBERT BOSCH. Shuttle armatures.
9,563, BLOXAM (*Siemens & Halske Akt.-Ges.*). Manufacture of glass.
9,977, ALLGEMEINE ELEKTRICITÄTS-GES. Electrical power transmission systems.

Complete Specifications open to Public Inspection before Acceptance.

1908 Patents

3,366, DE LA NEZIÈRE. Vulcanising apparatus.
4,461, MICHAUD & DELASSON. Manufacture of filaments.
11,064, TIMAR & VON DREGER. Starting switches.
11,524, SIEMENS & HALSKE AKT.-GES. Manufacture of metal filaments free from carbon.
11,603, SIEMENS & HALSKE AKT.-GES. Manufacture of tungsten filaments.
12,265, KOCH. Systems of signalling.

Expiring Patents

No patents of electrical interest expire during the current week.

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☞ An Index for Volume III. will be given away as a Supplement to the next issue of *Electrical Engineering.*

Binding Cases for Vol. III. may now be ordered, price 2s. each, post free 2s. 4d. Readers can have their volumes bound by their own bookseller; or they may send their numbers to us, carriage paid (with the reader's name and address), and a remittance of 4s. 6d. under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad.

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SUMMARY

"J. W. B." and "Chief Assistant" contribute letters on the desirability of having an Assistant Engineers' I.M.E.A. Convention, which was suggested in our Editorial Notes last week. (Pages 48 and 70.)

A company has been formed for supplying London with a service of electric taximeter cabs. The first 100 cabs will be housed at the garage of the Electromobile Co. This company is also supplying the first 100 cabs, and has entered into a contract with the new company for the running and general upkeep of the cabs. The electrical equipment of the cabs is the same as that in use on the well-known private cars of the Electromobile Co. (Page 49.)

The Convention of the Incorporated Municipal Electrical Association was resumed on Thursday at Nottingham. Mr. S. L. Pearce, City Electrical Engineer, was elected President for the coming year, and Manchester, of which city Mr. Pearce is the Electrical Engineer, was selected as the meeting place for the next Convention. Mr. W. W. Lackie (Glasgow) now becomes senior Vice-President in place of Mr. Pearce, and Mr. J. Christie (Brighton) was chosen as junior Vice-President. We publish a list of the other members of Council. The Council's report was next discussed, and considerable attention was devoted to the question of local authorities' liability under the Workmen's Compensation Act, and "third party" insurance. The refusal of the Local Government Board to sanction delegates' expenses being paid was criticised as usual, and there was also a debate, initiated by the Scotch members, on the action of a railway company in granting wayleaves to power companies. A resolution was passed instructing the Council of the Association to take action in this matter. On Thursday afternoon two Papers on questions of the design and operation of generating stations were read and discussed. Mr. H. Richardson, Chief Electrical Engineer, Dundee, referred to the new station he had recently designed (of which we publish drawings), and discussed various matters relating to the construction and working of generating stations. He favoured reinforced concrete piles for foundations, and steel skeleton buildings with either light brickwork filling, or corrugated iron walls and roofs, and he compared brick, concrete, and steel chimneys to the disadvantage of the last-named. The Paper also initiated a discussion upon the use of gas engines in electricity works, and Mr. S. L. Pearce's contribution to this showed that he had been considerably impressed with the possibility of employing gas engines in conjunction with steam turbines in the manner advocated by Mr. Leonard Andrews (who also spoke). Boiler house

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construction and practice came in for a share in the debate, and incidentally also it appeared that one of the Local Government Board inspectors had suggested that the galvanised iron end of an engine room should be paid for out of revenue. Mr. C. M. SHAW, Chief Electrical Engineer, Worcester, who read the second Paper, described how this undertaking had been reconstructed with a view to benefiting by the water power which had hitherto been something of a white elephant. On Friday the proceedings were opened with a Paper by Mr. A. M. TAYLOR (Assistant Electrical Engineer, Birmingham), suggesting the employment of accumulators on a far bolder scale than hitherto. He proposed, for instance, that a works with a maximum load of 10,000 kw. should only have a plant capacity of 6,000 kw. (including spares) in generators, and that the peak should be taken entirely by batteries. The author brought a formidable array of curves and tables to show that this policy would be economical, but his premises were attacked by the central station engineers who took part in the discussion. The last Paper was on the testing and standardising department of an electricity works, and was presented by Mr. H. A. RATCLIFF, who is in charge of this department at Manchester. The Paper covered the whole subject in considerable detail, and dealt with meter testing, photometry, mains testing, fault localisation, &c. It was followed by a short discussion. (Pages 50-68 and 81-85.)

LORD CROMER'S Committee has now concluded its inquiry into the London Electric Power Bills, and all three Bills have been reported to the House of Lords for third reading. Among the alterations in the clauses of the London and District Electric Power Bill is the reduction of the amount which a power user may use for lighting purposes, from 20 per cent. to 15 per cent., which the Committee desired in view of the arguments put before it that the introduction of metal filament lamps had an influence upon this question. The renewals fund is also to be made obligatory to the extent of half per cent. of the capital expenditure after the company has paid 5 per cent. dividend. Clauses have been inserted providing for the subscription of £600,000 capital within one year and a substantial commencement of the works within two years, whilst in deference to the wishes of the Coal Smoke Abatement Society, a very definite "nuisance" clause, mentioning specifically "reasonably preventable evolution of oxides of sulphur," has been put upon the company. (Page 69.)

SOME notes are given on new patterns of loud-speaking telephones and accessories. (Page 70.)

A SHORT article describes a form of totally enclosed motor with forced ventilation, which has been developed for use under special circumstances. (Page 70.)

REPORTS dealing with depreciation and obsolescence of the plant of the Coventry Corporation electricity undertaking have been issued by Mr. J. A. JECKELL (Manager and Engineer) and Mr. E. T. PEIRSON (Professional Auditor). (Page 71.)

A LARGE party was entertained at lunch on Tuesday in the buildings being erected for the Manchester Electrical Exhibition, when an opportunity was given of seeing the excellent progress that has been made. (Page 73.)

THE accounts of the Sheffield Corporation for the past year show a profit of £4,796 after providing for interest and sinking fund charges. In a report upon the financial and commercial position of the electrical undertaking, a special sub-committee states that over 50 per cent. of the price paid to the old company for the underaking is now unrepresented by tangible assets. Sir Alexander Kennedy has also reported in connection with the advisability of concentrating all generation at Neepsend.—The Worcester Corporation electricity accounts show that considerable economies have been effected by the reconstruction of the system. —The National Telephone Co. have given notice of a revision of rates in Swansea on the expiration of the present contracts.—A profit of £6,254 for the past year is shown in the accounts of the Burnley Electricity Department.—A deputation from Dundee has visited the Continent to inspect examples of the trackless trolley system. It is stated that they will urge its adoption on the outskirts of Dundee.—It is reported that Messrs. Beardmore are negotiating with a view to the establishment of electrical works in Johannesburg in competition with the Victoria Falls Power Co.— Legal proceedings will probably be taken by the Stepney Borough Council against the City of London Electric Lighting Co., in respect of the supply now given by the latter at the Tower of London.—The accounts of the St. Pancras Electricity Department for the past year show a profit of £9,454, after meeting working expenses, interest, and sinking fund charges. —An inquiry is taking place by the Board of Trade into an application by the Hove Corporation for a reduction of the prices now charged by the Hove Electric Lighting Co. The right of the Corporation to institute this inquiry was given under an agreement in 1892. (Pages 73 to 76.)

LARGE quantities of telephone material are required by the Australian Postmaster-General's Department. Mechanical stokers are required by the Croydon Corporation. The Kendal Corporation are applying to the Local Government Board for a loan of £10,000 for the construction of a new generating station. The Woolwich Borough Council has applied to the London County Council for a loan of £2,610 for electrical extensions. The London County Council require six electrically-propelled stores transporter vehicles. The Finance Committee of the London County Council recommend a loan being granted to the Poplar Borough Council for £22,180, in connection with the electricity undertaking. It is announced that large contracts in connection with the Moscow tramways have been awarded to Messrs. Dick, Kerr & Co., and the British Insulated & Helsby Cables, Ltd. The Hampstead Borough Council has decided to fix a Berry series gear in all their sub-stations, the experiments which have been carried out in one of the sub-stations having proved successful. For the information of wiring contractors we give particulars of a large number of buildings about to be erected in London and the provinces. (Pages 76 to 78.)

THE Metropolitan District Railway Bill, which provides for the issue of £750,000 prior lien debenture stock, has been passed by a Committee of the House of Commons. Another Committee of the House of Commons has passed the South Wales Electrical Power Distribution Company's Bill, under which the company's power stations have been transferred either to individual companies or to the local authorities. (Page 79.)

A MEETING of the holders of Underground Electric Railways Company of London unpaid coupons for interest in the profit sharing secured notes of the power-house debenture and power-house second debentures, has approved arrangements between the company and the Westminster Bank, Ltd., under the financial scheme recently published. The British Aluminium Co. invite subscriptions for £700,000 5 per cent. redeemable mortgage debenture stock, and the Electric Taxicab Co. is offering 300,000 ordinary £1 shares for the purpose of placing electric cabs in the streets of London. (Page 80.)

COL. H. A. YORKE'S report on the fatal accident last February between Tividale and Oldbury on the system of the Birmingham & Midland Tramways Co., attributes the occurrence to the breakage of a wheel when passing through the points. (Page 71.)

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A DESCRIPTION is given under "Electrochemistry and Electrometallurgy" of a large new tank house and copper furnaces, which the Karitan Copper Co. have recently added to their works. (Page 85.)

AMONG the Patent Specifications published by the Patent Office on Thursday last, is one by H. T. HARRISON and HUGO HIRST relating to slow burning electrodes for flame arc-lamps. The manufacture of tungsten filaments is the subject of a specification by the BRITISH THOMSON-HOUSTON CO., and the FELTEN & GUILLEAUME FAHMEYERWERKE AKT.-GES have one relating to variable speed single-phase commutator motors. A specification by J. T. IRWIN describes an oscillograph in which the movement of the mirror is controlled by the electrostatic attraction between metal diaphragms and fixed discs. A method of starting a mercury vapour lamp without tilting is described in a specification by P. H. THOMAS, and the SIEMENS-SCHUCKERT-WERKE have a patent referring to methods of starting and running three-phase motors off single-phase supply circuits. An application for amendment to a specification relating to telegraphic apparatus has been made by S. G. BROWN. (Page 86.)

THE technical discussions at the meeting of the Incorporated Municipal Electrical Association this year were, as usual, largely devoted to a comparison of opinions and experiences on points of detail which are all-important to the electrical engineer, and we have no doubt that our lengthy report of the Proceedings will, for this reason, be appreciated by all our readers, whether they be municipal electrical engineers or not. On matters of more general principle, the main subjects were the use of gas engines in electricity works and the application of accumulators for the purpose of taking the actual daily peak loads. On the gas engine question opinions are still divided; their champion, Mr. ANDREWS, has apparently made some converts so far as the gas engines themselves are concerned, but he was given a broad hint that he must turn his attention to the gas producer as well as to the engine itself. Mr. TAYLOR'S proposal to employ accumulators on a grandiose scale received little support, and we cannot but think that the battery makers themselves were rather shy of identifying themselves with his conclusions. It is fair to state, however, that subsequent conversation with their representatives after the meeting revealed the fact that they are quite prepared to give maintenance contracts on their usual terms for batteries which are to be discharged regularly at the one-hour rate, and that they would also guarantee good watt-hour efficiencies under these conditions. On the other hand, it must not be forgotten that even a momentary serious overload at the time of this maximum rate of discharge might go far to ruin the battery which is to be depended upon by Mr. Taylor to take the next day's peak load. It will require more than Mr. Taylor's painstaking deductions from diagrams and tables to convince the station engineer that his proposition is a sound one.

IN view of the large financial issues which have to be decided by Electricity Committees and their engineers, it is of interest that a question involving only the expenditure of a few pounds in each individual case should obtrude itself more or less prominently at every annual meeting of the Incorporated Municipal Electrical Association. We refer to the oft-repeated grievance that the delegates to the Convention sent by those Local Authorities whose accounts are subject to Local Government Board Audit, have to pay their own expenses. In the case of the Corporations which are happy in the possession of elective auditors, no question is asked apparently, and the expenses of the councillors and engineers who attend the Convention are paid out of the funds of the Department; but the Local Government Board is adamant. Although the expenses cannot be great in any case, it appears to be an absolute fact that the liability upon the individuals to pay them has actually acted as a serious deterrent to joining the Association. It was stated that some of the London Borough Councils had declined to join for this reason, and that some which had formerly belonged, had even withdrawn their membership on this account; no less than 64 municipal electricity committees are not represented on the Association, and it is suggested that in many cases this matter of expense is to be taken to explain their absence. So far as a means of remedying the evil is concerned, there appears no definite way out of the difficulty. If the annual subscription alone were the deterrent, the ingenious suggestion that there should be a subscription to the published "Proceedings," which should cover the subscription to the Association, could be adopted, but we presume that it is the actual travelling and out-of-pocket expenses of the delegates that are more thought of. An obvious remedy so far as the engineers are concerned, is to make it clear that they are expected to attend the meetings of the Association, and that their salary is computed on this basis, but this would be of little comfort to the unpaid councillor who desires to accompany the engineer. The same difficulty of expense is what stands in the way of the adoption of the proposal that there should be one or more assistant engineers' conventions during the year, and in this case the remedy we have just mentioned is quite applicable. The chief, who is as a rule responsible for fixing the salaries as well as choosing his assistants, should make it a condition that his assistants should join the Association, and that they should attend all its meetings, for which leave can be granted. The correspondents whose letters we publish this week are both Chief Assistants of electricity works of important towns, and their views should carry weight.

THE announcement is made in another column that a scheme is on foot for the placing on the London streets of a large number of electrically-driven "taxi-cabs." The past history of electric cabs in London has not been a bright one, and everybody will remember the dismal failure of an early attempt in this direction. Since then, however, there has been a good deal of experience with accumulator road traction. Its limitations, as well as its capabilities, are now well understood, and, we may say, by no one better than the company under whose technical management the vehicles are to be. The crux of the whole matter is, of course, the ability of the batteries to stand the heavy work demanded, without excessive cost of maintenance. The estimated expenses given in the prospectus of the new company that is being formed are based on systematic observations of work of a similar nature, and it is important to note that the vehicles will be under the charge of the same engineers. There is thus

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nothing experimental on the technical side of the venture, and considering that the advantages of the electric cab in respect of silence, freedom from smell, steadiness, &c., are just of the kind which appeal to the public, we see no reason why excellent results in the matter of receipts should not be obtained. Its capabilities for speed may not equal those of the petrol vehicle, but this may be a blessing in disguise, as not presenting the same temptation to reckless driving which is but too often succumbed to by the newly-fledged driver of the petrol taxicab.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, JULY 9TH.

Tramways and Light Railways Association.

11 a.m. First Day of Annual Congress. Meeting in the Congress Hall of the Franco-British Exhibition, when Sir Clifton Robinson (vice-president) will give a lecture on "The Tramways of the World," followed by a Paper on "Tramway Rail Joints," by Mr. A. H. Gibbings.

FRIDAY, JULY 10TH.

Tramways and Light Railways Association.

11 a.m. Second Day of Congress. Meeting in the Congress Hall of the Franco-British Exhibition, when Prof. C. A. Carus-Wilson will deliver a lecture on "Rail Corrugation."

7.30 p.m. Association Dinner at the Banqueting Hall of the Franco-British Exhibition.

SATURDAY, JULY 11TH.

Mining Exhibition.

Opening Ceremony at Olympia.

Accident at a Motor-car Works.—In the course of some experiments on electric accumulators, which are being carried out by Mr. A. P. Strohmenger, Analytical Chemist, at the premises of Messrs. Holmes & Co., Petrol and Electric Motor-car Builders, 37 and 38 Margaret Street, W., there was occasion to prepare a mixture of sulphuric and nitric acid. The fumes arising from the tank containing the mixture attracted the notice of a passer-by on Saturday last, and an alarm of fire was raised. The firemen, not knowing the nature of the contents of the tank, opened a tap and allowed the contents to flow out over the concrete floor towards a drain. This, of course, considerably increased the amount of fuming, and sixteen officers and men of the fire brigade staff were quite overcome. Eight members were seriously affected, and some had to be conveyed to hospitals.

Infringement of Electrical Patent.—On Tuesday, in the King's Bench Division of the High Court, Mr. Justice Channell had before him the case of Hills' Patents, Ltd., *v.* Dick, Kerr & Co., Ltd. The question had been raised as to whether or not Mr. H. F. Hills, one of the two plaintiffs in the action, should not be struck out, on the ground that the statement of claim which had been delivered disclosed no right of action by Mr. Hills. The defendants took out a summons to have Mr. Hills dismissed from the action. The summons came before Master Chitty, and he ordered that a question on a point of law be argued, and that order was confirmed by Mr. Justice Ridley. The action was brought to restrain the infringement of letters patent 28,932 of 1902, the patent being known as an improved safety apparatus for use in overhead electric tramways. Hills was the inventor of the patent, and had parted with his interest in it to a company, and the company had all the rights in respect to it. Hills assigned the patent to the company, and that assignment was subsequently registered. Although the assignment was not registered until after the date of infringement of the patent, it was submitted that Hills ought not to be a co-plaintiff. Mr. Justice Channell, in giving judgment, said that Mr. Hills ought either to be plaintiff alone, or joint plaintiff in respect to damages prior to the actual assignment. That being so, it was sufficient for disposing of the motion, which, he said, he must dismiss, the costs to be costs in the cause.

Wireless Apparatus on Channel Boats.—The Great Eastern Railway Co. have fitted the turbine steamer *Copenhagen* and the twin-screw steamer *Dresden*, with wireless telegraphy apparatus, enabling the public to send telegrams from on board these vessels. The other steamers on the Hook of Holland service are also being fitted with wireless apparatus.

CORRESPONDENCE

ASSISTANT ENGINEERS AND THE I.M.E.A.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Your suggestions for rendering this Association more useful to the assistants in municipal electricity works are of great interest.

The deputy engineers form a numerous body, and there is a growing tendency amongst committees to select managers from their ranks, which testifies to their ability and to the confidence reposed in them by their chiefs. The days of frequent change and rapid advancement have apparently passed, and the younger members of the profession can no longer rely upon confidence and close attention to advertisement columns to secure them rapid increases in salary and responsibility. Great widening of the business of electricity supply and close specialisation by designers and makers of electrical plant render it more and more necessary that the man who aspires to a general manager's position should supplement his theoretical knowledge and training in the works by wide experience of modern practice in building up and administering electric supply systems, and by continuous study of modern thought and methods in connection with the larger problems of municipal finance, cultivation of the demand for public supply, and the influence of purely commercial considerations upon engineering ideals.

It is obvious, therefore, that the Association could be of the greatest value to officials whose attention is practically confined to routine duties and the work of the purely technical societies. That it is undesirable for an assistant to be away from his works for any length of time in the absence of his chief is too obvious to need discussion or to constitute a grievance in the mind of any man who appreciates the importance of his position. But it should not be too difficult to arrange for a distinct convention or series of meetings at some time of the year other than the height of the business or holiday season. If such meetings were held in a large industrial district, more or less central geographically, it should be possible to secure a good attendance of assistants with a minimum of inconvenience to engineers and expense to those attending. The latter question must not be neglected, as the salaries paid are not always princely, and there would possibly be some difficulty in persuading an electric light committee to grant the necessary funds, unless some conspicuously ingenious member could make out a case for charging them to capital, "Staff betterment A/c" perhaps. A convention of several days' duration might have advantages over a number of separate meetings, inasmuch as travelling expenses would be reduced, local works and stations could be visited, and a certain amount of recreation, which could be worked in without detracting from the utility of the meetings, would help to act as an incentive to the more distant members. In short, the methods adopted with such success by the presidents and organisers of the regular annual conventions might be followed on a more or less modest scale according to the support received.

Some expression of opinion on the part of the Council concerning this subject would, in the writer's opinion, be of great interest, and possibly lead to further suggestions being made.

I am, Sir,

Yours faithfully,

July 7th, 1908. J. W. B.

[Another letter on this subject will be found on p. 70; the matter is also commented upon in our Editorial Notes.]

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ELECTRIC TAXIMETER CABS FOR LONDON

A COMPANY has been formed under the name of the Electric Taxicab Co., Ltd., to provide London with a service of four-seated electric taximeter-cabs, which, to use the words of the prospectus published on another page, will be particularly suitable for the conveyance of passengers with luggage to and from the London railway stations, as they will be provided with a luggage roof capable of carrying as much luggage as the ordinary four-wheeled cab. The cleanliness, silent running, and absence of smell and smoke render the electric cab "eminently desirable." The company has entered into a contract with the Electromobile Co. by which the latter company agrees to do the following: (1) To supply 100 electric cabs complete, except for batteries, tyres, and taximeters, at the price of £360 per cab, with the option to the company to require them to supply a further 400 cabs on the same terms; (2) to garage at their Mayfair garage the first 100 electric cabs owned by the company for a fixed term of three years for a sum at the rate of £60 per cab per annum; (3) to supply 150 suitable batteries for the running of these cabs at the price of £60 per battery; (4) to charge with electricity, and to renew and maintain all such batteries for a sum equal to threepence per mile run; and (5) to maintain the chassis and bodies of these cabs in a proper and serviceable state of repair for a sum at the rate of £45 per cab per annum.

The chassis of the car, which is illustrated below, will be substantially of the same type as those used by the Electromobile Co. for their private carriages, but will be especially

ELECTRIC TAXIMETER CAB.

built for the new company in accordance with the requirements of Scotland Yard. The motor is rated at 8 B.H.P. at 1,500 r.p.m. for continuous load, but can exert more than 100 per cent. overload for short periods. It is of the iron-clad type, bi-polar, and series-wound, having two separate commutators connected to separate armature windings. The motor drives through a double train of double helical gearing to the differential, and thence to the hubs of the rear wheels, by live shafts, which revolve in an external tubular axle. This axle is stationary except for the slight radial movement permitted by the suspension springs carrying the motor.

Further particulars of the motor, accumulators, and method of control employed by the Electromobile Co. were given in a description of an electric ambulance supplied by that company to the City Police, which appeared in ELECTRICAL ENGINEERING, Vol. I., p. 653; the equipment is practically the same.

The Electromobile Co. have at present over 200 cars in their garage at Hertford Street, Mayfair. During the next few months the larger number of the privately owned cars kept in the garage will not be required by their owners, and there will be ample space and facilities for dealing with the first hundred taximeter-cabs as arranged in the contract. Ten of the taximeter-cabs will be running almost immediately, and in the course of two or three months the cabs will be delivered at the rate of six per week until the first 100 are running. The Electromobile Co. have already purchased a large block of buildings adjacent to their garage, and building will shortly be commenced on this site. As soon as the accommodation is again insufficient, the taximeter-cab company will build a garage of their own. The garage in Hertford Street, which was described and illustrated in ELECTRICAL ENGINEERING, Vol. II., p. 793, covers over half an acre, and is built in three stories, of which the basement forms the motor-generator room, charging and battery rooms, and also the repairs department. The ground floor, at the entrance of which are the accumulator lifts and pits, is adapted for storage purposes, and the next floor will accommodate some 150 cars. Current for charging is taken at a particularly low rate from the Westminster Electric Supply Co. at 400 volts, and converted to 110 volts by the motor-generators. At least three different makes of accumulators are in use in the Electromobile Co.'s cars, and after the contract number of 150 batteries has been supplied to the new company, the latter is free to use any other make which may be more suitable.

The Electromobile Co. has had some five years' experience in the running and management of electric cars, and the total mileage of the cars owned by the company amounts to over 2,000,000. On the basis of this experience, the Managing Director of the Company, Mr. J. G. Chambers, has estimated the following probable earnings and expenses:—

The authorised tariff for a motor-cab, fitted with a taximeter, and licensed to carry four persons, is eightpence for the first mile, or for the first period of time not exceeding ten minutes. For each succeeding quarter of a mile or period of time not exceeding two and a half minutes, twopence.

Working upon this tariff the average gross earnings should not be less than two pounds per cab per day. Deducting seven shillings a day for the driver, there will remain an average gross profit per cab per day of £1 13s.

Expenses.

	Per day per cab. s. d.
1. Garage accommodation and operating costs	2 8
2. Maintenance and upkeep of the chassis and bodies, including lubricating oils and stores	2 8
3. Electricity and maintenance and replacement of the batteries	9 2
4. Tyres (supply and maintenance) ...	5 0
	19 6

These expenses are calculated on the basis of a cab-mileage estimated to be sufficient to earn the above sum of £2 a day. Thus:—

	£ s. d.
Gross profit per cab per day	1 13 0
Less expenses	0 19 6
Balance of profit per cab per day ...	£0 13 6

Considering now the total number of cabs running, we have the following:—

500 cabs at 13s. 6d. profit per cab per day (reckoning six days a week) = say ...		£105,630
Less annual charges:—		
Taximeters to be rented at £7 per annum per cab ...	£3,500	
Licenses: £2 15s. per annum per cab	1,375	
Insurance against fire, accidents, and third-party risks per annum	12,500	
Provision as reserve to replace the whole cost of the chassis and bodies in seven years (the batteries and tyres being maintained out of revenue) on the basis of the sum which would be required if invested at 3 per cent. per annum compound interest	23,490	
		40,865
Profit balance ...		£64,765

This balance of £64,765 will—after providing for administration expenses, directors' remuneration, and, if thought desirable, further reserves—be available for dividends on

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£300,000 share capital. The above figures are based upon a complete scheme of 500 cabs garaged and run by the company in and from its own garage, and the profits shown should be earned when all the cabs are so garaged and running. The delivery of 500 cabs, and the acquisition of a garage sufficient to accommodate so large a number, must of necessity take time, but the directors anticipate that the whole of the cabs ordered can be running on the streets within two years. The first 100 cabs should be running on the streets within eight months. As above stated, these first 100 cabs will, according to the contract entered upon with the Electromobile Co., be housed and maintained in working condition by that company. The payments provided by such contract, reduced to a basis of a daily charge per cab, will, in respect of each cab so garaged, increase the before-mentioned figure of daily cost per cab of 19s. 6d. to 22s. 0d. per day, and consequently reduce the before-mentioned figure of profit per cab per day from 13s. 6d. to 11s. 0d. This reduction in the profits in respect of the first 100 cabs will be more than compensated for by the avoidance of having to work in the early days of the company on the unremunerative lines of a large garage only partially filled, whilst the company will also be able, during this initial period, to obtain the fullest benefit of the technical experience of the Electromobile Co.'s staff in connection with the working of electric carriages. Although provision is made in the above estimate for the replacement of the whole of the cost of the chassis and bodies at the end of seven years, this must not be taken to indicate that the cabs will be worn out at the end of that term. Many of the private carriages of the Electromobile Co. have been in constant service for over five years, and it is stated that they show now scarcely any sign of depreciation, whilst the freedom from breakdown is almost complete.

In conclusion, we wish to express our thanks to the Electromobile Co. for much information with respect to the arrangements which have been made for the housing and upkeep of the new company's cabs.

THE THIRTEENTH CONVENTION OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION

ON the Incorporated Municipal Electrical Association resuming its proceedings at Nottingham on Thursday, after a day's relaxation in Dovedale during exceptionally fine weather, the first business was the holding of the Annual General Meeting for the election of the new President and Council, the choice of a place of meeting for next year, and the reception of the Council's Report. The remainder of the Convention was devoted to the discussion of technical Papers.

Thursday, July 2nd.

The Annual General Meeting was held in the morning at University College. The first business on the agenda was the election of officers and Council for 1908-9.

The ballot for the new Council resulted as follows:—

PRESIDENT:

*S. L. Pearce (Manchester).

VICE-PRESIDENTS:

W. W. Lackie (Glasgow), (*Senior*),
*J. Christie (Brighton), (*Junior*).

PAST PRESIDENTS:

J. E. Edgcome (Kingston-on-Thames), S. E. Fedden (Sheffield), H. Talbot (Nottingham).

HON. SOLICITOR:

Alderman G. Pearson (Bristol).

HON. TREASURER:

J. E. Edgcome (Kingston-on-Thames).

HON. SECRETARY:

H. Faraday Proctor (Bristol).

COUNCIL:

Alderman Bruce (Sunderland).
C. E. C. Shawfield (Wolverhampton).
Alderman J. P. Smith (Barrow-in-Furness).
G. Wilkinson (Harrogate).
T. P. Wilmshurst (Derby).
*Councillor Howarth (Manchester).
*Alderman West (Coventry).
*Alderman Wilkinson (Luton).
*Councillor Sinclair (Swansea).
*A. C. Cramb (Croydon).
*A. A. Day (Bolton).
*V. A. H. McCowen (Salford).
*H. Richardson (Dundee).
*F. M. Long (Norwich).

New members of Council and members filling a new office are denoted by an asterisk. Mr. J. K. Brydges (Eastbourne), Mr. A. A. Day (Bolton), Alderman Dowson (Doncaster), Mr. V. A. H. McCowen (Salford), Mr. H. Richardson (Dundee), Councillor Sinclair (Swansea), and Alderman Wilkinson (Luton) retired from the Council in the ordinary course, and additional members had to be elected in the place of Sir John Turney (Nottingham), who retired owing to pressure of other business, with one year still to serve, and Mr. J. Christie (Brighton), who was elected Junior Vice-President. It will be seen that Mr. Day, Mr. McCowen, Mr. Richardson, Councillor Sinclair, and Alderman Wilkinson were re-elected.

The place of meeting for the 1909 Convention was unanimously decided to be Manchester, and Councillor Howarth, Chairman of the Manchester Electricity Committee, said he had been authorised to give the Association an invitation to go there, and to promise them a hearty welcome.

Mr. Standen Leonard Pearce is the son of the late Rev. Standen Pearce, of Crewkerne, Somerset. He was born in 1872 and educated at Bishop's Stortford College and Finsbury Technical College. In 1888 he was apprenticed to Messrs. J. G. Statter & Co. and after two years with them, completed his time with Messrs. Thos. Richardson & Sons, of Hartlepool. After over four years with this firm, the latter part of which he spent in the drawing-office, Mr. Pearce entered the service of the

S. L. PEARCE, THE NEW PRESIDENT OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

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British India Steam Navigation Co., of London, and was for two years with them in charge of a "watch" on different vessels. From 1896 to 1899 Mr. Pearce was with the Metropolitan Electric Supply Co., and then joined the British Thomson-Houston Co. during the construction of the Central London Railway, afterwards acting for a short time as Superintendent Engineer at the Railway Co.'s power-house. In 1901 he was appointed Deputy Engineer to the Manchester Corporation Electricity Department, and in 1904, on the resignation of Mr. Metzger, he received the appointment of Engineer-in-Chief.

Mr. Pearce was Chairman of the Manchester Local Section of the Institution of Electrical Engineers in 1905-6, during which year he acted as Chairman of the Local Reception Committee in connection with the visit of the foreign kindred institutions. He was also a Member of Council of the Institution of Electrical Engineers in 1907-8. He has read the following Papers: "Polyphase Sub-Station Equipment and Working" (I.M.E.A., 1904), "Manchester Tramways Power Supply" (Inst. Electr. Engrs., 1905), "Steam Turbines" (Manchester Section Inst. Civil Engrs., 1907), and "Steam Turbine Engineering" (Manchester Association of Engineers, 1908).

Mr. Pearce, in addition to being the City Electrical Engineer at Manchester, is also responsible for carrying out the extensions there. A 6,000-kw. turbo-alternator put down to his specification and under his supervision was recently started, and another of similar size is in hand, in addition to extensions of the boiler plant, and new arrangements for the water supply. Mr. Pearce has identified himself with the work of promoting and organising the electrical exhibition to be held in Manchester in October, and is taking an active part in the preparations.

ANNUAL REPORT.

The annual report of the Council for the year ended June 30th, 1908, which is abstracted below, was taken as read:

The membership of the Association now stands at 385, made up as follows:

Committees (Members)	... 165
Chief Electrical Engineers (Members)	... 168
Honorary Members	... 2
Chief Assistants (Associate Members)	... 10
Assistants (Associates)	... 40
	385

After allowing for resignations, removals, and lapses due to members leaving municipal employ, there is a decrease of seven on last year's total, principally in the class of Associates. During the last two months 13 municipalities and 11 engineers have joined the Association.

Council meetings have been held in London, Nottingham, and Wolverhampton. There have also been a number of meetings of Standing and Special Committees and Sub-Committees.

ACCOUNTS OF LOCAL AUTHORITIES.

A Sub-Committee of your Council is co-operating with the Municipal Tramways Associations in considering the report of the Departmental Committee appointed to inquire into the accounts of local authorities.

LOCAL AUTHORITIES LIABILITY UNDER THE EMPLOYERS' LIABILITY ACT, &C.

The attention of your Council has been drawn to the liability of a local authority in connection with damages to persons or property occurring in connection with works carried out for the local authority by contractors. This liability divides this up into two sections—first, the liability caused by an accident to the contractor's workmen under the Employers' Liability Act, and secondly, the third-party risks, *i.e.*, accidents or damages caused to persons or property not under the control of the contractor. Several Corporations have been communicated with to ascertain the clauses in use in contracts for safeguarding the Corporations in question against such liability. Whilst it appears to be the invariable practice to insert a clause in contracts making the contractor responsible for all accidents and damages, it appears to be almost exceptional that the precaution is taken of requiring the contractor to take out an insurance policy under the Workmen's Compensation Act, in the name of the Corporation, or, in the event of such already existing, of adding an endorsement to such policy showing that the insurance company relieves the Corporation from all liability in connection with the works. This appears to be necessary owing to the fact that a person sustaining an injury will often prefer taking action against a Corporation rather than against his employer, very probably on account of the general impression that it is more easy to get judgment against a Corporation than any other body or person, in the case of accidents or damages. Such a course seems to protect a Corporation as far as is possible, regarding the first-named difficulty, but it is understood that insurance companies generally will not accept third-party risks, enabling Corporations to be insured against liability for accidents to third parties, and this matter has yet to be looked into more fully. Your Council will welcome any suggestions with a view to overcoming this difficulty.

SUPPLY OF ELECTRICITY BILL.

Early in the session your Council circularised the members asking them to use their utmost endeavours to get the Bill passed into law, and in February last the matter was discussed at a special general meeting of the Association held in London. A full report of this meeting was afterwards circulated to the members, and will be embodied in the proceedings. The Board of Trade have been approached again, relative to this matter, and whilst they regret that they consider the present time to be unsuitable for making an effort to get the Bill passed, they state that they will put it forward at the first opportune moment. The Board of Trade have been asked, and have promised to consider the introduction of clauses, to enable Corporations to supply fittings, &c., on hire.

TRAVELLING STUDENTSHIP.

Mr. R. McCourt (Associate), Mains Superintendent, Harrogate, has submitted his report of his tour of inspection of various electricity works in London and the provinces, and the same has been approved by your Council, and will be published in the proceedings. It is hoped that it may be the means of stimulating others to compete, as the result has shown that the scheme is of the greatest practical benefit to the holder of the scholarship. Your Council regret to report that there have been no entries for the scholarship this year.

INCOME-TAX AND DEPRECIATION.

Representatives of your Association have met the Sub-Committee of the Institute of Municipal Treasurers and Accountants, relative to the absence of uniformity of treatment accorded to Corporations as regards depreciation of assets for income-tax purposes, and the desirability of obviating the necessity for appeals, by the introduction of more systematic treatment of depreciation of assets of local authorities charged to capital account. The matter is still under consideration, and negotiations are proceeding with the Board of Inland Revenue.

HOME OFFICE REGULATIONS.

Your Council have to record that they gave very careful attention to the draft regulations issued regarding the generation, distribution, and use of electrical energy under the Factory and Workshop Act, 1901. Combined action was taken with the Association of Municipal Corporations, and most valuable amendments were secured.

FRANCO-BRITISH AND MANCHESTER EXHIBITIONS.

Your Association is represented in the Electrical Engineering Section of the Franco-British Exhibition, and also on the Executive Committee of the Manchester Exhibition to be held in October next, by the President, Mr. H. Talbot.

GREAT EASTERN RAILWAY GENERAL POWERS BILL.

The attention of your Council was called to Clause 19 of this Bill, which, it was felt, might seriously endanger the interest of municipal electrical undertakings if it passed into law. The original clause gave the company power to supply from their works at Parkeston or elsewhere, either in bulk or otherwise, electrical energy not required for their own purposes to any tenants of the company or occupiers of premises connected by siding with any railways of, or leased to, or worked by, the company, and to any local or sanitary authority, or to any company authorised to supply electrical energy. Your Council decided to take steps to oppose the Bill, and the clause was subsequently modified, so as to permit such power supply only to the company's lessees and tenants or occupiers. Your Council was preparing to proceed in the matter when intimation was received that the clause had been withdrawn.

ALLOCATION OF WAGES OF WORKMEN ON PERMANENT STAFF.

This matter has not been pushed so vigorously as last year, owing partly to the general political unrest throughout the country, and partly to time having been taken up so fully in connection with the Home Office regulations. It is, however, being kept well in view, and further steps will be taken to obtain an equitable ruling as to the allocation of all wages incurred in connection with capital works.

QUALIFICATION FOR MEMBERSHIP.

It should not be forgotten that heads of electrical departments are now, under certain conditions, eligible for full membership, and chief engineers can do much to extend the scope of the Association by enrolling eligible members of their staff. Associates have not the advantages which would accrue to them were they eligible for full membership, but, on the other hand, their subscription is a nominal one, and it is obviously to their advantage in many ways to be affiliated with a representative Association.

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DISCUSSION.

Discussion took place upon various matters touched upon in the report.

Allocation of Wages of Permanent Workmen.

Mr. H. Collings Bishop (Chief Electrical Engineer, Newport) asked if the Council had been able to do anything further in this matter. At Newport there had been an instance where the officers of the Local Government Board had charged to revenue a fairly large sum, which the undertaking had previously put to capital for wages in past times, and it might help other authorities to know that they had got several members of Parliament to move in the matter in the House of Commons, and ask a question. The point was referred to Mr. Burns directly, and within two days the whole amount was remitted.

Associate Members and Associates.

In declaring the annual report open for discussion, the President referred to this matter. He said it was very difficult to get Associates to join or to read Papers.

Although the Studentship was started two years ago, only one member had given a Paper, and a very good Paper it was. Although they had since tried all possible means of inducing associates to join, they had not been successful. The subscription had been reduced by some 50 per cent. in order to try and make things easier for them, and still they would not join. He thought it would be a very good thing on the part of engineers and chairmen of committees if they could see their way to do something to get these people to join as associates. They had sent 700 or 800 circulars around, but had only received about 60 replies. This showed what little interest was taken.

Mr. A. T. Yates (Swinton and Pendlebury) thought engineers could do a great deal by bringing the matter before their assistants. He would also like to throw out a hint to the Council. Another association to which his Corporation belonged offered prizes for Papers read by associates, and it generally followed that associates reading the Papers joined the Association afterwards.

The President said that the Association had already practically done this in offering a £10 prize for the best associates' Paper.

Local Authorities' Liability under the Employers' Liability Act.

Mr. A. C. Cramb (Croydon) wished to know whether the Council had any actual cases with which there had been trouble up to date. He understood that the average contractor covered the Corporation as to any liability of this sort.

Mr. S. L. Pearce (Manchester) said this matter came under the consideration of the Council owing to an accident which occurred in Manchester to a contractor's man working in a Corporation sub-station. The workman did not bring an action against his own employer, but against the Corporation, and he succeeded in getting very substantial damages. Seeing that it was possible for this to happen elsewhere, he brought the matter before the notice of the Council, for after consulting the Manchester Corporation legal department they were advised that in a case of that sort it was almost impossible to draft any clause that would meet the exigencies of the particular circumstances. When a case of this sort came before a jury, the verdict was almost sure to be against the Corporation. Mr. Faraday Proctor, the honorary secretary, had written around for copies of clauses in the various forms of contract prepared by various town clerks, and these were still under the consideration of the Council, but up to the present he did not think the Council had decided upon any clause which would fully meet every condition that might arise.

Mr. C. Turnbull (Tynemouth) asked if the Corporation had recovered from the contractor.

Mr. Pearce said no. In reply to further questions, he added that in this particular case it was proved to the satisfaction of the Court that there had been contributory negligence on the part of the Corporation.

Alderman Pearson (Honorary Solicitor) confirmed the facts stated by Mr. Pearce with regard to the action of the Council in the matter of preparing a standard clause. They had in Bristol a clause which was as good as any he had yet seen, but copies of others had still to come in, and they hoped to be able to propose something which would suit all conditions. He thought Mr. Pearce's remarks about contributory negligence rather explained the result of the action in that instance; at the same time it was a very serious thing that when such an action came before a jury, with an injured workman on the one side and a Corporation on the other, there was not much doubt as to which way the verdict would go, if there was the slightest justification for it. Therefore they should all be careful to see they had in their contracts an indemnity clause with regard to third party risks and with respect to risks such as these. In the course of the next few months he hoped the Council would have such a clause, which they would be justified in offering for adoption by the general body of municipalities.

Mr. C. C. Aichison (Rochdale) said he supposed the Manchester Corporation were insured, as most corporations were, under the Workmen's Compensation Act, and that therefore the risk would be taken up by the insurance company. The contractor would naturally be insured himself, and if the Corporation made sure that he was, then the liability would be very largely covered, and it would lie between the two insurance companies to settle the matter.

Mr. Pearce said at Manchester they generally suggested that the contractor should pay the premium in the name of the Corporation, so that they had a direct claim on the insurance company themselves.

Supply of Electricity Bill.

Mr. A. C. Cramb (Croydon) said he would have been glad if the Council had been able to report something more than they had been able to in this matter. They went on year by year, and still no progress was made towards securing the passing of this necessary Bill.

The President said it was the fault of Parliament, and not of the Association.

Mr. Cramb said that did not help matters forward at all. Many municipalities had the powers which would be granted under the Supply of Electricity Bill, and he thought it was time all municipalities had them without having to go to Parliament specially. For instance, any authority inside the county of London could wire houses, hire out fittings and motors, &c., and yet, half a mile over the border, the municipalities could not.

Alderman Pearson said that it was now two years since he had formed one of a deputation which waited upon Sir Hudson Kearley, who professed the most profound desire to get the thing through, if he could get a short time to take it up, but they might take it that they would see nothing of the Bill this session. The Supply of Electricity Bill was certainly one of the most important Bills dealing with the electrical industry of the country that had been before Parliament in his time, and it did seem a monstrous thing that when there was absolute unanimity of all persons in the industry that these powers were necessary and ought to be given, Parliament could not find time to put a small Bill like this through; it was absolutely unopposed, so far as he knew, by any municipality in the country.

The Proposed Home Office Regulations.

Mr. E. B. Vignoles (Grimsby) asked how many Corporations contributed towards the opposition of the Association at the Home Office inquiry into the proposed regulations concerning the electrical industry.

Alderman Pearson said that about 150 contributed, some contributing an absolute part and others limiting the amount they paid. The total cost, as far as the municipalities were concerned, was about £650. The total cost of the inquiry he should be very sorry to estimate.

Membership: L.G.B. and Delegates' Expenses.

Mr. A. C. Cramb (Croydon) said that if the Council could bring pressure to bear upon the Local Government Board to allow the expenses of delegates to the annual conventions, there would be a perceptible increase in the membership.

Alderman Pearson said this question had been before the Council for a considerable time, and they had endeavoured to get an interview with Mr. John Burns upon the subject, but although they had obtained the unanimous support of at least forty members of Parliament, Mr. Burns had decided that he would not hear what they had to say. He was bound to say he did not think there was the slightest chance of moving the Local Government Board in the matter, and inducing them to allow the expenses of delegates attending their conventions wherever the boroughs were subject to Government audit. Members of Boards of Guardians got all their expenses paid, but it was improper for a member of a town council. The London boroughs, who were under Government audit, had, in consequence, in some instances, declined to join, and in others they had been obliged to withdraw from the association.

Mr. A. G. Cooper (Colne) pointed out that Urban District Councils were also subject to Government audit, and thus came under the ban of the Local Government Board in this matter.

Mr. C. C. Atchison (Rochdale) asked if it was all due to the Local Government Board, for he noticed that there were 64 corporations not represented on the Association.

Mr. C. McArthur Butler, the secretary, said that all committees and engineers who were likely members, were circularised two or three times a year.

Mr. Atchison suggested that, in order to bring before the notice of some of the Councils who were not members the advantages of being members, they should invite a few of those in the immediate neighbourhood of the town in which the convention was being held as guests at each convention.

Mr. C. Furness (Blackpool) disagreed with this for the reason that it would discourage membership.

Bailie Murray (Edinburgh) said the attitude of the Local Government Board in the matter of expenses seemed strange to those in Scotland, because they had no difficulty there. The sooner Scotland annexed England, therefore, so far as this was concerned, the better.

Some other speakers took part in the discussion on this matter,

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one suggesting that the amount of the engineer's salary for the year should be increased by the amount of his expenses. Another gentleman urged that a subscription to the proceedings should cover the subscription to the Association. Curiously enough, the Local Government Board sanctioned subscriptions to proceedings, and the difficulty could be got over in this way.

The PRESIDENT then moved the adoption of the report, which was seconded by Alderman J. P. Smith, of Barrow, and carried unanimously.

Mr. J. E. EDGCOME (Honorary Treasurer) then presented the annual balance sheet. There was very little discussion upon it, and it was carried unanimously.

POWER SUPPLY BY NON-STATUTORY POWER COMPANIES.

Bailie MURRAY (Edinburgh), in connection with the reference in the annual report as to the Great Eastern Railway (General Powers) Bill, raised the question of whether a railway company was entitled to grant wayleaves to a private company without Parliamentary powers to lay cables along the railway lines for the purpose of supplying electric power in competition with local authorities through whose areas the railway ran. This was threatened in Scotland, and at a convention of Scotch burghs the other day he had been instructed to see that the point was raised at this convention.

Mr. H. RICHARDSON (Dundee) said this matter was being viewed very seriously in Scotland, the fear being that a bogus company would be created with the sole object of being purchased, although they might never have a reasonable prospect of making a profit. They did not fear real and genuine competition under Parliamentary powers.

Alderman PEARSON said it was quite within railway companies rights to grant wayleaves of the kind referred to. He quite agreed with the remarks of Mr. Richardson as to the buying out of companies, as Bristol had suffered in this respect in regard to the docks. If the Scotch burghs were a little more persistent and brought this matter, not only before this Association, but also secured the support of the Association of Municipal Corporations and their own Municipal Association, he thought it might be possible by such combined action to bring pressure to bear on Parliament in order to protect the interests of municipalities owning electrical undertakings.

Bailie WIGHTMAN (Govan) asked what was the good of the Scotch Corporations belonging to the Association if they were not to receive assistance of this kind.

Several other members discussed the question of the possible effect of the action of railway companies in granting wayleaves to non-statutory power companies, and opinions seemed to be divided as to the seriousness of the question. Eventually Bailie Murray, of Edinburgh, moved the following resolution, which was seconded and carried with one dissentient:—"That it be remitted to the Council to consider the question of the proposed supply and sale of electricity by private companies by means of wayleaves obtained from railway and canal companies, to draw the attention of municipalities to the proposal, and the dangers of same, with power to consult and co-operate with the Convention of Burghs in Scotland, and the similar Association in England if so desired."

A vote of thanks was unanimously accorded to the retiring President, Mr. H. Talbot, on the motion of Mr. G. Wilkinson. In thanking the meeting for the vote of thanks, the President asked for Papers or suggestions for Papers for the next convention. Papers would be preferred from engineers of small stations, and from chairmen of committees.

Votes of thanks to the honorary officials closed the meeting.

On Thursday afternoon, two Papers were dealt with, both dealing with the construction, design, and working of electricity stations:

SOME CONSIDERATIONS ON THE DESIGN OF A GENERATING STATION.

BY H. RICHARDSON.

(*Chief Electrical Engineer, Dundee.*)

Foundations.—In most large towns near rivers or estuaries, the railways run very near the water, therefore sites near the water possess a double advantage. Unfortunately, when such land is to be had at a reasonable price, it is usually found to be filled-in or made-up land, reclaimed within a comparatively recent period. Therefore, viewed from a foundation standpoint, it is always very bad, unreliable, and, in many cases, contains the potentialities of chemical actions which will cause the authorities grave distress ere long with regard to all pipes, cables, &c., which have been laid in the ground, if they are not specially and expensively protected. The problem of securing foundations giving a maximum of stability with a minimum of cost is, however, an interesting point in connection with such sites, and much could be said thereon. The cheapest system is the construction of a large floating or raft foundation, the main object of which is to distribute the concentrated weights of the plant and buildings over such an area that the resulting intensity of pressure is less than the safe bearing capacity of the ground. The commonest method was to use a plain concrete raft of considerable thickness, but there are very few cases where this has not developed cracks, and unequal settlement of superstructures has occurred. Many such rafts have been reinforced with old tramway rails, but with little improvement.

We now come to piling foundations, and as wood piles particularly in such grounds as the above are liable to rapid deterioration, the tendency in view of the experience obtained latterly is to make use of reinforced concrete in the construction of piles. If carefully and properly executed, no better foundations can be made, taking into consideration maximum stability with minimum weight and cost. In very bad made-up ground containing much silt, with distances of 25 to 35 ft. to rock, a safe load of 60 tons may be allowed on any well-constructed pile. In connection with the driving of these piles, it is often specified that a weight equal to 2 tons, falling 3 feet, is to be used, giving a specified maximum amount of set such as ¼ inch for 10 blows, before driving is stopped. The author is of opinion that this results in a needlessly severe blow in ordinary practice, the change of velocity on impact being too great, resulting in damage to the heads of the piles, and causing much extra work and inconvenience. Piles should not be driven until from 50 to 60 days old at least. Even longer than this should be allowed for the concrete to set if possible. The cost of the foundation, including the raft, the piles, and reinforced foundation for the pipe track and reinforced pump chamber in the generating station at present being constructed by the author, was £5,800. The depth from ground level to rock was 30 ft.

Buildings.—The advantages of reinforced concrete construction may be carried beyond the actual piling, as it can be used to make a strong and light raft or floor over the heads of the piles and monolithic with them, forming a very complete and stable foundation for the superstructure. As regards superstructures, buildings made of brick or stone entirely are unnecessarily heavy and expensive, although this is the form generally adopted when an architect is allowed *carte blanche*. The heavy burden of capital expenditure unnecessarily carried by many stations has undoubtedly been largely contributed to by such useless extravagance further aggravated in many cases by equally useless and more sinful ornamentation. Reinforced concrete superstructures are not cheaper, the stability is in no way superior, and while certainly lighter, considerable inconvenience is met with in the fact that, once up, the design cannot be interfered with in the way of alterations without prohibitive cost. Also, so much depends, apart from the value of the system itself, on highly skilled and expensive supervision, and one weak part involves heavy consequential damage. The composite, building consisting of a steel skeleton filled in with light brick work, appears at the present time to be the most perfect system of building, giving, as it does, a minimum of cost and weight when considered in connection with its probable life, reliability, strength, adaptability, neatness, and appearance. If the insides of the buildings are to be lined for the sake of cleanliness, the author is of opinion that opalite or crystopal tiles are very much superior in appearance, cleanliness, and expense, to the ordinary glazed brick. In many stations having splendid engine-rooms, the boiler-houses are unnecessarily dirty, gloomy, and apparently neglected, for some unknown reason. The author does not admit that, under modern conditions, there is the slightest excuse for the boiler-house to be any dirtier than the engine-room. It is by far the most important part of a generating station, and should be treated as such, both in design and management. A very great deal can be said in support of corrugated iron buildings throughout. Their life, though short, is possibly amply long enough, and in any case it is merely a question of putting the shorter life and more expensive upkeep against the considerable difference in price. In most cases the steel skeleton building with corrugated iron walls is the right form to use if the locality of the generating station does not require æsthetic consideration.

Chimneys.—All the peculiarities of brick chimneys are well enough known, and, providing that great care is taken to spend some weeks after the work is finished in gradually heating up the chimney, there is, perhaps, nothing to beat it. The unsightly and apparently dangerous cracks are more often due to bad treatment than to faulty design or settlement.

An interesting modern development is the reinforced concrete chimney. The author had occasion to go very carefully into the merits of this form of construction, and came to the conclusion that there is a good deal to be said for it, because, owing to the simplicity of form, the before-mentioned disad-

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vantages of reinforced concrete should not have an opportunity of attaining importance. Two of the firms which have built most of the reinforced concrete chimneys in existence were of opinion that such chimneys would stand a temperature at the base of 1,500 degrees F., without harm or deterioration, and claim that the usual fire brick lining is unnecessary, as they are mostly built with a separate internal concrete shell extending part of the way up.

The author was surprised to find that in comparing steel chimneys with brickwork the result is so very doubtfully in favour of the steel chimney. Dealing with chimneys from 120 to 200 ft. high, the steel chimney equals, and in some cases exceeds, the cost of the brick one, if the foundations are excluded, but as so many modern generating stations are built on very bad ground, the foundations have to be particularly good in both cases, so that the lower cost of foundations for the steel chimney is not in any proportion to its comparative lightness. On inquiry from several users of steel chimneys, it was found that their cost of upkeep is quite a considerable item, if they are maintained in a reliable condition.

The following are examples of comparative costs :—

Height and diameter	220 ft. by 11 ft.	80 ft. by 9 ft.
Brick chimney	£1,550	£400
Concrete chimney	1,300	470
Steel chimney	1,460	450

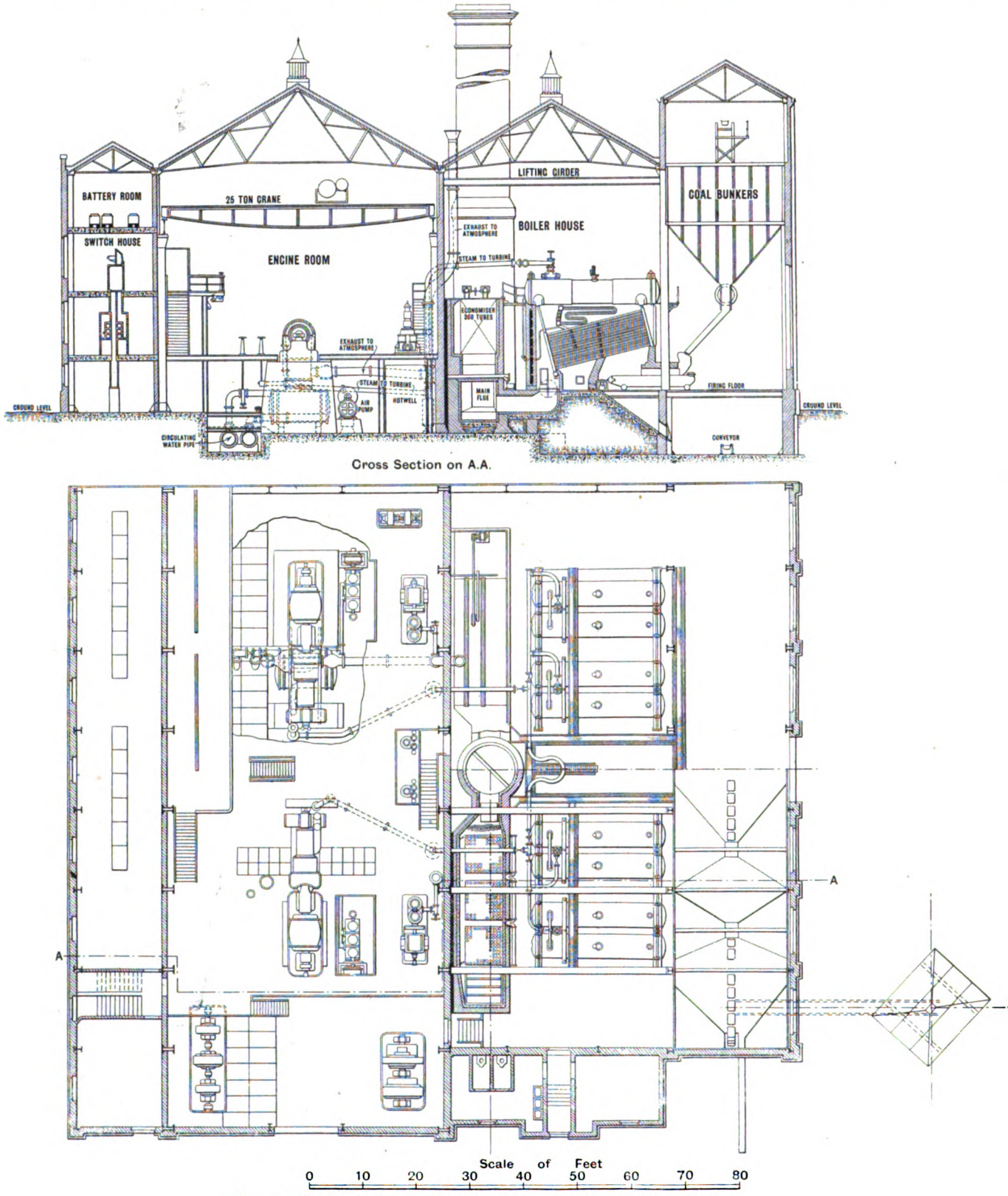

FIG. 1.—PLAN AND CROSS SECTION OF NEW POWER STATION, DUNDEE.

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In reference to chimneys generally, the great importance of a smooth interior is often lost sight of.

Types of Plant.—Being anxious to put in most up-to-date plant, and attain the best possible results in the supply of cheap power, the author was very desirous of using gas engines in connection with a new power station, and with much optimism made most detailed and careful inquiries from owners and engineers who were using such engines of modern types. Some six months were spent over this work, as answers had in many cases to be got from abroad. The inquiries were limited to the larger units and latest installations. The results were extremely disappointing, in that, by a large majority, opinions were unfavourable, principally on the grounds of unreliability, cost of upkeep, space occupied, first cost, and the inability to meet sudden overloads of short duration. This being so, the question was reduced to the consideration of the reciprocating steam engine *versus* the steam turbine.

On inquiry there seemed to be no doubt as to the superior efficiency of the steam turbine, but in view of the common accusations of high cost of upkeep and liability to breakdown, visits were made to several turbine plants in the country, and the result was distinctly in favour of the turbine on all points, and as regards reliability, the vertical impulse type was equal, if not superior, to the horizontal reaction type. One noticeable thing in all stations where both reciprocating and turbine plants were installed, was the fact that the turbines were running and doing the brunt of the work and the reciprocating plant, where possible, was standing idle. This was by no means due to any difficulty in stopping and starting the turbines, but entirely to their superior efficiency and lower repairs cost.

Generation of Steam.—In comparing the Lancashire boiler with the water-tube boiler, it appears, in the author's opinion, to fall behind the latter for the following reasons :—

First cost (taking into consideration the ample economiser plant necessary for equal economy).

Space occupied and cost of such space.

The extreme difficulty of making a good boiler-house arrangement of Lancashire boilers to fit in with a good engine-room lay-out of steam turbines.

Inferior combustion chamber giving less control over the smoke problem and limitations in the choice of mechanical stoker.

More inefficient complicated and expensive arrangement of piping, partly owing to the larger number of units required.

Before deciding the working pressure, the peculiarities of the type of turbine must be taken into consideration. Speaking generally for reaction turbines, a commercially high and quite successful efficiency is obtained with working pressure of from 160 to 200 lbs. per square inch, with a minimum of practical difficulties. As regards superheat, however, the author is of opinion that in order to avoid any working difficulties and secure at the same time a maximum reliable efficiency the amount of superheat should be that necessary to attain a working temperature of 550° degrees F. It is quite true that tests indicate a superior steam efficiency at higher degrees of superheat, but it is not at all certain whether in practice the total commercial result would show a similar improvement.

While the efficiency of the separately fired superheater is undoubtedly lower than that of a combined superheater, yet it has a great advantage in the possibility it holds out of maintaining a regular superheat at all loads. This is neutralised by the extra space, attention required, and multiplication of pipes and valves.

Economisers.—The development of the water-tube boiler has undoubtedly rendered the installation of these valuable adjuncts of less importance, and in particular where cheap coal is being used they have a difficulty in justifying their extra cost. At the same time, the author recognises that in connection with turbine plants, where the condensed water is at such a low temperature, they have their uses in protecting the boilers from the well-known bad effects of a cold feed. Under ordinary circumstances economisers should be put in and careful attention given to their position and size to give the best results from the commercial rather than the strictly technical point of view.

Brickwork Settings.—The settings both in detail and arrangement do not always receive that strict attention which is their due. So far as their arrangement is concerned, the principal rule to follow is to design the settings as compact, stable, and accessible as possible, and to shorten the lengths of all flues and passages to an irreducible minimum, giving good, sweeping, smooth curves at every change in area or direction. Much trouble has been caused when the flues have been roofed with brick arches by the expansion and contraction of the latter, causing the side walls to bulge, loosening the brickwork, and sometimes causing the collapse of the lining. Heavy T-irons and cast-iron plates get over this difficulty, besides providing a smoother surface. Although the loss by radiation appears comparatively small in ordinary boiler tests, it must be borne in mind that such tests are usually made at or near full load, and that, therefore, a constant loss like that of radiation assumes a much greater importance in the practical case of an ordinary generating station, where the boilers are often the reverse of fully loaded for the greater part of the time. Two practical devices suggest themselves in this connection; one is to build the settings with hollow walls, packing the cavities with a suitable non-conducting substance, and another to face the outside with glazed bricks. As an example of loss of temperature that may take place due to the above causes the author may mention a case with which he is well acquainted. The economiser is separated from the boilers by a flue about 50 ft. long, and although the brickwork of the latter is in good condition, there is a difference in temperature of the gases in this flue measured at two points 43 ft. apart of 100° Fahr.

Built-in fittings, particularly dampers, must be carefully designed with a view to freedom from sticking in working, due either to their position, settling of brickwork, expansion or contraction. Instead of being as rough as they often are, they should be most carefully fitted. Arrangements should be made to stop the leakage usually considered inseparable from dampers. The best cure for this is the use of butterfly dampers. Expansion being a considerable factor in such fittings, sufficient clearance must be left to ensure easy working when the boilers are being forced, as the inability to open or close a damper may have very serious effects.

The bricklaying should be done by men experienced in the construction of furnaces, because the requirements are not the same as for ordinary building. In all cases the joints should be as close as possible, and the cutting of bricks should be avoided. Where it is absolutely necessary, as, for example, the closing of an arch, the cut surface of the brick should be rubbed smooth to ensure a close joint. Great care should be taken to render all surfaces smooth, as the effect of rough surfaces on the draught are often under-estimated, and as far as the furnace is concerned, careless laying militates against durability under the effect of the fires. Certain schemes of reinforcing the brickwork by means of steel network in the joints, &c., are in the market, and there is much to be said for their consideration.

Draught.—The question of mechanical *versus* natural draught is likely to remain an unsettled one. If forced draught means brutal treatment of a boiler by forcing a supply of air for overworking an undersized combustion chamber, then the author would have none of it, but would substitute, for consideration against induced draught, a system of moderate pressure supply designed to control the air for combustion to a boiler within the limits of efficiency, and without deteriorating effects. In considering such a pressure draught, it is assumed that the air is supplied to a closed ash-pit, and that the pressure above the fire is equal to or very slightly below that of the surrounding air. The difference of pressure necessary to overcome the resistance of the boiler flues and economiser would then be provided by a comparatively short chimney. It is submitted that the pressure draught is superior for the following reasons :—In case of any leaks in the settings, the efficiency of the draught will be preserved, and as the difference in gas pressure between the interior of the flues, &c., and the surrounding air is much less, harmful air leakages will be avoided. If the quality of the coal is such as to require frequent opening of the fire-doors to break up clinkers, &c., the inrush of cold air, with consequent loss of efficiency and damage to brickwork and boiler will be avoided. The size and consequent price of the plant is smaller. This, of course, may be a disadvantage from the fan-maker's point of view.

Speaking generally of draught, the installation of a chimney of a capacity sufficient to deal with the normal full load of the plant is recommended, because this method is, after all, the most efficient, simple, and reliable, and appears to be cheaper in first cost. It should be understood that the author is not condemning the use of mechanical draught for all circumstances; the above recommendation only refers to the normal conditions while a power station is going easily. During the erection of extensions nearly all power stations are pressed; therefore, it is recommended that everything should be constructionally ready for the installation of a pressure or induced draught, not in recognition of the superior economy of such apparatus, but in appreciation of their temporary utility in producing a desirable margin of power.

Coal Handling Plant.—It is only after a power station has attained considerable size that any superiority in the mechanical or automatic handling of coal is made manifest. The most ideal conditions prevail in few towns, viz., the high-level railway where a trestle-supported siding can be run in at a higher level than the overhead bunkers. With the railway at the same

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level as the firing floor, the first questions to consider are the methods of filling the feed-hopper, and the position of the latter relative to the necessary conveyor. A not uncommon difficulty in made up ground is the limited depth to which one may go with the hopper. If the required depth is likely to be below the water-level, it is desirable to sink a watertight cast-iron tank lined with concrete. As to the means of emptying the waggons, there are four methods available, viz., by hand, bottom door emptying, end tipping, and side tipping. The choice between the last three necessarily depends upon the type of waggons available and the speed of service. The author's opinion favours the bucket type of conveyor, in spite of its considerably higher cost for the following reasons :—Longer life, neater and cleaner work, less wear and tear, less power used, less noise, increased reliability, less breakage of coal; in short, less total cost in working.

Although steel bunkers are convenient, light, and in more general use, yet a case is clearly made out for the serious consideration of reinforced concrete. An estimate of the probable saving in cost obtained from four known cases approximates 25 per cent. for equal capacities. In designing the bunkers, special attention should be given to the arrangement of the compartments with a view to storing different classes of coal to be easily drawn from by the engineers at their discretion.

furnace doors and front. This results in considerable damage by overheating, and is liable to set the coal in the hoppers on fire. Sticking and breakage of dumping bars and rods in some types due to overheating from ash accumulation is extremely awkward at times and not unusual. The cost of renewing the brick arches may become excessive unless they are constructed with unusual care. In some types clinkers will not ride over the dumping bars, but accumulate on the grate, reducing the effective area of the latter, and causing a drop in the steam pressure. In such types, also, the dumping bars give trouble by getting displaced and burning away.

Ash and Soot Handling Arrangements.—These should be designed so as to keep ash and soot out of, and away from, the boiler-house proper. The ash basement under the boilers or firing floor is the proper place for dealing with such refuse, and it is quite simple to load it into the conveyor, with a minimum amount of scattering or dust. The cleaning of the economisers ought to be arranged for in the same way, giving easy connection with the conveyor. In the new station designed by the author, an economiser arrangement was adopted which was intended for use with very small cheap coal. Specially designed screw conveyors are fitted in sloping-sided compartments, forming the floor of the economiser chamber. This will prevent the annoyance of shutting and cooling down of the economisers

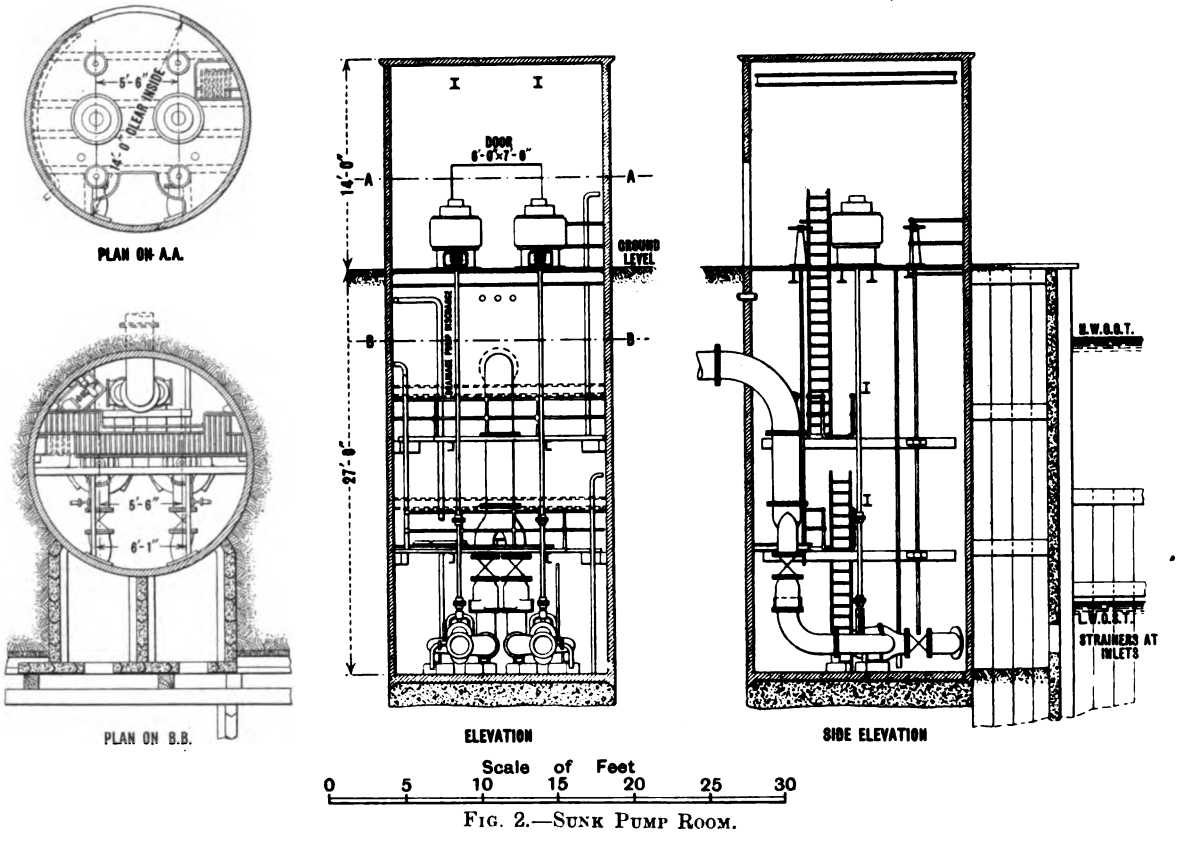

FIG. 2.—SUNK PUMP ROOM.

As regards the measuring of coal, the conflicting results obtained where the weighing system is in vogue, and the impossibility of tallying, however accurate the machines, decide in favour of the volumetric measuring as against weight measurement. This only refers to boiler-house measurement, and not to the measurement of coal supplied to the station, which, of course, must be weighed.

Mechanical Stokers.—So far as use with water-tube boilers is concerned, the author favours chain-grate close-linked stokers in spite of the following disadvantages :—Clinkers are very apt to adhere to the brickwork at the sides of the grate, and these scrape off the fire at the edges leaving the bars exposed. The act of breaking away these clinkers does considerable damage to the brickwork. The wear on the worms and worm-wheels is sometimes very severe, due to distortion of the whole grate, which takes place after a time and causes the gear to work very stiffly. This trouble is aggravated by the difficulty of keeping the working parts lubricated when working the stoker slowly with the dampers nearly shut, owing to the rise in temperature of these parts. The split cotters in the pins of the grates come out, the pins then work their way out, and jamb, generally somewhere at the back. If an attempt is made to deal with a very light load by reducing the air supply, it is found that the fire will ignite right back to the

for the necessary frequent cleaning, and will result in a considerable saving of labour.

Feed Pumps.—It would seem that where a pump is to work at a full-load rate for long periods the superior efficiency of the electrically-driven pump would point to its adoption. Such pumps, however, do not lend themselves easily and economically to regulation over wide ranges, and this combined with their appreciably higher first cost militates against their use under conditions of variable loads. It is necessary in any case to instal one steam-driven feed pump, at least, in a generating station for use in emergencies when electrical power is not available. Probably the best policy to follow is to start the first instalment of plant in a station with steam pumps and use electrically-driven pumps for the extensions. Although feed pumps are more frequently located in the boiler-house, there is a great deal to be said for situating them in the engine-room. The arrangement of feed-piping can often be simplified and made more direct, and the pumps are likely to receive more attention than they would get at the hands of the firemen. It is important in such cases to arrange for convenient regulation from the boiler-house.

Engine-room Lay-out.—In dealing with the lay-out of the engine-room with turbine plant of the horizontal type, the first thing is to decide whether the axis of the turbines shall be

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parallel to the length of the engine-room or across it. With the larger sizes of turbines of 1,500 kw. and above, and a single row of boilers parallel to the engine-room, considerable space can be saved by the first arrangement. Before taking the utmost advantage of this, however, it is well to forecast future possibilities in the way of other types of plant, such as vertical turbines, gas engines, &c., as the span and height of the crane may otherwise greatly handicap the choice of plant required for extensions. The condensers can either be placed lengthwise with the turbines, or across; the former gives a very compact arrangement with the turbines along the length of the engine-room. In condensers of the *contra-flo* type, however, the steam inlets are situated eccentrically, and such condensers must therefore be placed across the turbine.

With regard to the air-pumps, there are two or three modifications to choose from, viz., the simple air-pump or two separate pumps, one for dealing with air and vapour, the other for the water, or, thirdly, a vacuum augmentor in combination with the air-pump. The absolute pressures attainable respectively

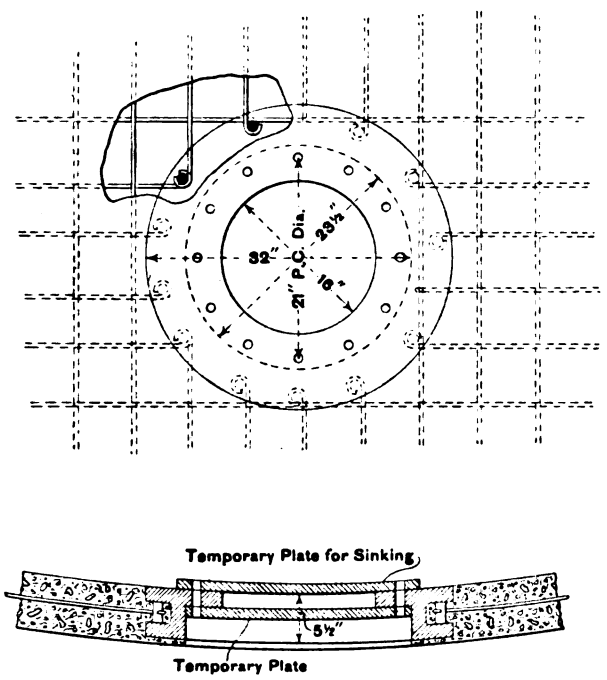

FIG. 3.—DETAIL OF SUCTION INLETS TO PUMP ROOM.

in the condenser decrease in the above order, the extra complications being intended to increase the density of the air and vapour before it is dealt with by the air-pump, which is done by cooling in the one case and by a preliminary compression with a steam-jet pump in the other. The practical advantage of the possible increase in vacuum by the use of such methods is rather doubtful, except, perhaps, in the case where the available amount of cooling water is limited and its temperature is high. It will also be found that this apparatus requires to be below the level of the condenser, and that the necessary depth cannot always be given owing to complications of sewers and liability of flooding. Facilities for the cleaning and replacement of tubes should not be lost sight of in the design.

Circulating Water-pipe System.—To reduce the power required for pumping the circulating water to a minimum, the outlet end of the discharge pipe should be below the level of the source of supply, so that the arrangement forms a species of syphon. Precautions are necessary to deal with air liberated from the water or leaking in at joints, if the top of the syphon is far above water level, otherwise the syphonic action will soon cease. The advantage of the syphonic effect is, of course, limited to about 30 ft. (practically it may be found to be much less), and in cases where the water has to be raised to a considerable height, the recovery of power rendered possible by the use of turbines situated near the lower end of the discharge pipe, and driven by the water on its return merits consideration. Every care should be taken in the laying and jointing of the pipes, and the latter should be specially protected from corrosion if the ground is bad. Trouble has been experienced in cases where cast-iron pipes have been embedded in solid concrete with breakage, due, probably, to expansion and contraction with the varying temperatures of the discharge water. A form of pipe which possesses considerable advantages for this work is one constructed of reinforced concrete. Such pipes are cheap and durable, and can be moulded practically in any desired shape. In any case, substantial foundation must be provided for the pipes to obviate subsidence, and if the ground is soft, piling becomes necessary.

It being necessary in the case of a pump-room which the author is at present constructing, to sink a large vertical reinforced concrete cylinder for use as a pump chamber to a depth of 30 ft., the difficulty of making the suction pipe openings below water level was overcome in the manner shown in Fig. 2, which may be of interest. The method there shown has been tried before in similar work below the water level, and found perfectly satisfactory. It also does not interfere with the sinking of the chamber in the way branch pipes would do.

Main Steam and Feed Piping.—The simplification and reduction of the amount of steam piping has its effects on the coal bill, while the reduction in the number of valves and joints is correspondingly beneficial in economy of maintenance. Although steam traps may possibly work correctly for a few hours or days, yet experience shows that they cannot be relied upon (without constant adjustment and overhaul) to prevent waste of steam on the one hand, and accumulation of water on the other. The diameter of the main steam pipes can advantageously be reduced when used for superheated steam. When turbines are used there are additional reasons, as the flow of steam is more uniform, and the retention of temperature of superheat is of greater importance than a slight reduction in steam pressure.

Generators.—The question of efficient ventilation has risen into great prominence since the advent of the turbo-generator, and ducts are generally formed in the concrete foundations for this purpose. If possible, it should be arranged that these ducts lead from a cool space in which the air is still, dry, free from oily matter, and has had time to deposit some of its dust.

Auxiliaries.—The use throughout a generating plant of continuous-current motors for driving auxiliaries is recommended in cases where direct current is to be distributed in the locality of the generating station, as it is very convenient to have a storage battery reserve for this class of work, and economical adjustment of speed has advantages.

Switchgear.—In moderate and large-sized stations the best system is to isolate the whole of the high-tension gear in special chambers, operation being effected from a gallery overlooking the engine-room through the medium of electrical control. The cellular type of board is to be preferred, and as much space as can be afforded should be allowed for the gear. This is a strong reason for arranging the switch chambers along the side of the engine-room, rather than across the end; besides, this method allows of some simplification in the connecting cables. The busbars should be divided by means of section switches, so that any part may be made dead for inspection or repair without interference with the supply. Too much thought cannot be bestowed in obtaining a safe working arrangement. In a system which is being carried out by the author the doors of the compartments containing the feeder isolating switches are provided with double locks. One key will be kept by the station department and one by the mains department. Whenever any cable is required to be disconnected for testing or repair, the isolating switch will be opened and the compartment locked by both parties. The cable then cannot be made alive again except in the presence of both the departments concerned. Facilities for earthing parts of the gear should be provided as a safeguard against their becoming charged by leakage or otherwise, while persons are working on them. It is almost universally acknowledged that oil-break switches are the only type that should be used for breaking high-tension circuits, and their breaking capacity should be chosen with reference to the total K.V.A. capacity of the station on a momentary short circuit.

DISCUSSION.

Mr. S. L. PEARCE (Chief Electrical Engineer, Manchester) dealt first with the driving of piles. The author had stated that a safe load of 60 tons might well be allowed on any well-constructed reinforced concrete pile, but figures of the section had not been mentioned, so that they were left a little bit in the dark as to the basis on which this load had been reckoned. He should imagine a section of about 14 or 15 square inches. With regard to the method of driving the piles, he thought that a weight of three tons with a three-foot fall gave about 41 or 42 tons force, which was not excessive if the supporting power of the pile was to be reckoned on the basis of 60 tons. He believed it was an accepted fact that a heavy monkey with a short fall did less damage than a light monkey with a long drop. If a long-continued pressure could be applied to these piles they could get very much better results. There were some interesting remarks in the Paper with regard to using reinforced concrete as a suitable material for chimneys, but he thought that 1,500° F. was altogether too high a temperature to which this material should be subjected without a suitable lining. Two reports had been issued fairly recently, one by the British

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Fire Prevention Committee and one by a committee which investigated the results of high temperature upon reinforced concrete work at San Francisco after the disastrous earthquake and fire, and he thought it was proved pretty conclusively that Portland cement began to lose its water of crystallisation at from 600 to 800° F., and therefore when reinforced concrete was subjected to an excessive temperature the concrete began to crumble, and the structure, he should imagine, would become absolutely unsafe unless a lining or inner ring of some material was used inside the reinforced concrete chimney. Dealing with the question of gas-engine plants which the author had dealt with at some length, the criticisms he had to make, he said, had been somewhat disarmed by a remark made by the author in reading the Paper, that his inquiries had only been directed in those quarters where the gas was produced on the premises. He took it the author meant producer gas, and if that was the case he ventured to think that the unsatisfactory nature of his replies was due more to the producer end than the gas-engine end. At the commencement of this year, through the kindness of Mr. Leonard Andrews and other engineers interested in large gas-engine plants, he was able to make a visit to the Continent and see several of the largest gas-engine plants of different makers, the Nuremberg, Cockerill, Körting, and Ehrhardt-Sehmer, and although he went somewhat biassed by the experiences at Johannesburg, he had returned in a somewhat different frame of mind; for the experiences and facts he had been able to get first-hand had convinced him, at any rate, that the gas engine had certainly a future in this country. Undoubtedly very considerable progress had been made in Germany, and it had been made in those countries where they could use the blast-furnace or coke-oven gas as a bye-product for the fuel of the gas plant installed; but whether the gas engine was used on town gas or coke-oven gas or producer gas or blast-furnace gas, there was no very great difference in the engine. All the first-class makers were prepared to build gas engines and guarantee them to work with all these forms of gas, and therefore he thought it was the producer end that really dominated the situation to-day. There were very few examples on the Continent of producers; there were a few using anthracite coal and still fewer using bituminous coal. The single-tandem engine seemed to be most in favour, but there were some very good examples of twin-tandem engines also to be seen. As to size, engines could be seen up to 2,500 horse-power, but this was about the limit where the work was divided between two cylinders, and gas-engine designers appeared to be agreed that the limit of power that could be got from a single-cylinder gas engine was in the neighbourhood of 1,400 effective horse-power. Therefore the twin-tandem type was the only one by which a higher capacity could be obtained, running up to 5,000 or 6,000 h.p. Such a gas engine would permit the use of electrical units of about 4,000 kilowatts, and there was at any rate one firm—probably there were more on the Continent—which was prepared to build these units to-day. The reason that they had not been built hitherto was that they had never been asked for. 3,500 h.p. seemed to be about the limit for works on the Continent, and that was where the gas engine had found its sphere of usefulness up to the present time. With regard to Mr. Richardson's objections, these must be admitted so far as the space occupied was concerned, and the inability to meet sudden overloads of short duration. As to capital cost, the author had stated that the generator and gas engine and producer was about 25 per cent. to 30 per cent. in excess of the reciprocating type, and, of course, the capital cost would be proportionately greater when using steam-turbine units. The same remarks applied to the space occupied. One maker was prepared to build a 4,000 kilowatt gas-engine set to take up 2,600 sq. ft. of space, and, comparing that with a 4,000 kilowatt turbo unit, the floor space in the latter case was about 400 sq. ft., roughly six to one in favour of the steam turbine. Weight was also in favour of the steam turbine; the weight of half the frame of a large gas engine was in the neighbourhood of 70 tons. This was an enormous mass, and there seemed to be very little chance of getting down the initial cost of gas engines in the future for this reason. With regard to reliability and upkeep, he was not quite in agreement with the author, because he found on investigation into the best examples of gas-engine plants on the Continent that there was not much to choose between the upkeep and maintenance of gas-engine plants as compared with reciprocating plants. In contrasting the advantages and disadvantages of gas-engine generating sets and steam-driven sets, it was not necessary to remind them of the great advantages of using gas plants in the shape of saving fuel consumption. Many of them had read Mr. Highfield's evidence before the London Power Bill's Committee,* and he did not think Mr. Highfield had overstated the case when he said that the best figure for steam plant was 2·75 lb. of coal per unit and for gas plant about 1·75 lb. He would like to make one reference to the advantage that had accrued in one particular works on the Continent, viz., the Cockerill Company's own works, where they had last year an output of 24,000,000 units, and the cost at the station per unit generated, including capital charges, was one-sixth of a penny. There was therefore a fair margin for fuel cost before they came anywhere near the best cost obtained with steam plants to-day. This question of gas engines and their possible use in central stations had been brought prominently forward in this country a short time ago, and Mr. Andrews took up the case that good use could be made of gas-engine plants in combination with the existing steam units, the idea being that the gas engine could be put to run on a steady load, leaving the steam turbines to deal with the peaks. He had looked into the matter from this point of view as regards Manchester. Their night load at Manchester averaged about 3,500 kilowatts, and therefore it was perfectly obvious that they could put in one or two gas engines and keep them running the whole 24 hours, leaving the rest to the steam turbine and reciprocating plant, and very substantial economies could be shown, despite the objections and disadvantages which the author mentioned. On the question of the steam pressure for turbines, with the so-called reaction type there was absolutely no advantage from the steam-consumption point of view of using 200 lb. as against 160 lb.; tests made some time ago on a 3,000 kw. Parsons-Brown Boveri set showed that at full loads there was only 5 per cent. decrease in steam consumption, at half load no economy could be shown for increased steam pressure, and at no load the steam consumption was greater than with the lower pressure. He disagreed with the author that a working temperature of 550° F. was a fair figure for the reaction type. It was altogether too high, and he was inclined to put the limit of superheat to be added to the steam at a maximum of 150°. The bulk of troubles experienced on the Continent with the Parsons type turbine was due to the excessive superheat. In a Paper on "The Influence of Surface-Condensing Plants," read by Mr. Morrison before the Institution of Naval Architects, tests were described which showed that in no type of condenser could the condensing capacity due to its dimensions be maintained, unless the air pump was sufficient to render all the tube surface available for condensing. In other words, they must have an air pump which was perfectly capable of dominating the condenser under all conditions of normal air leakage, and it was a good sign that this latter was now receiving more attention than hitherto. Personally, he preferred two separate pumps, one for dealing with air and vapour, and the other with water. In connection with the ventilation of generators he had adopted the method at Manchester of totally enclosing the alternator, and using an external fan blower with an air filtering apparatus for giving the necessary cooling effect on the machine.* On blowing 21,000 cubic feet of air per min. through the machine, the result was distinctly advantageous. The chief advantages were that they got a machine with a total absence of noise, complete cleanliness, and, therefore, less liability for the insulation to break down. Furthermore, for the same type they had less cost in spite of the extra cost for the blower and air filter, because they could use machines of a smaller rating for a given output, whilst the heating question which would have to be grappled with in the near future was overcome. With regard to auxiliaries, there was a limit for direct current for such purposes in large stations, as it would mean continually adding small generating units or increasing the sub-station plants with corresponding conversion losses, and therefore it was better to instal three-phase motors for the majority of purposes required. On the other hand, he strongly advocated installing a small storage battery for excitation purposes and for operating the trip circuits in connection with automatic relays. In connection with extra high tension switchgear, he was wholly at one with the author when he stated that the breakage capacity of switches should be adjusted in reference to the total K.V.A. capacity of the station that might be dealt with at any moment. It was becoming clearly recognised to-day that the capacity of the smallest oil switch must be the same as the largest.

Mr. LEONARD ANDREWS (Key Engineering Co.) confined his remarks to the gas engine question, although he complained that Mr. Richardson had rather knocked the bottom out of some of his arguments by saying that the remarks in the Paper applied only to producer gas stations, but he still thought it possible that he might be able to make one or two remarks that would be of interest. He entirely endorsed what Mr. Pearce had said: that the capital cost of gas engines was, and probably would always be, greater than steam turbines. At the present time it was correct to put this at about 25 per cent. greater; Mr. Pearce had put it at 25 per cent. greater than reciprocating engines, but he personally thought it was almost this amount greater than steam-turbine plant. Against that, however, there was a very big saving in the fuel consumption. Mr. Highfield's estimate of coal consumption, given before the London Power Bill Committee, was also about correct. Recently he had had the opportunity of seeing several gas-engine sets, which showed the figure of 1·75 lb. of coal as being on the high side. As to overload capacity, of course, the gas engine would probably never compare with the steam turbine, but a great deal of the bad repute respecting the lack of overload capacity of the gas engine had really arisen from the fact that its capital cost was high and the gas-engine makers had been inclined to overrate their plant. Gas-engine makers were now realising that this was a mistake, and were now rating their plant somewhat lower. A few days ago he had some particulars given him of a plant

* *Electrical Engineering*, Vol. III, p. 939.

* An illustrated description of the 6,000 kw. machine in which this system is employed and the ventilating arrangements appeared in *Electrical Engineering*, Vol. III, p. 735.

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in this country working on producers, which had a normal capacity of 820 kilowatts, but, owing to a breakdown on some other plant, the gas plant was called upon to carry a load of 950 kilowatts, and had done so quite easily for two hours. Of course, this was nothing like what the steam turbine would do in the way of overload, but it was about the highest that could be got out of the generator. This particular instance was 17 per cent. overload for two hours, and it was as much as they had been accustomed to expect before the days of the steam turbine. Against the argument that gas engines were still unreliable, he had collected figures which showed that the users of them placed frequent repeat orders. He found, for instance, that one firm which had turned out about 69,000 h.p. up to the present had received something like 40,000 h.p., or 60 per cent. in repeat orders. He thought they would find the idea which existed about the unreliability of the producer end would disappear in exactly the same way as had the idea that the gas engine was unreliable. There were some large producer installations in this country which had been running quite satisfactorily for years.

Mr. C. E. C. SHAWFIELD (Chief Electrical Engineer, Wolverhampton) said that he had found the cost of a steel chimney to be about one-third that of a brick chimney, but he would be chary of making the experiment of using a concrete chimney. He had noticed in the American technical Press a description of several accidents with chimneys of this description, and this appeared to be due to the fact that the strength of the concrete after mixing depended on the length of time which elapsed between the mixing and its final placing in position. Consequently, if the concrete had to be mixed on the ground, as was very often the case, the time that elapsed was longer the higher the chimney got, and he had noticed that in nearly all cases the failure of these chimneys had taken place at about the same total height from the ground, and that in each case it had been attributed to the fact that the concrete had stood just a few minutes too long before being formed. In an ordinary reinforced structure of ordinary height this difficulty would not occur, but in the case of a chimney, say, 200 ft. high, it was a consideration that should be taken seriously into account. Neither Mr. Pearce nor Mr. Andrews, in stating that the actual consumption of fuel for a gas plant was 1·75 lb. per unit and for steam plant 2·75 lb. per unit, had given much information, as it was quite possible that a steam plant using 4 lb. of coal produced its energy with a lower fuel cost than the gas engine using 1¾ lb. It depended on the class of coal and the price that had to be paid for it.

Mr. ANDREWS: Both Mr. Highfield and myself meant the same quality coal, viz., bituminous slack.

Mr. SHAWFIELD, continuing, said there was another question which had not been emphasised quite sufficiently by other speakers, viz., the vast difference between steam turbines and gas engines in the matter of overload. At the present time it was practically possible to couple a 1,000-kw. turbine on to a 2,000-kw. generator, making a 2,000-kw. unit. In the case of the gas engine, however, the total capacity of the plant appeared to be absolutely limited by the engine itself, and he had not been able to obtain a guarantee of more than 15 per cent. overload—and that only for a very short period—from any maker of gas engines, say, of 1,000-h.p. size. On the total cost of a station, therefore, it meant that the proportion of spare plant had to be normally greater for gas than for steam. With reference to the question of the influence of steam pressure on steam economy, he quite confirmed the figures given by Mr. Pearce, as he had found the reaction turbines which he had recently installed were actually more efficient throughout the whole range of load at 135 lb. pressure than at the 165 lb. pressure for which they were designed. He had experimented a good deal with both induced draught and forced draught, and had found forced draught to be in all cases distinctly less economical than induced. He thought the explanation of this was to be found in the fact that with positive pressure below the fire they also got a positive pressure above the fire, and, secondly, the air supply was limited to that which passed through the fire bars. When dealing with bituminous coal, it appeared to be absolutely necessary, in order to obtain the highest economy of working, that a certain amount of air should be admitted over the top of the fire, as otherwise a considerable amount of the unconsumed gas tended to pass away through the tubes. He had found that this occurred not with one class of boiler or stoker, but with three types of stoker and three types of boiler. In dealing with soot- and ash-handling arrangements Mr. Richardson had advocated an ingenious arrangement for dealing with the dust and dirt accumulating in the boiler flues and in the bottom of the economiser chamber. He was afraid, however, that the cost of this would hardly be justified by the total saving. It had occurred to him that a quite feasible and much cheaper way of dealing with the accumulation of ashes and soot in economiser tubes would be to instal along the line of the tubes, say, a 3-in. pipe connected to a vacuum chamber something on the general lines of the vacuum cleaner. He had experimented in a small direction with such apparatus, and had found the results hopeful. If it could be done, the first cost of the apparatus was really very small. There was one remark he would like to make with regard to feed pumps, and that was that Mr. Richardson had omitted to mention what was probably the most convenient and economical system of the present day, and that was the "Roturbo" centrifugal pump. He was aware that this had only recently been available, but he could assure them that after about eight or nine months' experience of it, in comparison with any other form of reciprocating pump it was a luxury.

Mr. A. T. YATES (Swinton and Pendlebury Electricity Committee, and of Matthews & Yates, Ltd.) said that, in his opinion, induced draught was more efficient in producing the greatest evaporation at the least expenditure in fuel than chimney draught. The reason was that by working at a high-water gauge a higher furnace temperature could be obtained, and therefore much more rapid evaporation took place. It was a fact quite well known that the highest calorific value in the coal was not obtained in the highest-priced coals, and that low-grade coals sometimes had a higher calorific value than the more expensive ones, and induced draught enabled this cheaper coal to be burned with economy; so that even if they had to burn a very much larger weight of coal for a smaller duty, they could burn coal of a very much cheaper quality and get more efficient work out of it. It had been proved in many tests that induced draught plant had paid for itself in the first year of its installation. The speaker also referred to the value of induced draught for meeting sudden fog loads. When everything was taken into consideration, he was perfectly satisfied they would find the first cost of a natural draught installation to be two or three times that of the installation of boilers with a smaller chimney sufficient to carry the smoke far enough from the surroundings in conjunction with the induced draught plant. The induced draught plant was also very advantageous in reducing the large amount of black smoke that was put into the atmosphere by many chimneys.

Mr. W. H. SEATON (British Westinghouse Company) said the first thing referred to in the Paper was the proper location of the site, and this was a question which worried him a good deal. In England it seemed to be the one idea to get on the side of a small stagnant canal, and if there were two or three cotton mills turning their condensing water into it, it seemed to be regarded as an additional advantage. On the question of distribution there seemed to be tremendous ignorance. He met a lot of power-company engineers, for whom he was always sorry, because he thought there were only two possibilities about them: one was that they might be able to generate at a farthing, and the other was that they might be able to sell at a half-penny. Obviously this left no margin for distribution. On the other hand, when he had received bills for electricity which seemed extravagant, and had gone to the town hall and asked for an explanation, he was told that distribution costs were a very serious matter indeed. Coming to gas engines, he said that many iron and steel works were sticking to steam absolutely, as there was in some cases a fear that gas engines might create an element of uncertainty in carrying out orders promptly to time. He agreed with Mr. Pearce when he stated that with the Parsons type of turbine 150° of superheat was amply sufficient. He had worked at higher degrees of superheat, and had very good reason to regret it. It was difficult to get proper control over the superheat, and he had had a particular case where he was guaranteed a total temperature of 550°, and the actual temperature varied from 400° to 700°. The consumption of coal per kilowatt-hour had been put at 1·75 lb. for gas engines, and at 2·75 lb. for the steam turbine. He would like to emphasise that this possible one pound of coal per kilowatt-hour saving was all that they could possibly say in favour of the gas engine, although he had known men who had tried to say a good deal less. He knew of cases where the oil bill was largely wiping out the coal saving.

Mr. C. TURNBULL (Chief Electrical Engineer, Tynemouth) spoke of a small producer gas installation in which the effect of the gas on the copper was such that the commutators were all black, and the 'bus-bars had the appearance of being lamp-blacked. The insulation broke down continuously, and the result was that everything was in an exceedingly bad state. He had heard that at Johannesburg they had had some trouble with the insulation, and if anybody present was going in for gas engines he would very strongly recommend them to get guarantees that the gas would not effect the insulation, because in several of these cases it had been a very serious matter. He also asked Mr. Richardson whether he himself would put in a reinforced concrete chimney. The question of upkeep was important with regard to reinforced concrete for bunkers, and he did not think ferro-concrete bunkers would do.

Mr. A. C. CRAMB (Chief Electrical Engineer, Croydon) remarked that a great deal had been said in favour of gas by one or two speakers, and it would almost appear that there was something behind it when a man like Mr. Pearce went whole-heartedly for gas engines. But would Mr. Pearce go in for a 4,000-kilowatt gas engine plant? Reference had been made to the gas engine scheme mentioned before the Parliamentary Committee by the London Electric Supply Companies, but neither Mr. Parshall nor Mr. Hammond nor any of those present attached very much importance to it, and everybody had a very poor opinion of the proposed station being satisfactory.

Mr. H. R. BURNETT (Chief Electrical Engineer, Barrow-in-Furness) said he had had a great deal of trouble in maintaining

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fire-brick arches and the walls of water-tube boilers with chain grates. His experience had been that frequently the arches did not last more than a couple of months. He also confirmed the author's remarks on the trouble due to the breakage of dumping-bars.

Mr. C. O. MILTON (Chief Electrical Engineer, Maidenhead), referring to gas engines, said that most of the remarks had been directed to forms of very large gas engines, but he would be glad to have some information with regard to the working of smaller gas engines, say of 150 or 200 horse-power. In many small stations there existed a day load which was of sufficient dimensions to make it economical to run a gas engine rather than to put in a battery, but not sufficiently large for steam-engine plant. He had been thinking of going into the matter himself, but had had a good many hints at this Convention that the producer end was practically hopeless.

Mr. C. C. ATCHISON (Chief Electrical Engineer, Rochdale), speaking on the question of extracting soot from the economiser, said that he had spent six months trying to get out some satisfactory means of doing this, but found that it would take too long to clean out the economiser pit in the manner suggested by Mr. Shawfield. He started off with about a six-inch pipe, and found he wanted a 14-inch pipe to get any suction on at all, and it took about four hours to get an ordinary cartload of soot out. At the same time, when they were dealing with a cheaper class of coal they also had to deal with a large amount of dust, and it was an important point to make the flues easily accessible, not only for men to crawl about and scrape the sides, but also to bring a barrow in and out easily. In putting down some economisers recently he had put in a good-sized door so that the men could wheel the barrow in and out again easily, instead of having to scrape the economiser out in the usual way at the sides. By having a large pit at the entrance of the economiser a very large proportion of the economiser dust settled in the earlier portion of the flue, and it was possible to get it away easily. He wondered if anybody had tried this with Lancashire boilers. In some cases the flues were rather narrow, and it took some time to get inside at one end, and if it could be done by a scraping arrangement so that the dust could be drawn out at the front instead of having to be shifted forward, it would save time. Some few years ago he had had an experience of firing-back in connection with forced draught, and two or three men had been burnt within the period of two or three weeks, but they were able to get over some of their trouble by erecting a locking gear between the fire-doors and the damper arrangements. Mr. Richardson had spoken of corrugated ends to engine-houses, but he had had trouble with the Local Government Board inspector on this point, and had had to put in brick, although he had told the inspector that it would be wiser to have galvanised iron, as the end would have to come down again. He was informed that a loan could not be granted for this, however. On the other hand, in the case of a tramway sub-station, in which borrowing powers had been obtained under a Tramway Act, he had used galvanised iron, and the Board of Trade had granted the loan. He also called attention to the air leakage which took place from the chain holes at the top of the economiser, and he had adopted a method of plugging these up when the scrapers were not in use, which was only for half an hour or an hour at night.

Mr. J. K. BRYDGES (Chief Electrical Engineer, Eastbourne), on the question of air-leakage, said he would like to mention what he believed had been mentioned at previous Conventions, namely, that air-leakage occurred between the sliding dampers and the frames. He had two sliding dampers fitted to Stirling boilers, and when he came to measure up the space he found it was equivalent to the area of a 4-in. pipe leading straight into the flue. This was a serious matter, so he built it up with brickwork above the height of the damper, when it was drawn out, leaving only a small hole for the wire-rope to go through, and in consequence the air-leakage was reduced to a minimum. He asked Mr. Richardson why he lined a cast-iron tank which he had sunk. Was it to weigh it down, or to make it extra water-tight?

Mr. RICHARDSON said it was an outside lining of concrete to keep the cast-iron tank from corrosion.

Mr. BRYDGES, continuing, said Mr. Richardson had also mentioned the superior efficiency of steam turbines over reciprocating engines, but this did not apply so much to smaller units. His reason for running steam turbines was not so much from their superior efficiency as from the fact that in the case of breakdowns he could get a steam turbine at work quicker than a reciprocating engine if he carried out the maker's instructions as to length of time for warming up. He also referred to the underfeed stoker, which he considered had the great advantage over the chain grate that it would burn practically any sized coal; it would burn what was called smudge and duff, and he did not think there was any other chain grate or automatic stoker that would burn this coal satisfactorily. He had also found that the repairs were not as large as they were with other types.

Mr. E. B. VIGNOLES (Chief Electrical Engineer, Grimsby), on the question of foundations, said that Mr. Richardson had mentioned the building of the station on a raft. Although this was successful in some cases, it had very often led to more or less disaster. In one case that he knew of, the raft was built for a building which was not a central station—and when the walls were put up a certain height one corner of the ground under the raft began to give way, as it was softer at that spot, and the whole building tipped over to an angle and had to be entirely pulled down and piles driven in. He thought the question of concrete and ferro concrete piles was one that required careful consideration, and he noticed the other day in going round a large dock site that, although they were using a very large amount of concrete, there were no ferro concrete piles to be seen. They were using timber in all cases and were driving with a small monkey and a long drop. The difficulty with ferro concrete appeared to be the fact that in certain circumstances the concrete opened up, and then there was the liability of wet getting into the concrete and the iron corroding away. He thought that this had been the cause of the failure of several chimneys, viz., that the concrete had been left too long before getting into position, and the iron corroded through wet getting in. They had heard a good deal about gas engines, and wh they had heard absolutely justified Mr. Richardson's conclusion that the gas engine was not a practical thing for generating stations. The author mentioned in one part of the Paper the question of measuring coal in the boiler-house. It seemed to him rather curious to weigh all the coal coming into the station and then measure it volumetrically in the boiler-house. What was the objection to an automatic weigher. He had one in his own station over which the coal was tipped and was automatically weighed, and it worked very satisfactorily. Mr. Richardson gave a very long list of diseases to which the chain-grate stoker appeared to be heir. The whole difficulty was that there were moving parts in the fire, and for this reason he had adopted the underfeed stoker. Repairs on the driving gear were expensive, but he thought he could get over that by driving with a motor. The repairs on the actual portion of the grate in the fire were very small indeed, and he believed that with this type of stoker they could get their repairs down to a minimum and burn practically any kind of coal and get very satisfactory results. When he advertised for tenders for the stoker some of the chain-grate people who were anxious to tender, when they heard of the coal that he was burning at Grimsby, said it was too small and would go through the grate. With regard to Mr. Atchison's remarks on the Local Government Board sanction for galvanised iron buildings, he mentioned the fact that the Local Government Board had sanctioned a loan for a galvanised iron end to the engine-room at Grimsby; the inspector thought it was the most sensible thing to do.

Mr. H. RICHARDSON, who reserved his full reply for the Proceedings, said he would like to make one or two explanatory remarks. Several speakers had mentioned forced draught and pressure draught. His interpretation of the latter was entirely different from that of forced draught. Replying to Mr. Turnbull, he said he was putting in a brick chimney. He was glad that the Paper had elicited an interesting discussion on ferro concrete for piles. He had no doubt, after going very carefully into the matter, as to the infinite superiority of ferro-concrete for the superstructure. He was surprised to hear of any large firm putting in wood piles at all. Although in many cases where the ground was suitable they might have extremely long life, in made up ground the life was not likely to be long.

THE RECONSTRUCTION OF AN ELECTRIC LIGHTING SCHEME WITH OBSERVATIONS ON THE WORKING OF A COMBINED STEAM AND WATER POWER PLANT.

BY C. M. SHAW.
(Chief Electrical Engineer, Worcester.)

Almost every engineer of a supply undertaking has at one time or another had to consider the very important question of the reconstruction or rearrangement of generating plant and mains system connected thereto, especially where such undertakings were laid down in the early nineties. The Worcester electricity supply proves no exception to this rule, and the systems in that city embody features of a highly interesting, engineering, and commercial nature which do not obtain in any other undertakings in this country. There are two sources of prime movers, viz., steam and water power. Two systems of distribution irrespective of traction supply. Two methods of supply, alternating and direct, each having two standard pressures, and finally, two tariff systems with nineteen separate prices for current. The capital expenditure on December 31st, 1905, amounted to £127,385, being £73 per kw. when all water plant was available, or £78 when such plant was useless through flood or drought. The deficit in 1904 and 1905 working after payment of all charges amounted to £1,290 and £298 respectively.

The following plant was in use in 1905:—

POWICK STATION (WATER AND STEAM).

420 kw. capacity driven by steam engines.
120 kw. capacity driven by water turbines.

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240 kw. capacity driven by water or steam power by means of clutches.
Six water-tube boilers: 10,460 sq. ft. heating surface.

HYLTON ROAD STATION (STEAM).

250 kw. capacity for D.C. supply.
500 kw. capacity for D.C. supply or traction.
70 kw. motor generator coupled to engine by a clutch used for A.C. or D.C. supply.
Three water-tube boilers: 9,420 sq. ft. heating surface.

The author devoted a full year to the close study of the conditions of working the two stations. As the systems at each works are different it was not possible to interwork the supplies, beyond the capacity of the small motor generator at the new works. During the time this data was also being obtained examination was made of practically every power plant in the district, with the result that several antiquated beam engines over sixty years old were found to be still in use. Unfortunately, not one of these users of old age plants could be obtained as consumers for a long period, even though the scale of charges was favourable, which prejudice was traceable to the faulty working of one single A.C. motor many years previously, and to the opposition of a flourishing gas company. The Department had, therefore, to take the initiative. Motors were borrowed from makers and fixed temporarily free of charge, in several works, with the result that a natural demand was eventually fostered.

In due course, the author arrived at a decided opinion that no great improvements could be effected in the cost of generation with the old conditions of working the two stations, though the acquisition of a limited day load was having its effect on the costs. The 1904 works costs, 1·56. per unit sold, on the combined output of the two works was unduly high, having regard to the fact that there was a water-driven plant by which current was generated cheaply, and, further, that the traction output should have assisted in lowering the costs. This high cost was, in a great measure, brought about owing to the heavy expenditure entailed in maintaining a steam plant and staff at Powick, when such plant was, during a great portion of the year, inoperative.

In 1905 the Powick output was 721,000 units, of which 380,000 were generated by water-driven plant. The salaries and wages item for current generated by water turbines should be very low, as few attendants are required. Sufficient men had, however, to be always in attendance to work the whole of the output by steam, owing to the uncertainty of the water supply. Although a full complement of men sufficient to work the steam plant were in attendance daily, it was found to be more economical to shut down the Powick plant entirely during daytime for 1,181 hours, over a period of 180 days during 1905, and 1,332 hours on 150 days during 1906, owing to floods or lack of water, during which time the whole of the A.C. output was dealt with by a small motor-generator at the Hylton Road works.

From the foregoing remarks it will be apparent that the steam plant was worked under very disadvantageous conditions, especially when consideration be given to the fact that no economiser was in use, that the lay-out of works necessitated very long double-steam ranges, also that the extra cost of carting coal 1½ miles beyond the new station was expensive, and, finally, the original steam plant was of old design, and very unsuitable for modern requirements. The author had, therefore, little hesitation in recommending the scrapping of four small boilers, and all the engines, &c., at the old works, and it was decided to dismantle the steam plant at Powick, and concentrate all steam generation at the Hylton Road works.

Previous to the change, two to four boilers had to be worked or kept under banked fires at Powick in case the water power, &c., failed. At Hylton Road one boiler was steamed, and one kept under banked fires, making five to six boilers in commission, whereas under the new conditions of working only three boilers are in use, viz., two steaming, and a third under banked fires.

The rearrangement of staff and workmen for working water plant at Powick and steam plant at Hylton Road has effected economies. The uncertainty of the water supply in times of flood or drought often releases the attendants at the water-power station. During winter, if floods occur, the staff are transferred to the steam station to assist in meeting the heavier call on steam plant. Should a shortage of water occur during summer, these men are particularly useful for assisting with the necessary overhauling of plant.

In preparing the scheme for rearrangement of works, due regard had to be given to the following conditions which obtained at Worcester: (*a*) The heavy capital expenditure already incurred. (*b*) The area of supply, being very large, necessitates a H.T. system. (*c*) The complete system of alternating mains and transformers already supplying outskirts and a portion of the centre of the city. (*d*) The high periodicity of supply (100 periods single-phase) is unsuitable for power purposes. (*e*) The system of D.C. feeders and distributors in the centre of the city and power area.

With the knowledge that most of the local industries were in a settled state with little prospect of any abnormal growth, it was not advisable to carry out any complete change of periodicity, as such was only necessary for a power load. A very extensive single-phase A.C. 100-periods network had already been laid down at heavy cost in residential districts for lighting demand. The area of supply was very extended, and the demand for power negligible, consequently a change over to D.C. with the sacrifice of capital expended on H.T. mains, &c., would not have been justified. It was, however, imperative that the old 100-periods supply be not extended more than possible, as such system might ultimately have to be changed.

New generators, switchboard, mains, &c., of a design easily convertible to 50 periods two-phase were accordingly installed. Fifty-period transformers of standardised capacity are also gradually displacing the original small 100-periods types. A slight percentage in efficiency is so sacrificed by using these transformers, which loss, however, is neutralised by the reduction of open-circuit losses.

In view of the fact that all present demands for power could be dealt with from the existing D.C. station, the following limited scheme was eventually decided upon:—

	£
Extension of engine-room for three generators ...	1,150
Two A.C. steam generators, 350-400 kw.	4,550
Switchgear	200
Mains	260
Contingencies	340
	6,500
Less receipts from sale of old plant	1,650
Net cost	4,850

Much consideration was given to this scheme, and it was eventually adopted. Then the question as to how the cost of the change should be met arose. As it was not possible to meet such a heavy charge out of revenue in one year, steps were taken to obtain sanction to spread the cost over three years. The Local Government Board were communicated with, and they held an unofficial inquiry. The inspector informed us that the Board would probably grant a loan for the full amount of £6,500 if the Council guaranteed the repayment of the outstanding debt of £4,072 on old plant within three years. An official inquiry was held at a later date, and sanction given to borrow £4,072 and £2,428 for three and eighteen years respectively. This procedure is not quite consistent with the usual practice of the Local Government Board, in that the Department have still to meet interest and loan charges on outstanding debt on discarded plant, for a further term of twelve years, even though same be non-existent.

The past year's results for the fifteen months ending March 25th, 1908, have clearly demonstrated the benefits resulting from the concentration of working and scrapping of out-of-date plant.

The 1905 works costs item of 1·193d. per unit sold has been reduced to 0·818d. This reduction, however, is not altogether attributable to the more economical working of rearranged plant, which has only been in operation six months, but to a combination of the economies effected by the new scheme: an increased power output, the increase of water output, and to the improved conditions of working the water plant resulting from our having full control of the whole water supply. [This was the result of successful negotiations for the surrender of two water-wheels used by the Worcester Royal Porcelain Co.]

It is also necessary to state that the estimated fuel costs were based upon coal at 9s. per ton, which price was increased to 11s. 10d. per ton on October 1st last.

A brief description of the turbine plant was next given in the Paper:—

The water turbine room is of very ample dimensions, having been designed to contain four vertical "Victor" turbines of 54, 54, 48, and 36 in. respectively, and considerable duplicate steam plant. In constructing this building it was necessary to excavate to a depth of 38 to 45 ft. below the floor level. The floor level was fixed some 3 in. above the highest flood, which occurred in 1886.

Little or no repairs have as yet been necessary to the turbine motion work after thirteen years' working. Belt-driven centrifugal governors were originally used for raising or lowering the cylinder gates, but this apparatus has been discarded as unsuitable for our conditions of working. As the available head very seldom exceeds 10 ft., it follows that large volumes of water

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have to be controlled quickly, otherwise the pressure of the supply quickly attains a dangerous limit if the load suddenly alters. Hand regulation of gates has proved to be the most satisfactory method of control, though the question of motor control is under consideration.

The following general points were also mentioned :—In erecting turbine plant it is essential that ample space be provided for the wheel to discharge into, for if there is not ample space

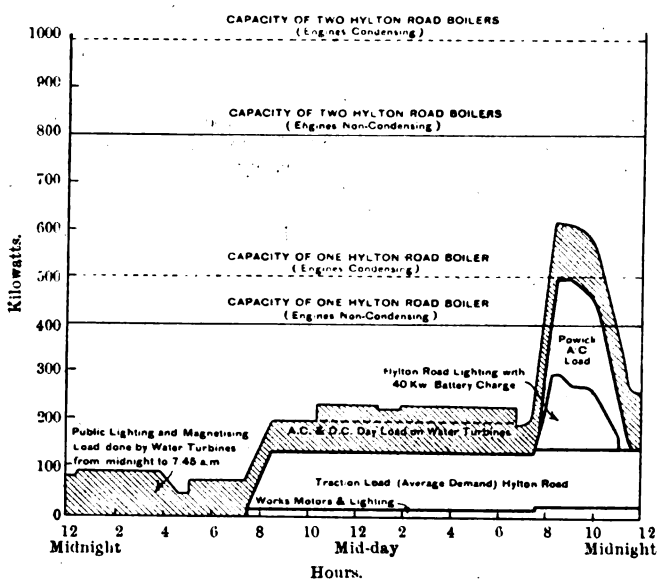

FIG. 1. (SATURDAY, MAY 6TH, 1905).—CHART SHOWING ADDITION OF STEAM-GENERATED OUTPUT FROM POWICK DURING EVENING WHEN WATER SUPPLY IS GOOD, NIGHT AND DAY LOAD TAKEN UP BY WATER TURBINES.

under the wheel for the water to pass away easily and quietly, it will react upon the wheel, and reduce its output to a serious degree. Another important point is the provision of a rack across the head flume to stop foreign matter entering the wheel, which might soon cause an extensive breakage. The area of the head race should be of ample width and depth and free from obstructions, to allow the water to flow quickly and easily to the wheels, and it is most essential that the discharge should pass away in a similar manner, otherwise the efficiency of the plant is sacrificed, and the working head considerably reduced. Unfortunately, the growth of timber along the course of the

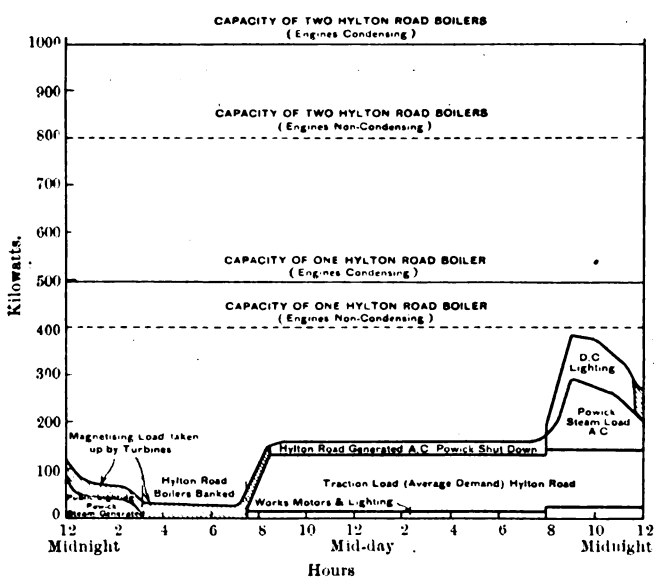

FIG. 2 (WEDNESDAY, JULY 26TH, 1905).—CHART SHOWING TOTAL STEAM LOAD DURING TIME WHEN WATER SUPPLY IS ONLY SUFFICIENT FOR SUPPLYING A PORTION OF NIGHT LOAD AT POWICK.

Teme, and the rapid flow of that river causes many old roots and silt to come down during times of flood. Obstructions are thereby formed which greatly hamper the flow of water. This applies more particularly to the tail race and the 1½ mile stretch of water from the works to the River Severn. This length has become very foul with stranded trees and the silt collecting, so causing shallow fords, with the result that the summer level of the tail water has risen over 2 ft. since the works commenced.

As has already been stated, the conditions of working at Powick were extremely variable from day to day, owing to the varied output of water plant. When the water supply is satisfactory, the running load factor of the water plant is ideal. The night and public lighting loads, together with a 30 h.p. motor at the water works is dealt with by water power from midnight on such occasions as these. After the extinction of public lighting in the morning, a second 30 h.p. motor is taken on, both being run continuously up to dusk. From the time when the public lighting is switched off, water begins to store up, and in the middle of the morning it is possible to start the motor generator for battery charging, so further increasing the value of the water. If these conditions of working could be continued, the works costs would come out at 0·10d. to 0·083d. per unit generated. The good effect of the water in such a case is neutralised to a certain degree, however, by the poor load factor on the steam plant on such a day.

Fig. 1 has been plotted showing the output of the water-power station on such a day, superimposed on to the output at the D.C. station. It demonstrates clearly the more economical condition of working, when the water is good, and the benefits that would have been derived had all steam plant been concentrated at one station.

A similar curve, Fig. 2, is obtained by superimposing the curve representing the conditions at the water-power station on Wednesday, July 26th, on the D.C. load at the new station for that day, and it affords an example of the worst conditions experienced with the turbines, when it is better to store up

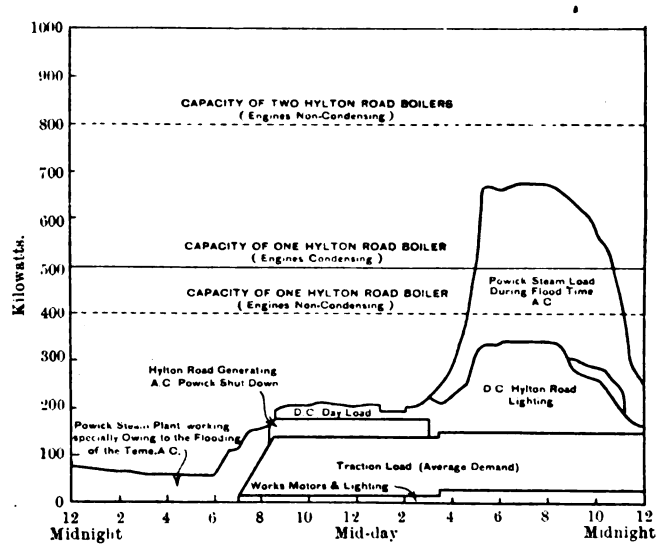

FIG. 3 (SATURDAY, JANUARY 20TH, 1906).—CHART SHOWING IMPROVED WORKING OF BOILERS AT HYLTON ROAD.

water for use on peak and deal with all output from the steam plant.

On January 20th, 1906, all A.C. load had to be dealt with by steam plant at the old station, through the turbines being drowned out by flood, the motor generator at the new works taking up the day load.

Fig. 3 shows the advantage that would have been obtained by amalgamation of the two plants at one station on that day.

The yearly outputs of current generated by steam and water power at the two stations have been plotted out in Fig. 4. From this the fluctuations to which the water-generated output is liable are clearly seen. During the early years of the undertaking, full use could not be made of the water supply, as the demand during certain hours was limited. The water output in 1901 only totalled 337,000 units, prolonged droughts being the cause of the small output. In 1902, the increase was exceptional, there being a steady flow of water throughout the year, after which a period of erratic flow was experienced which greatly affected the returns. The units reached the low-water mark in 1904, when only 293,000 units were generated. The two following years, 1905 and 1906, were also poor, though the output rose slightly, which was not due to an improvement of water flow, but to an increased power output.

The greatly increased output for power and the altered conditions of working since the steam plant has been concentrated at one works, together with a good supply of water during 1907, enabled good use to be made of the water power during the last year, with the result that 500,771 units were generated, which figure, it is hoped, will be exceeded in the future now that there is control of the full flow of water.

With one or two exceptions, the rise and fall of works costs from year to year inversely follows that of the water output. This effect is more clearly shown on the weekly cost and output

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curve for 1906 (Fig. 5). Fig. 6 gives a comparison between the poorest and best annual water outputs.

A series of floods were experienced during January and February, 1904, which greatly reduced the utility of the water by flooding out the turbines. From April to October, a decline took place, through a continued drought, and it was not until

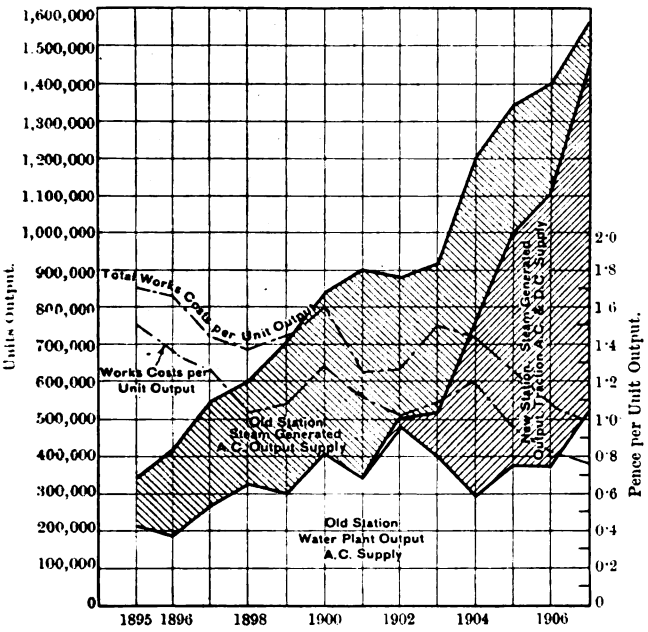


FIG. 4.—CURVES SHOWING RELATION BETWEEN TOTAL WORKS COSTS. WORKS COSTS AND OUTPUTS BY WATER AND STEAM PLANTS.

December of that year that the effect of the autumn rain was felt. The 1907 unit curve shows fluctuations of output through the effect of small floods during the early part of the year. The usual decline commenced during April; the effect of this loss of power was, however, prevented by full control of the water being obtained, as previously explained, so causing the hump, and avoiding the usual fall during the summer. The small

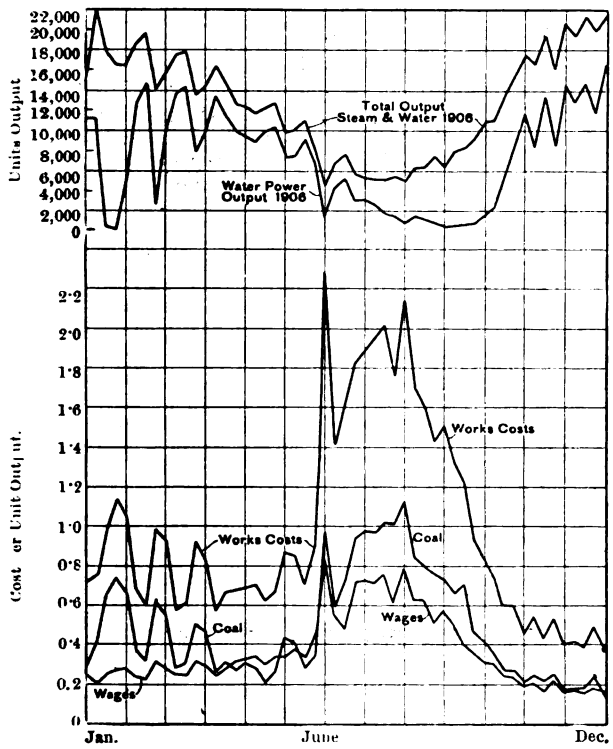
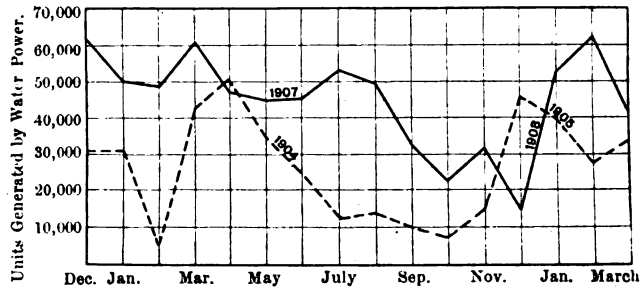


FIG. 5.—CURVES SHOWING RELATION BETWEEN WATER OUTPUT AND WORKS COSTS, &c., IN 1906.

output of October, November, and December was brought about by continued floods, which reduced the annual output by at least 100,000 units.

Due consideration must be given when comparing these curves to the fact that full use has been made of the water power during 1907, through having a sufficient outlet for same, whereas during 1904 only a small amount of power was connected. Undoubtedly, it is necessary to have a market for all current generated by water plant, otherwise full advantage cannot be taken of such power.



Years Output.

1907	... ...	500,771 Units.
1904	... ...	293,320 ,,

Monthly Average.

1907	January to December	41,731 Units.
1904	,, ,,	24,443 ,,

FIG. 6.—CURVES SHOWING RELATION BETWEEN THE HIGHEST AND LOWEST ANNUAL WATER OUTPUT.

In conclusion, the author has no hesitation in saying that a water-power plant similar to that at Worcester is of great value, if there be a direct market for such power, without the intervention of wasteful storage entailing heavy capital expenditure. He does not consider any system of storage entailing accumulators of sufficient capacity to take the maximum output is justifiable, as the maximum only endures for short periods. The proper combination is to build up a sufficient mean load throughout the day that such mean shall be greater than the maximum of the water output, surplus demands being taken up by steam sets of suitable size.

DISCUSSION.

Mr. E. E. HOADLEY (Chief Electrical Engineer, Maidstone) said that the Worcester station was one of the very best examples where an undertaking could be turned from, he might say, a bad failure to a very great success. Mr. Shaw had had a very high and, to a large extent, useless capital expenditure, as a very large proportion of it was in bricks and mortar. He had also an old-fashioned system and a very high periodicity, and its being a single-phase high-periodicity alternating-current system had practically debarred him from getting the power load, which was the only hope of salvation. Worcester, with its water power, was a place in which a big power load would be perhaps of more £ s. d. advantage than in any other place in the country. As they all knew, the original station, some two or three miles out of the town, had been intended for and designed as a water-power station, but it had really become a steam-driven station, with a lot of capital expenditure on the water plant which was to a large extent useless with the system which they had in use then. He felt certain that they could now build up a very profitable undertaking by means of the continuous-current plant, and by gradually changing over the single-phase 100-period system to a two-phase 50-period system, as Mr. Shaw was doing. Mr. Shaw had been able to make a very much larger use of the water power, which cost him practically nothing, and, by doing away with steam generation at Powick, he had saved a very great deal of money by the improvement in his boiler load-factor, and by turning out his steam units on economical plant instead of by turning them out with old-fashioned plant. The people responsible for the original design of the station thought the necessity of using the steam plant might occur on two or three occasions during the year when the water-power plant should be shut down either from drought or flood, but from his experience during the time he was at Worcester, these periods were sometimes of longer duration than the actual days when they made profitable use of the water power.

Mr. J. K. BRYDGES (Chief Electrical Engineer, Eastbourne) said that from his experience at Eastbourne there was no question whatever that it was best, when they were getting into difficulties with old plant, to take very severe measures, and go on for something new. When the Eastbourne Corporation acquired its undertaking from a company in January, 1900, they took over the old plant housed in the bottom floor of a building which was originally a brewery, and the upper floors of it consisted of stores, which contained a large quantity of inflammable matter such as hay and straw. The switchboard was very dangerous, and there was no doubt whatever that if there had been a fire the whole place would have been burnt down. The generating plant included belt- and rope-driven sets and two modern direct-coupled engines. There were two Hornsby boilers of the water-tube type, which were not now made, and these were all they had in the way of modern boiler plant; the remainder consisted of semi-portables and a loco boiler. It was decided that it was impossible to extend on that site,

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and as they had to do something, it was finally decided to go about one and a half miles out of the town and build an entirely new works. They moved the two direct-coupled sets and the two boilers referred to, and at the same time they changed their periodicity from 83 to 50, and did away with as many of the old-fashioned house transformers as possible. When they were changing over, they had to run both stations at the same time. The works costs had also been reduced by about 1½d., and although they were still running for the greater part non-condensing, and suffered from the disadvantage that south coast towns were not very favourably placed with regard to coal supplies, they were doing very well, and he put it down to the fact that they scrapped most of the plant and put in new and modern machinery at very considerable cost. Of course, they were struggling under the very big capital expenditure which they had had to pay to buy up the late electric light company. Mr. Shaw was suffering in exactly the same way, viz., from a very big capital expenditure on old plant which he had had to scrap.

Mr. E. B. VIGNOLES (Chief Electrical Engineer, Grimsby) thought that the author had not quite made out a case for water power in England, and that if he were to start again he would consider very carefully whether he would not dispense with the water turbine station altogether, and concentrate the whole output in one station, generating with larger steam units. The works costs could then be brought down considerably below what they were at present for the two stations; the capital costs would also be lower, and in that way the final result would be more satisfactory. He thought that governing of the turbines by hand, as the author did, would not afford good pressure regulation if there was a variable power load.

The PRESIDENT (Mr. H. Talbot) said that Worcester seemed to be one of those places where there was a river, and people thought that thousands of horse-power were running to waste. People in Nottingham had thought the same, and that thousands of horse-power were running to waste at the Weir, and that he was a fool not to make use of it. He remembered some years ago, when the British Association met in Nottingham, the late Sir Frederick Bramwell opened a discussion on water power at the University College, when he warned the members about water power, and said that he had been caught himself, and gave an instance. He said that some years previously he had been at Bristol, and had casually mentioned the enormous horse-power in the rise and fall of the tide. Some two or three years afterwards the Bristol Corporation wrote to him and asked for his advice for utilising that power. Sir Frederick went into the question very closely, and replied that he had been a fool. Mr. Talbot suggested that Worcester had probably been in a similar position.

Mr. SHAW, in a brief reply, said that although he had had to make the best of what he found, from the knowledge which he had acquired he felt that the water-power station ought to be worked, but he would not have put in so much brickwork and foundations as had been put in. The foundations for the boiler-house were run down to the same level as in the engine-room. The undertaking had been hampered immensely by the large capital expenditure, but as soon as the capital charges were paid off in eleven or twelve years, the water power would be particularly useful.

Friday, July 3rd.

Two Papers were discussed, the first dealing with a suggestion for employing accumulators in a generating station upon a much larger scale than hitherto, and the second on the testing department of an electricity works.

THE USE OF ACCUMULATORS FOR PEAK LOADS.

BY A. M. TAYLOR.

(*Assistant Electrical Engineer, Birmingham.*)

Many causes have conspired to delay the introduction of accumulators into central stations in this country for the purpose of supplying energy for light and power during the time of peak load. The non-fulfilment of the great expectations raised some twenty years ago has had its effect, and numerous failures in actual practice have caused central station engineers to lose confidence in all cells of every make for light and power supply as a substitute for generating plant. With a view to establishing confidence in cells of large capacity for this purpose, the author included in his Paper lists of the large batteries installed at several Continental and American stations.

On the question of efficiency, the author said that, if cells are installed exclusively to take the peak of the load, and are not discharged unnecessarily, the value of the energy wasted in the cells and accessories is only of the order of 1 to 2 per cent. of the value of the revenue introduced by them. He referred to the curves in Fig. 1, the lower one of which he took to represent a typical load curve for a station having a present maximum demand of 5,000 kilowatts. All further extensions are assumed to be carried out with batteries till, in 1913, the maximum demand reaches 10,000 kilowatts. Neglecting changes in the load factor, he assumed that, say 5,000,000 units are sent out in 1908, and 10,000,000 units in 1913. The battery would thus have introduced a revenue of, say, £31,200 per annum (if 1½d. be taken as an all-round price for light and power and losses in transmission are neglected in each case).

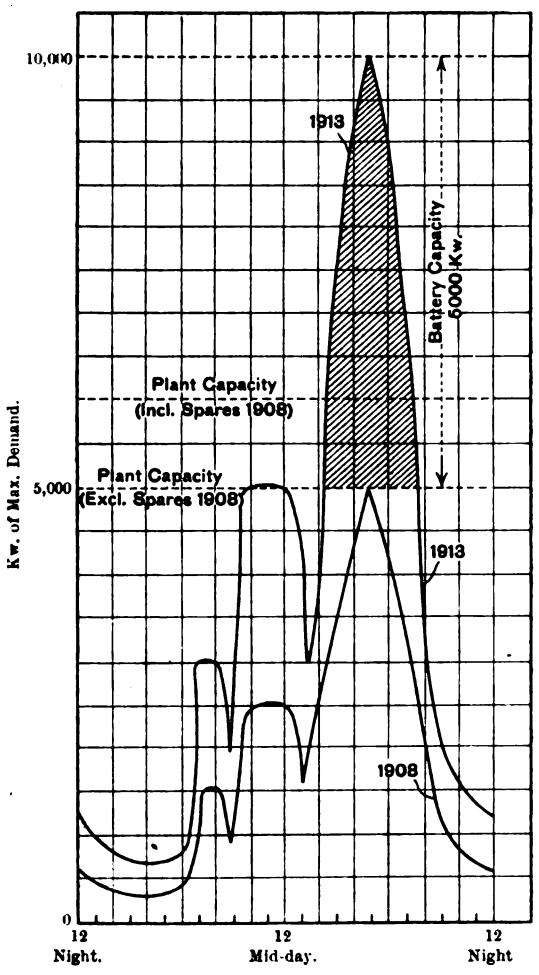

FIG. 1.

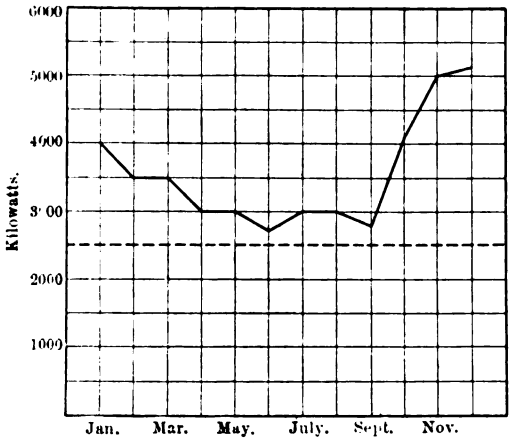

FIG. 2.—MAXIMUM DEMAND AT NEPTUNE BANK FOR EACH MONTH OF 1903. (EIGHTY PER CENT. OF THE UNITS WERE SUPPLIED FROM STATION, WHILE THE MAXIMUM DEMAND WAS UNDER 2,500 KILOWATTS, AS SHOWN BY THE DOTTED LINE.)

Fig. 2 shows the figures published for the maximum demands at Neptune Bank by Messrs. Merz & McLellan in April, 1904; from this the author has compiled the lower curve in Fig. 3 as a rough approximation to the relative periods of time which the station was working during the year on different loads.

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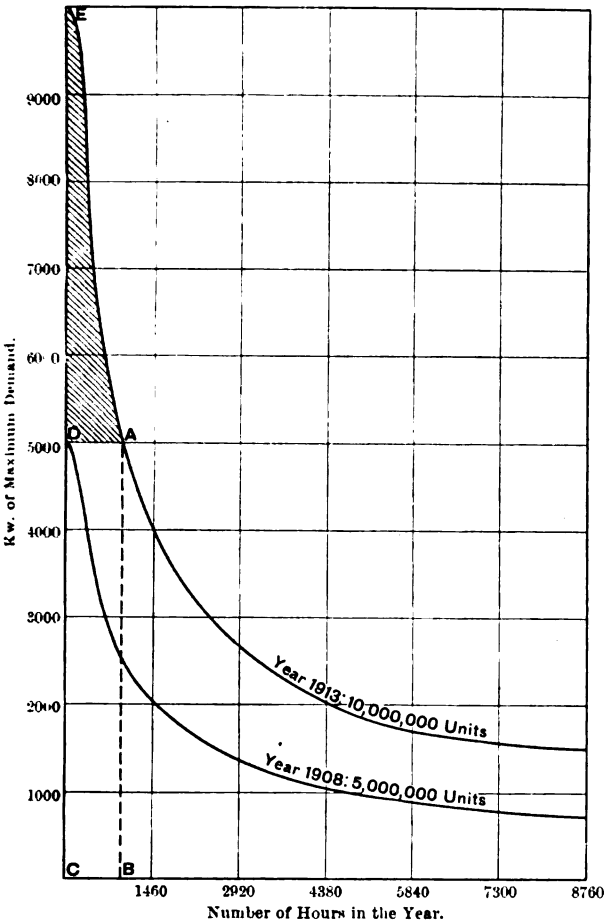
The upper curve of Fig. 3 assumes that a battery has been added, and that the output is increased from 5,000,000 to 10,000,000 units per annum, and that the batteries are only called upon to deliver energy when the peak exceeds 5,000 kilowatts. They are, of course, to be charged when the load is small, and the engines and boilers inefficiently loaded. The area *ADE* is to be supplied by the batteries only. To simplify the question, the author has only considered the employment of the battery in the winter, and for discharging at the heaviest peaks.

Some 1,100,000 units are put into the battery; of which some 700,000 are reclaimed as "useful" work; an overall efficiency of 68 per cent. is assumed. The cost of the coal, water, and petty stores consumed to produce these 400,000 units is assumed to be one-fifth penny per unit, or £334, which is slightly over 1 per cent. of the £31,200 mentioned above.

In the comparison next made it was assumed that there is no provision for dealing with fog loads, and that only sufficient



Area (*ADE*) + Area (*ABCD*) = 2,000,000 units : 80 per cent. of the units supplied are to the right of dotted line *AB*.

FIG. 3.—DIAGRAM SHOWING THE USE OF BATTERIES.

spare plant has been allowed to cover the chance of a breakdown of one of the generating units. A series of curves and tables were worked out on this basis, for a typical station for a series of six years, during which the output increased from 20 million to 54 million units per annum, the maximum demand from 12,000 to 29,400 kw., and the load factor from 19 to 21 per cent. In these, the costs of capital charges were calculated in detail, first on the assumption that the original plant capacity of 16,000 kw. of steam plant was gradually increased year by year to 32,000 kw. by adding new steam sets, and then on the assumption that the steam plant was not added to, but that batteries were put in as required to meet the increasing load. The capital cost of the cells and their accessories inclusive of building was put at £15 per kilowatt. Interest charges on the cells were taken at 3 per cent., and depreciation and maintenance charges at 9 per cent.

The author estimated that the savings introduced by the cells, as against steam plant, were £12,000, £24,000, £37,000, £46,000, and £64,000 respectively, in the first five years, these figures representing saving in total costs, including allowance for interest and sinking fund.

Incidentally, the author suggested the employment of accumulator sub-stations on alternating current systems. From inquiries made of accumulator companies, he has found that, where cells of very large individual capacity can be installed, it is possible to obtain a discharge representing 6 kilowatts (on a three-hour basis), for every square yard of floor space, for a single tier of batteries; and where there are two tiers this would be raised to 12 kilowatts, or if three tiers, 18 kilowatts per square yard of ground space. These figures do not include any space for the rotary converters, or the boosters or auxiliary apparatus. He thinks that a separate single-floor building of cheap construction could be erected for the cells for something under 7s. 6d. per kilowatt; or where the cells were arranged on two floors, or even three floors, that the cost of such a building need not exceed say 15s. to £1 per kilowatt. He proposes to use the batteries to deliver alternating current of high pressure into the line at times of peak load, while at the same time delivering direct current of suitable pressure to the 'bus-bars of the sub-station, and believes that this and other combinations would be valuable as a means of relieving the main generating station and feeders at the time of peak load. The efficiency to be obtained on discharge, as between battery terminals and E.H.T. A.C. 'bus-bars, will, in a large sub-station, he maintains, be found to be of the order of 93 per cent., and that between the battery and the sub-station D.C. 'bus-bars of the order of 87 per cent., and even in a small sub-station he is of opinion that these figures would not be materially less than 90 per cent. and 82 per cent. respectively.

We have endeavoured in the above abstract to indicate the author's general conclusions, and his main line of argument, and have also quoted some of his figures. Owing to the peculiarly diffuse method which Mr. Taylor follows in setting forth his assumptions and working out his deductions, and the necessity that he has found of making a large number of alterations in his figures, tables, and curves, since the Paper was first circulated, it has been impossible to do more than this. The same reason accounts for the fact that the speakers in the discussion were only able to deal with the general aspect of the question, as it is practically impossible to follow the author through the entire argument in his Paper.

DISCUSSION.

Mr. T. P. WILMSHURST (Chief Electrical Engineer, Derby) said he proposed only to deal with one or two general considerations. He would first like to draw attention to the title of the Paper. It was rather curious that whilst it was headed "Alternating-Current Sub-stations," A.C. sub-stations only took up something like two pages out of fifty of the whole Paper. The principal portion of the Paper was devoted to a consideration of taking the whole load of the peak for the next five years with batteries—rather a bold proposal, and one which he had no doubt would meet with much criticism. He presumed the author only advocated this system with direct-current distribution; he was not quite clear whether that was so. At any rate, if applied to alternating-current stations such as Leeds and Sheffield, the cost of the rotary converters and motor generators would make the scheme unworkable.

Mr. TAYLOR said the scheme would be applicable to any system, whether alternating or direct current.

Mr. WILMSHURST said, therefore, he must contend that its application to Sheffield or Leeds would not be practicable, because the additional cost, both capital cost and working expenses on motor generators, &c., would minimise or wipe out any savings which might accrue from the use of batteries. They must, therefore, fairly confine their attention to systems with direct current. A fundamental difference at once occurred between the conditions of supply, as between a steam plant and a battery plant. In the case of steam plant, the machinery was capable of working at its maximum output continuously for an almost indefinite period. With a battery designed to discharge on, say, the one- or two-hour rate, as soon as that discharge had taken place, the battery was of no further use for several hours, until it was charged up again, and that, to his mind, was one of the most serious defects of the system. With regard to fogs, these did occur, and his experience was that, the larger the town, the more it was liable to fogs, and although Mr. Taylor did give a larger battery for a foggy town, yet it seemed to him that he had rather glossed over this question too airily. Mr. Taylor was obviously dealing with the large towns in his typical case, for the maximum load was 5,000 kw. and the prospective maximum load in five years was 10,000 kw. The author had taken a typical load curve (Fig. 1), and had based his arguments on it, adding in the same diagram a curve for five years hence, which was practically the original curve twice the height, with exactly the same thickness or load factor. But he could not admit that this was a typical load curve. It might be a typical load curve for a purely lighting station, but for a large industrial town he did not think that the peak of the curve was nearly broad enough. He had taken his own case of Derby, which was an industrial town of 130,000 inhabitants, with traction, power, and lighting load, and had superimposed his own load curve on

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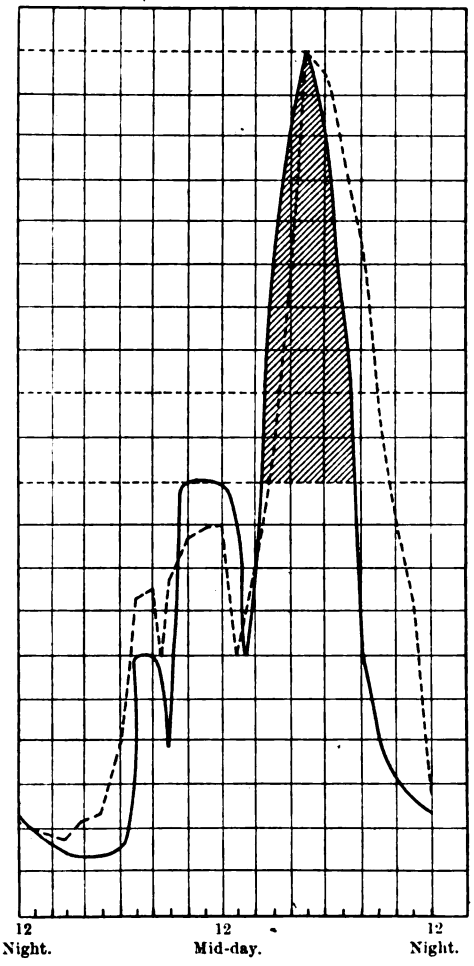
Mr. Taylor's (see diagram below), and his (Mr. Wilmshurst's) load curve was some 50 per cent. fatter at the point at which Mr. Taylor based his arguments. Mr. Taylor would want a 50 per cent larger battery, and a great deal of his saving would disappear. The author also neglected changes in the load factor, but it was not correct to assume that in five years' time their load factors would be no better than they were to-day. Then came the question of ampere-hour efficiency. He believed there were several battery-makers present, and he hoped they would have something to say about it. His impression was that with these heavy discharges of one or two hours, the ampere-hour efficiency of the battery was considerably lower than if the battery were worked in the ordinary way with a discharge of, say, six to nine hours. He would like to hear whether battery-makers would have any objection to constantly discharging the battery at the higher rate. The author had shown in the Paper the enormous batteries at Chicago, but did not say whether they were used regularly for one- or two-hour discharges, or whether they were used, as most of them used batteries, at a slow discharge, the enormous size of the battery being accounted for by the enormous size of the Chicago station. If the batteries were



used for this rapid discharge, he hoped Mr. Taylor would give some figures of working costs at Chicago, and also at some of the German stations, because his impression was that a modern British power station had nothing to learn as to efficiency and economical working from America or Germany. Whilst he could not go as far as Mr. Taylor in his advocacy of using a battery as a substitute, he thought they would all agree that a battery had an enormous use, they had all found it useful as an auxiliary for taking their light loads. In his own case he ran early workmen's cars up to breakfast time entirely from a battery, as well as a good deal of street lighting during the night.

Mr. L. BROEKMAN (Chloride Electrical Storage Co.) said that he was fully aware that prejudice against batteries was still to be found, the reason being mainly that there had been more than one instance in the past in which batteries had enjoyed bad health. But the extreme lassitude in manipulation of the batteries and the use of unsuitable water had a great deal to answer for. In connection with this point, he would like to say that automatic stills adapted for use with either steam or internal combustion engines were a most desirable adjunct in power stations. Frequent inspections were also necessary. He contended that batteries would stand overloads far better than any other class of machinery. Although important improvements in the manufacture of storage batteries had taken place in recent years, there was no striking departures from orthodox practice, and therefore the combination of storage batteries as proposed by the author afforded greater guarantee against antiquation than they had with steam or gas generating plant. That reliable batteries could be made was evident from a case which he knew, in which 3,000 consecutive discharges at the one-hour rate had taken place without the batteries showing any appreciable diminution in capacity. Abundant allowance of lead per cell had been more beneficial, and the practice of some prominent engineers who were in the habit of buying batteries more or less by weight had much to recommend it. The lead weight alone per cell in pounds should be not less than 30 per cent. of the ampere-hour capacity on a slow discharge. [The speaker was next referring generally to some well-known details in battery construction when he was called to order by the President, who pointed out that he was hardly discussing the subject of the Paper, and asked him if he had any information as to whether the use of batteries was increasing in the United States, and whether he could tell the meeting anything about the batteries in Chicago. Mr. Broekman said he had no knowledge of the Chicago batteries.]

Mr. H. RICHARDSON (Chief Electrical Engineer, Dundee) said he yielded to nobody in his admiration of the great amount of work which Mr. Taylor had spent on his Paper, but, he said it with all respect, it was an academic paper. The proposed system would never work out to be a commercial success. All over the country they were just turning the corner; stations were no longer museums; uniformity of plant, and several other valuable policies in the management of stations, and the generation and sale of current, had been initiated, and valuable results were just beginning to appear. And now it was proposed that they should go in for the same old thing that had been the trouble in the past: experiment, experiment, experiment! With regard to load factor, he agreed entirely with Mr. Wilmshurst, and would go even further. He was quite certain that, before this arrangement of Mr. Taylor's was working in a practical way, the conditions would be one of large power stations doing a little lighting, and not lighting stations doing a little power supply. Again, metal filament lamps were in his own town, and others also, already reducing the maximum demand proportionately to the number of consumers they were dealing with, and bringing it down to meet the rise in the power load maximum. Then Mr. Taylor had mentioned in his opening remarks the overloading of a battery for 100 per cent. for a short while, but this was just where the trouble began, and it was where the battery, instead of having a life of five years, would begin to look very "rocky" in the usual time that batteries did begin to look rocky. He had lately been to Germany, where consumers were paying at rates which indicated no particular economy by using the batteries of which Mr. Taylor had given a list.

Mr. J. E. EDGCOME (Chief Electrical Engineer, Kingston-on-Thames) asked how the author proposed to give a supply upon his system, in, say, the City of London. This was a very big supply, mostly lighting, with a comparatively small amount of power at the present time; in fact, the peak load in the winter was from dusk to 5.30. But they had fogs which involved darkness from first thing in the morning until the load came off in the ordinary way at 6.30 or 7. Though that was a load which most station engineers would like to have, what would be the feelings of the engineer who had half his plant in batteries, and had to charge them in order that they might be on full load from 8.30 in the morning until 6.30 at night?

Mr. E. S. NEW (D.P. Battery Co.) said that as makers, his firm would very much like to get 9 per cent. for maintenance, but the utmost they could extort out of the station engineer was 6 per cent., up to the present, so that Mr. Taylor's figure was rather too high. Another point was the question of efficiency which Mr. Wilmshurst had raised. There was no material difference in the efficiency of a batery, either at the one-hour rate or the ten-hour rate; in this he thought other battery makers would bear him out. There might be a slight difference in the watt-hour efficiency, but Mr. Wilmshurst had referred to the ampere-hour efficiency.

Mr. E. S. JACOB (Tudor Accumulator Co.) said that one point in the discussion had been very striking, namely, the tremendous prejudice against accumulators. In the early part of the 'nineties batteries were not what they were to-day, and they proved failures. In the later 'nineties people began to put them in regularly with direct-current supply; they put in a small battery that was useful for the day and night load during the first year, for the day load during the second year, and for nothing at all during the third year. Then they were burdened with the sinking fund on the capital outlay, and said that it was all the fault of the battery. In one of the other discussions it had been urged that when small units had been put down in the past for generating plant, they should be scrapped, but nobody appeared to do this with batteries. Now, however, accumulators had not only been improved, but their cost had gone down tremendously, and what was in those days not commercially possible was now quite feasible. On the question of taking a very high rate of discharge, largely for taking the peak load, he mentioned that this was already done regularly in a tremendous number of stations in Germany, and also in this country. As a matter of fact, the largest battery

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had been put in a London station, giving an output of from 6,000 to 7,000 kw., and these batteries were useful in time of fog, and offered additional security for taking the peak load under normal conditions.

Mr. J. E. EDGCOME asked Mr. Jacob if he knew what proportion this big battery bore to the entire plant; not 50 per cent., he took it.

Mr. JACOB said it was about 25 per cent.

Mr. H. M. TAYLOR (Chief Electrical Engineer, Middlesbrough) said that the conditions in Middlesbrough had necessitated the Corporation taking a supply from the local power company. The terms of purchase would depend upon the sub-station load factor, and it opened up a very big question indeed in connection with a load consisting of about 2,000,000 units annually, half of which was power load. Throughout the night the sub-station would be absolutely idle, and to get the current from the power company at a reasonable price would depend upon the load factor there.

Mr. F. CHARLES RAPHAEL wished to know to what extent the battery makers who were present backed up the Paper. He would like to know whether perhaps the battery makers had not been treated rather unfairly in being invited to come to the discussion, and whether it was not really a case of "battery makers, battery makers, come and be killed." The Paper said the only salvation with regard to capital expenditure in the future was batteries. The battery makers were asked to come and support this, and then possibly they would be blamed if the arguments were proved to be fallacious. Therefore, if they did not want to answer the questions he was going to ask them, they need not. A statement had been made in the discussion that the ampere-hour efficiency was just as good at the one-hour discharge rate as it was at the ordinary six-hour discharge rate, but from the station engineer's point of view the question of efficiency was simply one of kilowatt-hour input and kilowatt-hour output, and they did not want to go into the academical point of the ampere-hour efficiency and make allowance for the loss owing to the drop in pressure through discharging the battery at a higher rate. If any more battery makers were going to speak, would they say what the watt-hour efficiency at the one-hour discharge rate would be? He would also like to ask a question with regard to the maintenance. A 9 per cent. maintenance contract was assumed in the paper, but they had just heard that some makers would even accept 6 per cent. Would they accept this if the battery was used as Mr. Taylor suggested it should be used? The whole Paper depended on that and practically on nothing else; if the battery was discharged daily at the one-hour rate, and if there was a risk that when a fog came on, it might have to be discharged at a ten-minutes or a quarter-hour rate, would the battery makers be prepared to give the 9 per cent. maintenance? He did not think they would, and he did not see how they possibly could. The one-hour rate of discharge was usually considered as the emergency rate, and he did not think any battery-maker would guarantee this as the regular rate, and four times the discharge rate on emergency.

Mr. S. J. WATSON (Chief Electrical Engineer, Bury) said that one or two points had been mentioned during the discussion which he thought hardly dealt with the subject as put forward by Mr. Taylor. For instance, it had been argued that in foggy districts the battery would probably be totally discharged and meet with entire destruction. He did not see why much should be made of that point. If they considered the case of gasworks, they had exactly the same question to tackle, and there should be no difficulty whatever in proportioning the units so that the battery would be capable of handling the load in conjunction with the steam plant in an equally satisfactory manner. Another point had been raised by Mr. Wilmshurst, and it was one always raised when the question of steam plant *versus* batteries was considered, viz., that they took the capacity of the generating plant and said it was capable of giving its output 24 hours a day, whilst a battery would only give its output for from one to three hours, according to the rating. He did not think that point should be emphasised in this way, because the peak never exceeded one, two, or three hours, and the extra length of time that they could use a generating set was of no use to them. The whole thing, however, really came down to the question of load factor. If they were going eventually to obtain load factors from 25 per cent. to 35 per cent., he did not think the handling of the bulk of the output by means of a battery was likely to be of any use, but he did conceive that in cases of purely lighting districts where the load factor was only from 10 per cent. to 15 per cent., a battery might be exceedingly useful. With regard to the question raised by Mr. Taylor, of Middlesbrough, respecting bulk supply from a power company: as the prices charged for bulk supply were so much per kilowatt, and say about a farthing per unit, where the load factor of the district to be supplied was comparatively small, there was not the slightest doubt that excellent use could be made of the battery. He had been looking into the costs in connection with the few batteries with which he was connected, and found that taking the one-hour rate, the capital cost of the battery, with buildings, worked out at approximately £8 per kilowatt, and came up to £19 or £20 on the seven-hour rate. He quite agreed with the last speaker that the question to be considered was watt-hour efficiency, and not ampere-hour efficiency; but if the battery dealt with the peak only—say 10 or 20 per cent. of the total output—the actual efficiency of it was not a very great consideration.

Mr. P. J. TIDDEMAN (Chief Electrical Engineer, Stoke-on-Trent), on the question of cost, pointed out that although the depreciation of the battery was paid out of revenue, there was also the sinking fund to take into account, and as they could not borrow capital for more than ten years for batteries, there was something like 10 per cent. to go on to that. With regard to fogs, these were so indefinite that they ought not to count on more than 50 per cent. of the discharge capacity for regular use, and they would have to put in a very much larger battery. There was one very good use to which a battery could be put, and that was, it was very useful indeed for burning out faults.

Councillor J. H. MCGAUL (Birkenhead), speaking from the chairman's point of view, said he had looked over the Paper, and really expected very great things from it, but from the discussion and from the criticism that had been heaped upon the Paper, his hopes had been dashed to the ground. At the Birkenhead station they were now full up with steam plant, and had no more room, and his object in coming there that day was that he thought they might be able to put in a sub-station of accumulators that would be a great profit to them.

Mr. C. TURNBULL (Chief Electrical Engineer, Tynemouth) said he was in Italy a little time ago, and had seen some very enormous batteries there, and this, in conjunction with the fact that they were used to an enormous extent in America and also on the Continent, showed that there must be more in them than many supposed. One of the reasons that batteries in the past had given bad results had undoubtedly been the instructions of the accumulator-makers. Battery-makers said they must only have pure water, but it was frequently found that there was no pure water to put into them. He had sent to one of the best-known battery-makers in the kingdom, and asked them to advise him as to a means of getting pure water. After about a month or so, they sent him on a drawing of a most elaborate condensing plant to cost £500. This proved that they had never really gone into the matter at all. He had been told by some battery-makers that he must not use lead stills and must not take steam out of the boilers. If accumulator-makers would go into the matter properly, and get up a pamphlet telling people what to do, it would greatly help them and greatly help others. When electric cabs first came up, he asked a battery-maker how he got on with his battery guarantees, and the reply was that something generally happened which exceeded the guarantee, and then the maintenance was "off." Battery-makers in the past had done this in central stations. In conclusion, Mr. Taylor suggested the use of batteries to level the load in the case of electrified main railways.

Mr. F. A. NEWINGTON (Chief Electrical Engineer, Edinburgh) asked the author in his reply to give the works costs of the stations in America, where these very large batteries were installed; it seemed strange that the really useful figures on which the whole scheme would depend had not been given. Our American friends, as a rule, were not diffident in publishing any records they made, and he hoped that Mr. Taylor would be able to add these figures in his published reply.

Mr. TAYLOR will give his full reply in the Proceedings.

THE TESTING AND STANDARDISING DEPARTMENT.

BY H. A. RATCLIFF

(Testing and Standardising Department, Manchester Corporation Electricity Works).

THE Paper is not intended to constitute a treatise on the arrangement of a testing department, but rather a collection of notes on various features of practical interest with which the author has been brought into contact during the period he has been in charge of the Testing Department of the Manchester Corporation Electricity Works.

The necessity for, and value of, a well-equipped testing department is beginning to be realised, and there is no doubt that the time is not far distant when such a department will be regarded more as a valuable financial asset than as a scientific luxury. Although at present the latter point of view prevails to a great extent, it is a fact that by judicious testing of mains, meters, and distributing apparatus generally, the proportion of units sold to units generated may be considerably increased.

It is probable that there will always be a few small stations where it would not pay to sink the necessary capital in a sufficiently extensive testing equipment, and it should therefore become possible for the necessary work to be undertaken by a larger neighbouring authority possessing the requisite equipment. The author considers this point worthy of consideration by municipal authorities, particularly in such neighbourhoods as Lancashire, Yorkshire, and the Midlands, where the smaller towns practically join on to each other. Another advantage of such a co-operative scheme is that, owing to the extensive and

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commercial scale on which the work would be executed, the cost would certainly be much below any figure at which it could possibly be undertaken by any college or private laboratory. That the scheme is practicable is shown by the fact that the Manchester Corporation undertake the testing and calibrating of a considerable number of meters for other authorities and companies, &c., and the prices charged are far less than would be the case elsewhere, although leaving a fair margin of profit

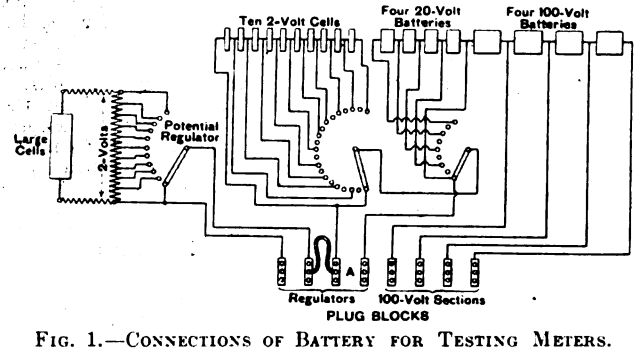

FIG. 1.—CONNECTIONS OF BATTERY FOR TESTING METERS.

on the work. Such a department should also be able to test the candle-power of lamps, &c., and check and calibrate ammeters, voltmeters, and other instruments for consumers and contractors.

Scope of a Testing Department.—Speaking generally, it would appear to be advisable for the testing department to be responsible for, and to carry out, the whole of the electrical and chemical testing that the requirements of the particular station have shown to be necessary. Mechanical and steam tests, &c., would usually be undertaken by the station staff, but even for this work the co-operation of the testing department is desirable for the checking and certifying of any electrical data involved in the calculations. The following list of work undertaken by the department with which the author is connected will, perhaps, serve to indicate more clearly the extent of the duties which may with advantage be allocated to such a department.

For convenience of control, and in order to obtain the maximum degree of efficiency out of the men, the work is divided into two sections:—

Meter and General Testing Section.

Testing, calibrating, and repair of all house service, generating station, and sub-station watt-hour meters.

Testing, calibrating, and repairing of instruments, recorders, and clocks, &c., of every description, from the various generating and sub-stations.

Re-winding and calibration of H. T. instrument transformers.

Conversion of instruments of all descriptions, and the construction of any special instrument or apparatus that may be required.

Photometric tests on various types of electric and gas lamps in the photometer room, and also in the street with portable photometer.

Mains tests of every description, including H. T. tests with portable 30,000-volt set.

Insulation, conductivity, and fault localising tests, &c. Tests at cable-makers' works.

Testing of switches and fuses.

Miscellaneous tests for Tramways Department.

Generally any work of a technical or scientific nature that may rise from time to time.

Motor Section.

Testing of all new and repaired motors, motor starters, and armatures, &c., used in connection with motor-hiring scheme.

Fixing of motors, &c., on consumer's premises and the execution of any repairs which may be necessary whilst on consumer's premises.

Repairs of every description to motors, starters, and accesseries, including the re-winding of armatures, &c.

Construction and repair of resistance frames, circuit breakers, and switches, &c., both for the testing and other departments, and generally the execution of all mechanical work required in connection with the various duties of the Testing Department.

A fairly extensive staff is naturally required to cope with such a large amount of work.

EQUIPMENT.

Supply of Current for Testing.—If the testing and calibrating work is to be conducted with any reasonable degree of accuracy, it is absolutely essential that a steady source of current should be available, quite distinct from any of the public supply circuits. (This, of course, does not apply to motor testing.) For D.C. work, secondary cells fulfil all requirements. A very usual arrangement in test rooms is to have a small number of very large cells, and generally some arrangement of links or plugs for putting them in series or parallel, for obtaining different output currents, &c. The disadvantages of this method are that, owing to the low voltage available, it is difficult to maintain the discharge current constant, unless all the joints and contacts, &c., in the circuit are exceptionally good; very little spare E.M.F. is available for regulating resistances, and it is impossible to test a long row of meters owing to the comparatively large voltage drop. There is also considerable difficulty in measuring the output of the various cells, with the consequent probability of their not all receiving their proper charge, and, moreover, unless a heavy current is used for the purpose, the cells will never be charged at the normal charging rate, and frequently for that reason will not receive the necessary full charge, owing to the increased time required at the lower rate.

These difficulties have to a great extent been overcome by the arrangements adopted at Manchester, and which are as follows:—

The batteries are arranged for two separate classes of work, one consisting of tests which require a small current at voltages up to 500, such as voltmeter calibrations, incandescent lamp tests, and for exciting the shunt circuits of watt-hour meters. The cells used for this work have a maximum discharge rate of about 6 amperes; they are, however, so well constructed that no damage has been done to them by occasional short circuits, &c., involving very much larger outputs. This battery is divided into five sections of 100 volts each, all the sections being joined in series. The first, or "A," section, is further sub-divided as shown in Fig. 1. This arrangement enables the voltage to be raised by one-cell steps from 2 volts to the full 500. By the additional connections to a battery of larger auxiliary cells and a potential regulating resistance, any voltage from 0·2 to 500 volts may be obtained, rising by 0·2-volt steps—*i.e.*, 2,500 different voltages.

For the heavy or main current work, large cells are used; they are connected in groups of ten, each group constituting a unit, and feeding a separate panel on the testing circuits switchboard. Ten-cell units were chosen because experience showed that 20 volts was the lowest E.M.F. that could conveniently be used, when taking into consideration the necessity for absolutely steady currents, adequate regulation, and the possibility of testing a reasonably large number of meters at one time. For larger current than the above, the units are put into parallel at the switchboard. Under no conditions does any unit ever feed more than one circuit at the same time. By the existing arrangements, when once the current taken from the battery has been set to any particular value, it will remain at that value for a sufficient length of time to enable a row of 20 meters to be tested without any readjustment of the current, except in the case of heavy discharges.

The small pressure cells are charged in 100-volt sections off the 200-volt mains, through lamp resistances, about 145 volts being required. The large batteries are charged from a special motor-driven low-voltage generator.

Alternating-Current Supply.—The supply of the necessary alternating current is not quite such a simple matter, as it must of necessity be derived in the first place from rotating machinery. The best source of alternating-current supply is undoubtedly a small motor three-phase generator combination, preferably with a rather slack belt-drive, and the addition of a flywheel on the alternator shaft, should the motor only be comparatively light. If the alternator is large in proportion to the actual output required of it, so much the better, since it can then be used with equally good results for either single-phase or three-phase supply.

Tables and Stands.—The author does not favour the use of elaborately constructed stands and racks in a test room; such stands are never, as a rule, so convenient or accommodating as they are supposed to be, and are more often a nuisance than otherwise. For testing ampere-hour meters of the mercury motor type, and generally all those which are made to stand on brackets, the most simple and convenient arrangement is to have long narrow tables on which two rows of meters can be placed back to back with reasonable clearance between. The tables should be long enough to accommodate about 20 meters in a row. A deep groove or channel should be cut all round the edge of these tables in order to collect spilled mercury, the grooves communicating with small collecting vessels fixed in cupboards or boxes at the end of the tables. Meters of the watt-hour type are generally constructed for fixing on a vertical board, and for testing purposes the most simple and convenient arrangement is to have long wooden partitions, or deal boards, fixed to the wall.

Watt-hour meters when on test require to have all the shunt coils excited from a circuit independent from the one feeding the main coils: otherwise meters at the commencement of a row would have passing through their main coils the shunt currents of the meters beyond them.

(*Continued on p.* 81.)

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LONDON ELECTRIC POWER BILLS

THE FINAL AMENDMENTS IN COMMITTEE.

LONDON AND DISTRICT ELECTRICITY POWER BILL.

THE feature of the final proceedings in connection with the clauses of this Bill was the prompt manner in which the Chairman refused to hear any amendments which were at all irrelevant consequent upon the Committee's decision on the preamble, and the large number of proposed amendments and new clauses which were rejected.

In the first place the London companies intimated their intention of not discussing the clauses on this Bill, and although several attempts were made by various opponents to bring up clauses having the effect of excluding their areas from the operation of the Bill, the Chairman in all cases firmly refused to allow them even to be discussed. Similarly, several amendments were proposed, having the effect of altering the position of municipalities from what it now is under the common law with regard to such matters as breaking up of streets, laying of mains, &c., but they were rejected one after the other.

The first important matter discussed was with regard to Clause 52, "Conditions affecting Supply," which, as we have already announced, the promoters have changed over to practically the ordinary Kitson clause. The only point in dispute was with regard to the 20 per cent. limit for lighting. It had previously been argued before the Committee that in view of the higher efficiency of metal filament lamps, 20 per cent. for lighting on the part of the power-user was too high, and in giving their decision on the preamble, it was clear that the Committee had been influenced by these arguments. The promoters, however, felt themselves unable to offer any suggestions on the matter, but after some discussion the Committee reduced the amount to 15 per cent.

In their decision upon the preamble, the Committee also criticised the proposed sliding-scale clause in the Bill, and the promoters now submitted the following, which the Committee accepted :—"If in any year the revenue obtained by the company from the supply of electrical energy is less by 1 per centum or more than the revenue which the company would have obtained if they had charged for such energy the respective maximum prices set out in the second schedule to this Act, the dividend which the company may pay in respect of that year may be increased above the standard rate to the extent of one-quarter per centum upon the paid-up capital of the company in respect of every one per centum by which the revenue so obtained by the company has been less than the revenue which the company would have obtained by charging such maximum charges for such supply."

On the question of the renewals fund, the promoters accepted a direction by the Committee that this should be obligatory after a 5 per cent. dividend has been paid; the said renewals fund to be at the rate of ½ per cent. of the capital expenditure.

The only outstanding point between the London County Council and the promoters was that the County Council should be specifically mentioned as the purchasing authority pending the creation of some other body by Parliament, but the Committee rejected the proposition, for the reason that they thought they ought not to decide so long beforehand, but should leave it to the decision of Parliament for the time being.

The new cesser of powers clause reads as follows :—

"Unless the company shall within twelve months of the passing of this Act obtain a certificate from the Board of Trade that not less than £600,000 of the share capital of the company by this Act authorised has been subscribed, and unless within two years from the passing of the Act the company shall have substantially commenced their works for the purpose of carrying out their powers under this Act, the Board of Trade, after considering any representations which the London County Council may desire (and are hereby authorised), may order that the powers of the company under this Act shall cease as to the whole or any part of the area of supply, and on any such order being made such power shall cease accordingly."

An attempt was made on behalf of the Brentford Gas Co. to secure special protection in the matter of electrolysis, and to put upon the power company provisions with the object of minimising the possibilities of explosions taking place in street-boxes as the result of leakage into them from gas-pipes, but both were rejected.

For the Westminster City Council, amendments were brought up having the object of safeguarding the rights of purchase which the Council now possesses, and with one or two alterations these were accepted.

With regard to the suggestion put before the Committee by the Coal Smoke Abatement Society that some provision should be made for the prevention of the emission of smoke, the promoters submitted the following, which the Committee accepted :—"Provided nevertheless that nothing in this Act shall exonerate the company from any indictment action or other proceedings for nuisance caused or permitted by the company on any lands used by them for generating electrical energy where such nuisance is caused—(*a*) by non-consumption of smoke; (*b*) by the reasonably preventable evolution of oxides of sulphur; (*c*) by the use of any refuse destructor; or (*d*) by the emission of oil or other matter in conjunction with steam."

LONDON ELECTRIC SUPPLY BILL.

The promoters brought up this Bill redrafted to bring it into conformity with the Committee's decision on the preamble which eliminated all reference to a Joint Committee, &c., leaving it practically a "linking-up" scheme with the additional powers of supply to railways, tramways, docks, canals, &c.

A clause was approved preventing the companies from supplying to any dock undertaking in the Borough of Stepney, or to the Victoria Dock in West Ham, without the consent of the local authority in each case.

The Metropolitan Water Board sought protection with regard to the laying of electric mains near water mains, and asked that when these were within 6 ft. of each other seven days' notice should be given to the Water Board, and that a plan should be submitted, but the Committee rejected the proposition.

On the application of Mr. Seymour Bushe, for the five companies promoting the other Power Bill, the names of these companies were struck out of the schedule of the present Bill, although the promoters strenuously opposed this.

The Committee did not insist upon some clauses proposed by the Commissioners of Works for the protection of Royal palaces and parks, but suggested that the promoters should consult with the Lord Chairman of the Committee in order to arrive at some satisfactory arrangements. The main reason for the Committee's attitude was that the clause in question was retrospective.

LONDON, WESTMINSTER, AND KENSINGTON ELECTRIC SUPPLY COMPANY'S BILL.

There were no contentious clauses upon this Bill; the vital clauses have been brought into line with those of the previous Bill.

The three Bills were then ordered to be reported to the House of Lords for third reading.

The Helion Lamp.—Some further particulars of the Helion incandescent lamp, which is now described as being about ready for commercial use, are given in the *Electrical World* (New York). The inventors, Prof. H. C. Parker and W. C. Clark, have developed a filament which they say is in its final form, and that only mechanical details have now to be completed before the lamp is ready for the market. The filament, as completed, possesses certain very interesting features. It looks like a section of Russia iron, and can be handled almost as carelessly as a piece of wire, although it is somewhat more brittle. The filament is short, coarse, and strong, and is made by flashing a carbon core and producing a deposit of Helion composition on it. The finished filament has from three to five times the diameter of the carbon core, and possesses a very high resistance. Helion has a specific resistance 50 times that of carbon. A remarkable feature of the filament is that it can be heated to incandescence in the open air, and resists attack for quite a long period of time. Another quality is that, being short, it is necessarily immune from the detrimental effects of vibration. Work on the filaments has reached such a point that they are standardised for 110- and 220-volt circuits. It is proposed to make the lamps in standard ratings of 20 and 40 c.p., and for regular voltages. The filament for the 220-volt lamp is 3 in. long, and that for the 110-volt lamp of half the candle-power rating is, of course, only half that length. When heated in the open air the filament shows the pure white light which was characteristic of the lamp when first exhibited. The filament when burning in air is, of course, not so efficient as when enclosed in a globe, and especially in a vacuum; but even in air it gives a brilliant white light. A peculiarity of the filament is that as soon as it is heated, the surface oxidises, and a protective skin is said to be formed which guards it from further attack. The life of the filament burning in air has not been determined, since obviously it is not intended to be used in this way, but enclosed in an ordinary incandescent lamp bulb. An interesting point, especially when viewed in connection with the filaments of other recently developed lamps, is that the cost of the Helion lamp is stated to be little more than that of the ordinary carbon lamp. Thus, while the lamp is claimed to have a higher efficiency than that of other lamps recently placed on the market, its cost is very much less. It is also claimed that a high vacuum is not necessary, so that the slight increase in cost due to the filament itself is partially offset by the saving due to a lower vacuum.

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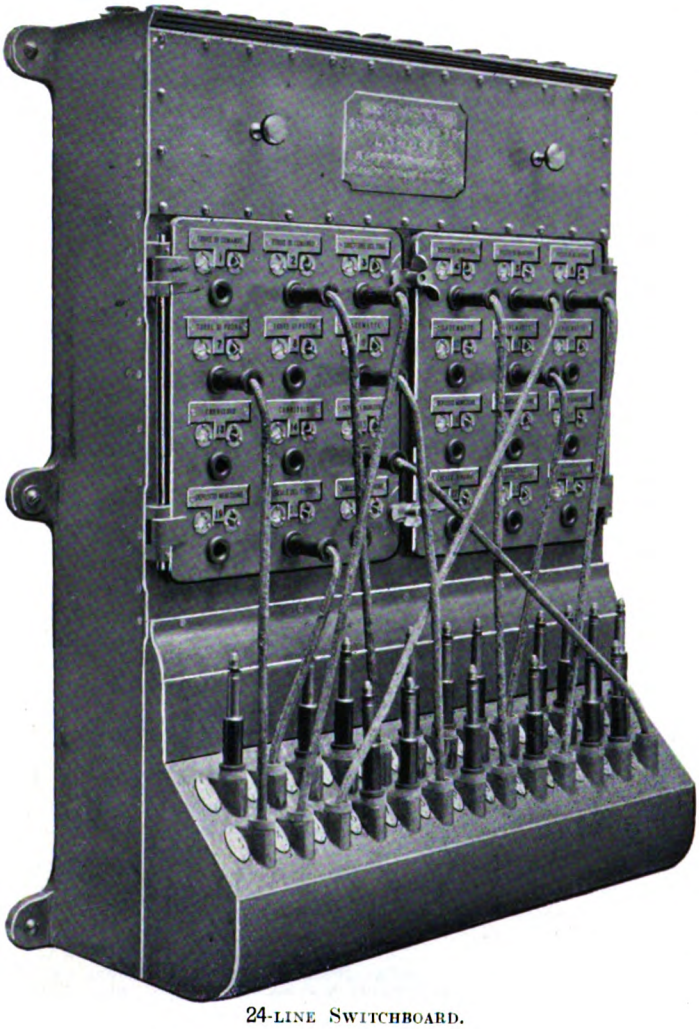
"LOUD-SPEAKING" TELEPHONES

"LOUD-SPEAKING" telephones have become almost as much a necessity in electricity generating stations as on shipboard, especially in engine-rooms in which a certain type of turbo-generator is employed, and they are also now largely used in other works where the ordinary telephone is not suitable. Although in such cases it is rare that a watertight construction is actually necessary, yet the strong mechanical protection of the loud-speaking naval instrument is an advantage, and many people prefer to adopt the standard type that does such good service as a naval telephone. Messrs. Alfred Graham & Co.'s new catalogue, a copy of which has been sent us, contains descriptions and well-executed illustrations of a variety of patterns of this instrument; and it is interesting to note how important details are thought out in the design. Thus in a telephone on a floor pillar, designed primarily for such positions as the navigating bridge of a vessel, but also particularly applicable to the switchboard gallery of an electricity works, the position of the fixed transmitter microphone and arrangement of the rotatable receiver arms is such that the speaker can



24-LINE SWITCHBOARD.

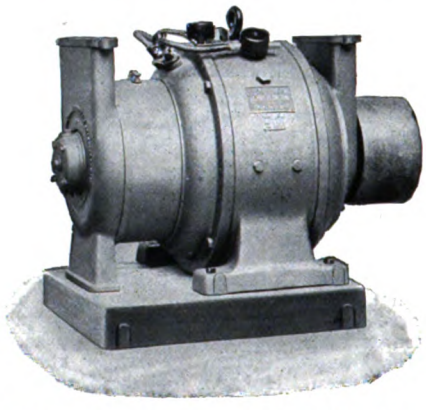
watch any object while he is speaking; and in all the newer instruments a device is fitted by which the carbon granules of the microphone are automatically agitated before the instrument is used. It is stated that speech from these instruments can be heard at a distance of 20 ft. or 30 ft. from the receiver. The catalogue also contains descriptions and illustrations of small exchange switchboards, designed on similar lines to the actual instruments. One of the pictures, which we reproduce, shows a 24-line switchboard, with lamps as calling and clearing signals. The board is a "single-cord" board, so that every telephone can be in use simultaneously, and the number of conversations going on at one time is not limited to the number of pairs of cords as on a double-cord board.

Messrs. Graham & Co. have also recently perfected a system to dispense with primary batteries, and they supply small motor-generator sets, specially enclosed for ship use, which can be employed to take the current from the lighting supply. A power switchboard has been designed for use with one of these sets, and arranged so that the ordinary ship's low-tension supply is used as a stand-by, and comes into use automatically when supply from the motor-generator is not available.

TOTALLY-ENCLOSED MOTORS WITH FORCED VENTILATION

IT frequently happens that electric motors are required to work in dusty or damp places, or in factories where the production of acid-bearing steam or gases is unavoidable. The motors may be rendered fit to operate under these unfavourable conditions by protecting them to a greater or less degree, and they then fall under the heading of partially or totally enclosed machines. As a natural result of this protection a motor for any required output must be considerably larger and correspondingly more costly than an open-type machine. To overcome this objection to the employment of electric motors in places where such conditions prevail, the Felten & Guilleaume-Lahmeyer Company has developed a series of totally-enclosed motors with forced ventilation, which may be rated as equivalent to open-type machines. The motor frame is completely enclosed, with the exception of two openings, one at the pulley end and the other at the commutator or slip-ring end. The former serves for the ingress and the latter for the egress of the air, which is impelled through the machne by a fan mounted on the armature shaft. Each of these openings is in connection with a conduit, in order that the circulating air shall not communicate with the atmosphere of the room in which the motor is at work, but be drawn from a pure source outside the building.

It is, of course, an essential condition for the employment of these motors that a supply of clean and cool air is available without the provision of an excessive length of conduit. The air supply and exhaust connections to the motor may be made either from above or below, the junction pieces cast or screwed to the end brackets being arranged accordingly. In order to give the machines sufficient stability they are mounted on base-plates, in which there are openings connecting the air conduits



ENCLOSED MOTOR WITH FORCED VENTILATION.

with the motor housing, assuming that the air supply is taken from below. When the air supply is derived from above, the bracket at the slip-ring or commutator end of the motor is supported by a foot resting on an extension of the base-plate, as shown in the figure.

Motors with forced ventilation may be employed also without special conduits leading to the open air, in cases where the object of protecting them is to prevent access to their working parts by unauthorised persons, or to render them proof against dripping water in places not otherwise excessively damp. The air openings in the motor housing are then usually directed upwards, and capped by a small hood. Machines built in this way have an advantage over the usual type of ventilated protected or drip-proof motors, inasmuch as their ventilation is considerably superior, and their output for a given size correspondingly higher.

CORRESPONDENCE

ASSISTANT ENGINEERS AND THE I.M.E.A.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I quite agree with the first part of your Editorial Note dealing with the position of the Assistant Electrical Engineer in the Incorporated Municipal Electrical Association. An assistant, if married and without private means, cannot afford, with the average salary paid, to belong to several institutions or associations, especially the one referred to; and I am afraid that the results of the schemes mentioned will be disappointing until the assistants are treated in the same manner as their chiefs, who in the majority of cases have their subscription and out-of-pocket expenses, incurred in attending the Association's meetings, refunded by their Corporations.

Yours faithfully,

July 2nd, 1908. CHIEF ASSISTANT.

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REPORTS ON DEPRECIATION AT COVENTRY

LENGTHY reports with respect to depreciation and obsolescence of plant have been prepared by the Engineer (Mr. J. A. Jeckell) and the city professional auditor (Mr. E. T. Peirson). The conditions under which the loans were obtained, and the sinking fund for their repayment created, are recapitulated, and the purposes for which a reserve fund may be applied are defined. The report continues :—

"Apparently this reserve fund may be used for the following purposes :—(1) To supplement the revenue in a lean year when possibly the revenue did not equal the expenditure. (2) To replace plant which has done its duty and been worn out in the ordinary course at a time prior to the date at which the equated loan, in which it was included, would be extinguished. (3) To replace plant which has proved unsatisfactory and which has had to be dispensed with on that account. (4) To replace plant which has become obsolete or which it is desirable to supersede from any other cause.

"Unfortunately, the Local Government Board have as yet not stated clearly what course they propose to adopt with regard to allowing re-borrowing powers to replace plant which has been worn out in the natural course, the money for which was sanctioned in an equated loan, and therefore it may become necessary to replace a considerable portion of this plant out of revenue before the equated loan has been extinguished. In order, therefore, to meet this contingency, it is extremely desirable that the reserve fund should be built up as rapidly as possible. Many of the loans on this undertaking will be extinguished in twenty years. For the first ten years £1,000 per annum will be required to replace plant which will be worn out in the natural course in that time. During the succeeding ten years £3,000 per annum will be required if the Local Government Board do not grant re-borrowing powers to replace plant worn out in the natural course before the equated loan in which it is included has been extinguished, that is to say, £40,000 in the next twenty years. If this amount is set aside as reserve fund, then the undertaking will be in an absolutely sound financial condition, and I venture to think it will be well if this fact is borne in mind in building up the reserve fund."

Lists of accounts which should be charged to reserve instead of capital have been made, and schedules of all the plant which has been superseded. It is pointed out that many of these items were perhaps rightly charged to the capital account then, though at the present time there is no available asset to represent them; it therefore is desirable that they should be deleted from the capital account of the balance-sheet.

These accounts amount to £10,411, to be transferred from capital to revenue, exclusive of plant superseded. Elaborate schedules accompany the report, showing the totals for each year, the details of the accounts superseded, the details of the plant superseded, the details of the existing plant with the estimated life, the agreement of these amounts with the balance-sheet, the depreciation to date, and depreciation to be found in future years.

The totals of these are as follows :—

	£ s. d.	£ s. d.
Amount of accounts to be transferred from capital to revenue		10,411 0 9
Plant superseded		16,579 17 4
		26.990 18 1
Deduct :—		
Amount at present in sinking fund applicable to these items ...	7,835 0 8	
Estimated present worth of superseded plant	100 0 0	
Sales of plant	1,789 12 11	
Arc lamps already renewed out of revenue	206 0 0	
Amount found for year ending 1906	2,886 9 9	
Amount found for year ending 1907	2,451 13 10	
		15.268 17 2
Leaving to be found for obsolete or superseded plant		11,722 0 11

The lives taken for the plant are based very much on Sir William Preece's figures, which he estimated when he was called in to value the plant for the Bristol Corporation.

The following remarks are made on the subject of obsolescence :—'With regard to obsolescence, as it is called, viz., the plant becoming obsolete because new and better plant is invented, considering the extremely efficient plant we have now here, no account need be taken of this. It is quite true that already some of the plant has become obsolete and has been superseded, but this was because the plant was obsolete at the time it was installed, and there appears to be no likelihood of any vast improvement being made in the generating plant as we now have it, except by some invention which would to a great extent revolutionise the whole of the machinery throughout the world."

The auditor's report agrees generally with Mr. Jeckell's opinions, but he writes as follows upon the question of dealing with assets superseded :—"It was decided by Lord Kyllachy in the Outer House of the Edinburgh Court of Session in 1898, that when a tramway company alters its system from horse traction to cable traction, nothing need be written off capital account before paying dividends out of current profits, as he assumed that the system of conversion would not have been embarked upon were it not honestly considered that the undertaking would, when completed, represent reasonable value for the gross capital expenditure. The same argument might well apply to the alterations effected in your undertaking. In this connection I consider the 'reasonable value' is not actual realisable value, but a capitalised value based upon earning capacity. On the other hand, the Professional Auditors recently appointed by the London County Council to report upon the accounts of their various undertakings issued a report dated March 14th, 1908, upon the tramways undertaking, and therein they stated it as their opinion that the cost of the superseded horse traction must be written off before there can be any profits available for the relief of the rates. I prefer, however, to follow the decision of Lord Kyallchy, and I consider that, seeing the Local Government Board sanctioned a loan for the expenditure in connection with the new plant in connection with the alterations considered necessary, the provision made for writing off the £25,201 5s. 2d. original expenditure for superseded plant, &c., as shown by the Manager's Schedule No. 1, by way of the original sinking fund, is adequate."

Figures are then gone into relating to the amount of the sinking fund, and the conclusion is come to that the sinking fund is adequate to meet requirements in respect of wasting assets.

The report continues :—"The only points, therefore, which remain to be considered are :—(*a*) The provision for renewals required before the expiry of the loan periods. Your Manager, according to his report, estimates that there will be required the sum of £1,000 per annum for the next ten years, and possibly a further sum of £3,000 per annum for the succeeding ten years. (*b*) The risk of obsolescence or serious breakdown. Your Manager states in his report there is little likelihood of this contingency coming to pass, but I consider the Committee would be wise to make moderate provision for the same. I think it would be well to set aside a fixed annual sum to provide for these items, and in all the circumstances I venture to suggest that a fair and reasonable provision would be a sum of £2,500 per annum for the next six years, making £15,000 in all, when the matter could be reconsidered in the light of further experience which will then have been gained."

CATALOGUES AND PAMPHLETS RECEIVED

ACCUMULATORS.—A leaflet from the Chloride Electrical Storage Co., Ltd., of Clifton Junction, Manchester, describes a line of small 14-cell batteries, with capacities ranging from 20 to 160 ampere-hours, for working in small house installations in conjunction with metal filament lamps. The larger sizes are fitted with the latest type of box negative, which is made in two halves, the active material being inserted between.

CONTINUOUS CURRENT MOTORS.—We have received an advance copy of a list of continuous-current motors and starters of the "Fortiter" type, from the Union Electric Co. The list gives for the range and horse-powers that it covers a very large number of alternative speeds for the different horse-powers. Care has been taken in the arrangement of the list, so that all points of technical detail shall be perfectly clear, and dimension drawings are given so that there should not be any delay in the preparation of foundations for the machines which are stocked, completely finished, and tested, in all current sizes. Particulars of air-cooled as well as oil-cooled motor starters with no voltage and overload release devices are also given.

ELECTRIC FANS.—The latest catalogue issued by the Sun Electrical Co. deals with electric fans, and contains particulars of a number of types, including table and desk fans, ventilating ring fans, ceiling fans, and large centrifugal ventilating fans. One of the special types is an electric punkah fan with rocking deflector blades, arranged with the motor completely hidden in an ornamental *repoussé* brass bowl.

IRON AND STEEL TUBES.—A catalogue is to hand from John Spencer, Ltd., of Wednesbury, giving particulars of a great variety of iron and steel tubes for various purposes, including boiler tubes, steam and water pipes, tramway poles, &c., together with a long series of valves, joints, and fittings. A revolving pocket perpetual metal calender accompanies this useful catalogue.

MOTOR-CAR ACCESSORIES AND SPARE PARTS.—A very complete catalogue of motor accessories and tools, which include also spare parts for a few makes of cars, is to hand from Messrs. G. T. Riches & Co., of 19 Store Street, Tottenham Court Road. We notice particularly lists of spare parts for various makes of magnetos which should be very useful.

SHOW CARD.—Messrs. Siemens Brothers' Dynamo Works, Ltd., are issuing an attractive show card to dealers handling their tantalum lamps.

TRAVEL.—We are favoured with a copy of an artistically illustrated booklet, entitled "East Coast Holidays," from the Great Eastern Railway Co.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1906	1907	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	7%	10½—11	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10⅝	
Do. 6% Cum. Second Pref.	10	6	6%	10⅝—10⅞	
Do. 4½% Debenture, Red.	Stock	4½	4½%	100—103 xd	
Bromley (Kent) E.L.& Power Co., Ld.	5	[illegible]	5⅛%	4⅜—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co., Ld.	5	10	10%	7—8	
Do. 7% Cum. Pref.	5	7	7%	6¾—7¾	
Central E. S. Co., Ltd.. 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	5%	3¾—4¼	
Do. 4½% Cum. Pref.	5	4½	2½%	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4%	95—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3¾—4⅛ xd	
Chelsea Electric Supply Co., Ltd.	5	4½	4½%	3—3½	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125 xd	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103 xd	
City of Durham E. P. Dis. Co.	5	4	2%	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ld.	10	5	5%	7⅞—8¼	
Do. 6% Cum. Pref.	10	6	6%	10⅜—10¾	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108 xd	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	98—101	
Edmunson's Electricity Corp., Ltd.	5	4	1/6*	⅝—¾	
Do. 6% Cum. Pref.	5	3½	—	⅝—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	63—73	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	96—99	+1
Hove Electric Lighting Co., Ltd.	5	9	8½%	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	10%	8—9	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	4	2½%	⅞—1⅜	
Do. 6% Pref.	5	6	6%	4⅜—5	+⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	8	6½%	4⅝—5⅛	+⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—4⅝ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109 xd	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89 xd	
Midland E.Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½%	94—97 xd	−2
Newcastle & Dist. E. L. Co., £9 paid	10	5	4%	7¾ 8¼	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97 xd	
Newcastle-upon-Tyne Elec. Supply.	5	8	8%	5½—6	
Do. £2 Pm.	5	8	8%	5½—6	
Do. 5% Pref. (fully paid)	5	5	5%	5¼—5½	
Do. 10/- Pm.	5	5	5%	5⅛—5⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7½	7%	12—13 xd	
Oxford Electric Co., Ltd.	5	7	7%	5¾—6⅛	
Do. 4% Deb. Red.	Stock	4	4%	95—99	+1
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	7½—8½	+¼
Do. 7% Non-Cum. Pref.	5	7	7%	6¼—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	83—88 xd	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	nil	—	⅛—¼	
Do. 4% Deb. Red	Stock	4	4%	70—74	
South London Elec. Sup. Corp. Ltd.	5	3	4%	2⅜—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	1/-	⅝—¾	
Do. 7% Cum. Pref.	1	7	7%	1—1⅛	−1/16
Do. 4½% 1st Deb. Red	Stock	4½	4½%	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5%	1—2	
Do. 5% Cum. Pref.	5	5	5%	1⅞—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	87—90	
Westminster Elec. Sup. Corp., Ltd.	5	12	10%	7⅜—8⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5¼ xd	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	90—92	
Central London	Stock	4	3%	75—78	
Do. 4% Preferred	Stock	4	4%	90—92	
Do. Deferred	Stock	4	2%	55—58	−1
Do. 4% Debentures	Stock	4	4%	103—106	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	80—83 xd	−2
City and South London Cons.	Stock	2⅜	4⅛%	38—40	−1
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	5%	113—116	
Do. 5% Perp. Pref. 1896	Stock	5	5%	112—115	
Do. 5% Perp. Pref. 1901	Stock	5	5%	110—113	
Great Northern & City Pref. "A"	10	4	11⅛d.	¾—1¼	
Gt. Northern, Piccadilly & Brompton	10	4	4%	6½—7	+⅛
Do. 4% Perp. Deb.	Stock	4	4%	87—90 xd	
Mersey Cons.	Stock	nil	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	nil	—	3—6	
Metropolitan Cons.	Stock	1	1%	38½—39½	−½
Do. 3½% Preference	Stock	3½	3½%	86—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	+1
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	nil	—	12—13	
Do. 6% Perp. Deb.	Stock	6	6%	117—122 xd	
Do. 4% Deb.	Stock	4	4%	71—76 xd	
Do. Perp. Extension Pref. (5%)	Stock	nil	—	23—28	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3	3½%	44—48	
Underground Elec. Railways Co. of London 5% Profit Sha. Sec. Notes	Various	5	5%	42—44	+1
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104 xd	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	5	1/-*	¼—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾ xd	
Do. 4½% Deb. Red.	Stock	4½	4½%	85—90	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91—94 xd	
British Electric Traction Co., Ltd.	10	—	—	1⅜—1⅝	
Do. 6% Cum. Pref.	10	6	6%*	4¼—4⅜ xd	
Do. 5% Perp. Deb.	Stock	5	5%	94—97	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	+1
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1906	1907	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	6%*	12½—13½	
Do. 6% Pref.	10	6	6%	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	93—96	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	1¼	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61 xd	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	88—91 xd	
London Street Tramways Co.	4	4/9	4/6	15/16—1	
London United Trs., Ld., Cm. Pf.	10	5	5%	7—8 xd	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	79—84 xd	
Metropolitan Elec. Trams, Ltd., Def.	1	nil	—	1/32—5/32	
Do. 5% Cum. Pref.	1	5	5%	1/16—1/8	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96 xd	
National Elec. Construction Co. Ltd.	1	10	2/-	⅜—½	
New General Tr. Co., 6% Cm. Pf.	5	nil	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	1/-*	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92 xd	
Potteries Electric Traction Co. Ltd.	1	4	4%	¼—½	
Do. 5% Cum. Pref.	1	5	5%	⅜—¾	
Do. 4½% Deb. Red	Stock	4½	4½%*	93—96	
Provincial Tramways Co. Ltd.	10	3¾	4%	4⅝—5¼ xd	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼ xd	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	—	6%	¾—1	
Do. 4% Deb. Red.	Stock	—	4%	75—79 xd	
Sunderland Dst. E.Trs. 1st Mt. Db. Rd.	100	5	5%	74—79 xd	−2
Yorkshire (West Riding) Elec. Trams	5	nil	—	⅞—1⅜	
Do. 6% Cum. Pref.	5	nil	—	3¼—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85 xd	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3⅝	15/-*	58—61	−1
Do. 6% Pref. Ord.	Stock	6	30/-*	102⅜—103⅝	−⅜
Do. Def. Ord.	Stock	1¾	1%	15½—15⅞	−¾
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	83—86 xd	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103 xd	
Direct United States Cable Co. Ltd.	20	4¼	4/-*	13⅜—14⅝	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	98—100 xd	−2½
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	101—103	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	7/6	12⅜—13½	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100½—102½	
Eastern Telegraph Co.	Stock	5⅜	7%	133—136	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	100½—102½	
G. N. Tel. Co. (Copenhagen)	10	20	20%	27—29 xd	−½
Indo-European Telegraph Co. Ltd.	25	13	65/-	54—57	
Marconi Wireless Telegraph Co. Ltd.	1	nil	—	7/16—7/16	−⅛
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	5½	6%	113½—115½	+½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—12½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—12½	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅝	
Do. 3½% Deb. Red	Stock	3½	3½%	98—100 xd	
Do. 4% Deb. Red.	Stock	4	4%	100—102½ xd	
Western Telegraph Co., Ltd.	10	7	7%	13⅜—13⅝ xd	
Do. 4% Deb.	Stock	4	4%	99½—101½ xd	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	nil	—	7/32—11/32	+1/32
Do. 6% Cum. Pref.	1	6	6%	25/32—30/32	
Babcock & Wilcox, Ord.	1	20	1/7½*	3½—4⅛	
Do. 6% Pref.	1	6	7½d	1 1/16—1 1/16	
British Insulated & Helsby Cables, Ld.	5	10	10% & bonus	6—6½	+½
Do. 6% Cum. Pref.	5	6	6%	6—6½	+½
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	100—103 xd	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	—	4½%	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	nil	—	7/8—1 1/8	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48 xd	
Brush Electrical Engineering Co.	2	nil	—	0—⅛	
Do. 6% Pref.	2	nil	—	3/16—7/16	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	53—58 xd	
Callender's Cable and Const. Co., Ld.	5	15	15/-	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜ xd	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—107 xd	
Consolidated Electrical Co., Ltd.	1	3	3½%	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅝—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	92—95	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜	
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅜	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	
Edison & Swan United "A." £3 paid	5	4½	2/6	⅛—¾	
Do. do. (fully paid)	5	4½	4/2	1⅜—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79 xd	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	¼—⅜	
Do. 7% Cum. Pref.	2	7	—	1¼—1⅜	
Do. 4% 1st Mort. Deb.	Stock	4	4%	63—66	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7⅛—8 xd	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	87—90	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	15%	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—107	+1
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	15	17½%	31—33	
Do. 4% Deb. Bds. Red.	100	4	4%	100—102 xd	−2
Willans & Robinson, Ord. Shres	1	nil	5%	¾—1¼	
Do. 6% Cum. Pref.	5	nil	6%	3¼—3½	+⅛
Do. 1st Mtg. Deb. 4% Red.	100	4%	4%	72—76	+2

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THE MANCHESTER ELECTRICAL EXHIBITION

THE arrangements for the electrical exhibition, to be held at Platt Fields, Rusholme, Manchester, are now very well advanced, and considerable progress has been made with the special building which is being erected for the purpose. At the invitation of the management, a large party, including a number of representatives of the technical and daily Press, made an inspection of the building on Tuesday, and were entertained at lunch in the portion which is now completed. The site of the exhibition has already been indicated in ELECTRICAL ENGINEERING, Vol. III., p. 551, when a map of Manchester, showing its position, was published. The skeleton of the building is of wood, as this form of construction was considered more suitable than steel for temporary purposes. The framework is all in place, but of course a good deal of the roofing and walls remains to be completed; nevertheless, sufficient advance has been made to render it possible to obtain an excellent idea of its scope. The exhibition will be held in a single building 500 ft. long by 185 ft. wide, and the stand space will amount to 65,000 sq. ft., or more than the total available even at Olympia. The building is by far the largest temporary structure that has been erected in the North of England. The foundations for the sub-station in the centre of the building, through which the supply from the high-tension corporation mains will be taken, are already in place, and this promises in itself to be an exhibit of some interest.

Councillor W. KAY (Deputy Chairman, Manchester Corporation Electricity Committee) occupied the chair at the luncheon, and was supported by Councillor W. Barrett (Chairman of the Salford Electricity Committee). Amongst the engineers of corporations who are supporting the scheme, we noticed Mr. S. L. Pearce (Chief Electrical Engineer, Manchester Corporation, and President of the Incorporated Municipal Electrical Association), Mr. H. Talbot (City Electrical Engineer, Nottingham, Past President of the I.M.E.A.), Mr. A. A. Day (Borough Electrical Engineer, Bolton), and Mr. S. J. Watson (Borough Electrical Engineer, Bury). The National Electrical Manufacturers' Association was represented by Mr. F. H. Nalder (Messrs. Nalder Brothers & Thompson) and Mr. H. H. Berry (Messrs. Berry, Skinner & Co.), and among the members of the General Committee representing the exhibitors there were present Mr. H. Bevis (General Electric Co.) and Mr. D. N. Dulop (British Westinghouse Co.), and the management was represented by Mr. C. S. Northcote (general manager) and Mr. W. Davenport (secretary).

The toast of the Press was proposed first of all by the CHAIRMAN, who spoke of the reasons for holding the exhibition in Manchester, which city he described as the centre of commercial growth of the industrial applications of electricity to be exemplified in the exhibition. He looked forward to great benefits accruing from the display, and instanced the excellent results which had been produced by a gas exhibition on similar lines. The exhibition was in no way run for private gain, but the object was to forward the interest of both municipal and private branches of electrical business and industry.

Mr. H. TALBOT also spoke from the point of view of the other municipalities supporting the venture, and emphasised the suitability of Manchester for its venue as a more important centre than the other surrounding towns.

The official support of the Incorporated Municipal Electrical Association was spoken of by Mr. S. L. PEARCE, who stated that already some 30 or 40 municipalities, including Manchester, Salford, Nottingham, Derby, Bolton, and Bury, were actively supporting the scheme, and he hoped that several others would come in.

Mr. H. H. BEVIS made a speech expressing his views as an exhibitor. He thought that electrical exhibitions, like doctors, should be called into requisition as seldom as possible. One large representative exhibition, such as they hoped this would be, held at intervals of about three years, was much more productive of good than a multitude of smaller exhibitions.

Mr. W. DAVENPORT then rose to give some particulars of the building and the scope of the exhibition, which, he said, would represent the application of electricity to a number of industries. The exhibits would include special displays of domestic appliances, electric furnaces, textile, wood-working, and other electrically-driven machinery, and lectures and demonstrations would be given. The attractions to the public would be well attended to. Already the band of the Coldstream Guards had been engaged, and an elaborate scheme of illuminations had been planned. They looked forward to even better results in the way of being able to contribute to the electrical charities than were obtained after the Olympia exhibition, and hinted at the prospect of a substantial bonus being returned to exhibitors. Representatives of the Press replied, and after the Chairman's health had been drunk, the party dispersed.

LOCAL NOTES

AMBLE: *Electric Lighting.*—A resolution has been passed by the Council that the Board of Trade be asked to revoke the Provisional Order which the Northern Counties Electric Supply Co. has for this district, owing to their not having put it into force. The Council has other proposals before it with regard to electric lighting.

BARNES: *Electric Lighting Accounts.*—The accounts of the Corporation electric light undertaking for the year ended March 31st, 1908, show a total capital expenditure to date of £60,647, of which £7,114 were expended during the year under notice. There is a balance of unexpended capital of £3,350. The revenue amounted to £10,678, and the expenditure to £4,376, leaving £6,302 to be carried forward to net revenue account. After deducting interest and sinking fund, &c., there is a balance of £4,271, which is carried forward. The number of units sold was 868,942, of which 188,444 were for public lamps and the remainder sold to private consumers. The total maximum supply demanded was 451 kw.

BECKENHAM.—The Urban District Council has decided that a bonus on the year's working of the electricity undertaking be given to stokers equivalent to £10 for each 0·1d. reduction in the coal costs.—The consulting engineers, reporting to the Council regarding contracts for new machinery, &c., stated that the battery and booster in hand are well advanced. The Underfeed Stoker Company are to instal a new trial stoker.

BELFAST: *I.M.E.A.*—At the weekly meeting of the Tramways and Electrical Committee, held on the 6th inst., Sir Robert Anderson, Lord Mayor, presiding, Mr. T. W. Bloxam, electrical engineer, reported that he had attended at the Conference of the Municipal Electrical Association in Nottingham, and obtained much valuable information which would be for the benefit of the undertaking.

BOURNEMOUTH: *The Recent Tramway Accident.*—With the object of preventing further accidents on the Poole Hill route, new regulations have been put in force. There is a new stopping place between Poole Hill and the first curve, and drivers are to test all brakes on leaving the brow of the hill and at each terminus.

BURNLEY: *Tramways.*—At the meeting of the Burnley Town Council last Thursday, in referring to a decision to purchase 50 watt meters for the tramcars, it was asked if they could be relied upon at £5 each. Councillor Aspinall said that at Bradford they had brought about a saving of 10 per cent. on electricity. The efficacy of these meters was called into question, and the matter was eventually referred back for further consideration.

A complaint was laid before the Council regarding the bad ventilation of the electric tramcars, and a suggestion was made that the committee should have at each end of the cars a wire gauge with a movable cover, which the driver or conductor could operate at will. Attention was promised to the matter.

Electricity Accounts.—The electrical engineer has issued his annual report, which shows the growth of the undertaking during the last year to be as follows:—Units for lighting, 638,903, an increase of 79,688, or 14·25 per cent.; units for motors, 192,957, increase 61,530, or 46·81 per cent.; scar top-mill motors (temporary), 326,087, increase 295,078; and units for traction, 2,277,032, increase 44,075, or 1·97 per cent. These give totals of 3,434,979, increase 480,371, or 16·26 per cent. The increase in units for lighting purposes is 14·25 per cent. against 13·32 the previous year for motor purposes, 46·81 against 84·08, and for traction purposes 1·97 against 4·87. The total capital expenditure has been £94,761 7s., an increase of £1,921 19s. 6d., accounted for chiefly by extending mains and consumers' services (£1,293 7s. 5d.). The amount borrowed on capital account has been £95,886, and the total paid off by the sinking fund £22,914 1s. 6d. During the year the net income amounted to £22,389 15s. 8d., against £21,280 3s. 3d., an increase of £1,109 12s. 5d. There had been several reductions in charges. The net profit is £6,254 15s. 6d., against £5,384 7s. 1d. last year, an increase of £870 8s. 5d. The profit has been disposed of as follows:—£3,000 for relief of rates and £3,254 15s. 6d. to depreciation fund. The generating plant remained the same as last year, with a capacity of 1,990 kilowatts or approximately 3,000 h.p. The electrical engineer is of opinion that the question of crane capacity should receive consideration, as some

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parts of special new plant will exceed 10 tons in weight, whilst the existing cranes are only of 6 tons capacity. The cooling-tower should be extended and made at least half as big again to deal with 66,000 gallons of water per hour, and there should be more ground for storage purposes. That electricity is making headway he concluded for heating and other domestic purposes is now a foregone conclusion. The metallic filament lamp seems to have been almost universally adopted by the consumers, but owing to the increased candle-power, and the fact of having to burn two or more in series, it is questionable whether the higher efficiency lamps have made any material difference compared with the ordinary carbon filament lamps, either in the revenue account or the station's load. At the same time, the consumer has received a much more satisfactory light, and the ultimate result is bound to be beneficial to supply stations.

CARDIFF: *Electric Lighting and Tramways.*—The Electric Lighting and Tramways Departments are the subject of much discussion at the present moment, and at the next meeting of the Corporation one of the councillors will move that an expert be engaged to report upon the tramway track, while another will move that the application of the employees for a conciliation board should be granted.

CROYDON: *Tramways.*—The net surplus on the tramways which were acquired by the Corporation from the company in June, 1906, has been £1,627, as compared with £9,053 for the preceding ten months. There has been a loss of £2.150 on the extension to Thornton Heath, and the Corporation decided last week to discontinue running this part of the line

DUNDEE: *Trackless Trolley System.*—The deputation which was sent to the Continent to inspect examples of the trackless trolley system, has now returned. Their report has not yet been completed, but it is understood that they have a high opinion of the trackless trolley system, and will urge its adoption on the outskirts of Dundee.

EASTBOURNE: *The Generating Station.*—The Electrical Engineer is to report as to the advisability of duplicating the motor driving plant, together with an estimate of the cost. This is in consequence of a breakdown at the electricity station. Recently, owing to the burning out of a motor driving the pump which circulates the cooling water through the condenser of the turbine, the vacuum was lost, and it was necessary to run the plant non-condensing for part of an evening. The Electrical Engineer has reported that the existing water heater and softener, which is used for softening the town water required in excess of that obtained from a tube well, is not giving satisfactory results, and he has suggested that a modern cold process water softener be installed. The Electric and Street Lighting Committee of the Town Council has resolved that the matter be deferred to enable the Electrical Engineer to report further thereon.

EGHAM: *Electric Supply.*—The Egham Electric Lighting Syndicate have given notice that they are about to apply for a Provisional Order for the supply of electricity in this district.

EVANTON: *Bazaar.*—A somewhat unusual course of holding a hazaar in August to defray the costs of the installation of electric light in the village is proposed.

FLEETWOOD: *Rating of Tramroad.*—A case in which the Fleetwood Council sued the Blackpool & Fleetwood Tramroads Co., for payment of rates amounting to £525, has been settled in accordance with a recent decision of the Court of Appeal that the defendants were only liable for quarter rating, and an order for payment accordingly was made.

GUILDFORD: *Staff Outing.*—The staff of the Guildford Electricity Supply Co. held their annual outing last week at Bournemouth.

HANWELL: *Technical Advice.*—The District Council, at its last meeting, agreed that an account of £105 for the professional services of Mr. Russell, consulting electrical engineer, to March 10th be paid, but endorsed the opinion of the Finance Committee that no further expense for technical advice should be incurred without the authority of the Council.

HASLEMERE: *Electric Lighting.*—The Hindhead and District Electric Supply Co. have given notice of their intention to apply to Parliament next session for a Provisional Order to supply Haslemere and some of the adjoining districts.

HOVE: *Application for Reduction in Price.*—The Hove Corporation has applied to the Board of Trade for a reduction in the prices charged by the Hove Electric Lighting Co. When the Provisional Order was transferred to the company in 1892 the Corporation was given certain rights in this matter, and they now state that the company, during the last seven years, have distributed dividends equal to an average of 10 per cent. per annum, and that, therefore, they were now entitled to put their rights into force. The company argue that the agreement with the Corporation entitled them to pay 10 per cent. not only upon the ordinary shares, but also upon the amount standing to the credit of the reserve fund. An inquiry into the matter began as far back as December, 1906, when it was decided by the inspector that the company had paid 10 per cent. dividend, and the present inquiry in London, before Mr. Sims Williams at the Surveyors' Institution, Great George-street, is mainly to fix the amount of the reduction. Mr. Robert Hammond and Mr. A. H. Dykes have given evidence on behalf of the Corporation. All the evidence and cross-examination was completed on Tuesday, and the final speeches will be made on a day to be fixed later.

HULL: *Telephones.*—At a meeting of the Corporation Telephone Committee last week, the extension of the telephone system from Cherry Burton to Wamme was approved.

JOHANNESBURG: *New Electrical Scheme.*—It is reported in the *Financial News* that a representative of Messrs. Beardmore is negotiating with a view to the establishment of a new electrical works in Johannesburg in competition with the Victoria Falls Power Co.

KING'S NORTON: *Tramways.*—The Tramways Committee have reported that the reconstruction of the Moseley and King's Heath routes have exceeded the estimates by £5,376. A credit balance of £4,000 exists in reference to the Pershore Road tramways undertaking, but as this is not available, it is proposed to approach the Local Government Board for sanction to an additional loan of £5,700.

LEICESTER: *Power Supply.*—The following rate for the supply of electricity to power consumers has been agreed to by the Council, on the recommendation of the Tramways Committee :—(*a*) The sum of 15s. per quarter for every horse-power in respect of the maximum horse-power required by the consumer, and (*b*) a sum of ¾d. for every Board of Trade unit supplied. These charges are subject to a scale of discount ranging from 10 to 15 per cent., according to the load factor in each case.

LEYTON: *The Electricity Undertaking.*—The District Council have had under consideration the charges for current, and in this connection have received a letter from the local Ratepayers' Association urging a reduction in the price and the need for the partial or entire abolition of meter rents. In the result it has been decided to adjourn consideration of any revision in the charges for current for six months, but meter rents are to be reduced from 1s. 6d. to 1s. per quarter. With regard to a suggestion that the Council should make fuller use of their powers with regard to the sale or letting for hire of motors, they do not consider the demand is sufficient to justify the expense which would be incurred in the organisation and the maintenance of a department for this purpose, especially as motor manufacturers are now prepared to supply motors on hire-purchase terms. A letter is to be sent to the Ratepayers' Association pointing out the economy which can be effected by the latest types of lamps which may be inspected at the Council's show-room. The freehold of the private road between the two portions of the electric light and power station is to be purchased from the owners of St. Patrick's Cemetery for a sum of £1,000. Messrs. Mather & Platt have written to the Council regretting that it is not possible to promise delivery of the new generator until about the beginning of September. The Electrical Engineer has been authorised to obtain some posters illustrative of the advantages of electricity, from the Associated Municipal Engineers (Greater London), who are prepared to supply these (80 in. by 60 in.) at 1s. 8d. each.

Tramway Inspector Summoned.—An inspector of the Leyton Urban District Council tramways was summoned at Stratford last week for acting as conductor without a licence, and Mr. Schofield, the tramway manager, was also summoned for knowingly allowing this to take place. The defence was that according to custom, if a driver or conductor was taken ill on the road, an unlicensed man could take his place for not more than 24 hours, and it was under the impression that he was acting in accordance with the regulations that the manager put the inspector upon the car. The Bench upheld this view and dismissed the summons.

LONDON: *Electric Lighting at the Tower.*—A curious dispute has arisen between the Stepney Borough Council and the City of London Electric Lighting Co. It appears that the company have maintained a supply to the Tower of London since September, 1905, although, strictly speaking, the Tower is within the borough of Stepney and outside the company's statutory area of supply. The company have been approached with a view to inducing them to withdraw the supply, but have declined to do so, and it is reported that legal proceedings are pending.

Bermondsey: Electric Lighting Audit.—In regard to a recent question in the House of Commons relative to the auditing of the accounts of the South London Electric Supply Corporation, the Electricity Committee has decided in favour of forwarding to the Government a communication protesting against the action of the Board of Trade, and also in favour of asking all other borough councils having electrical undertakings to take similar action.

St. Pancras: Electricity Accounts.—According to the accounts of the Borough Council's electricity undertaking, which have just been issued, the gross income for the year ended March 31st amounted to £77,602, an increase of £3,430 as compared with the previous year, which, after meeting all working expenses and the repayment of loans and interest charges, leaves a net profit of £9,454. This profit compares with £6,495 for the previous twelve months, the latter period having borne the cost of an action amounting to £3,585. On March 31st there was a credit balance on the net revenue account of £10,332, and this the Electricity and Public Lighting Committee has decided to carry forward as a working balance for the undertaking. The net balance in the reserve fund at the end of the year totalled

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£29.541. The total capital expenditure of the undertaking at March 31st was £525,149.

Southwark: "Free" Wiring.—On October 30th last the Electric Light Committee reported on the progress made in wiring consumers' premises under the resolution of January 9th, 1907, and intimated that, owing to the success attending the scheme, it would be necessary, in order to meet demands of new consumers, to expend a further sum of £500 over the original amount estimated. The Committee on Monday reported having received a communication from the Electrical Engineer, stating that the sum now expended on the work amounts to £925, and that there are orders in hand which will increase the foregoing amount to about £1,250.

Woolwich.—At the meeting of the Borough Council on July 2nd, it was decided to issue 5,000 copies of a pamphlet with a view to stimulating the demand for electricity in the borough. Some time ago the L.C.C. sanctioned the borrowing of £820 for the installation of a cooling tower at Plumstead works. Owing to the many modifications in the arrangement of the plant the present cooling tower is considered to be of sufficient capacity to be worked in conjunction with the direct-current plant and the loan is therefore not required. The Council decided to rescind the resolution passed on October 17th, 1905, accepting the tender of Sugden & Co., at £820, for the supply of a cooling tower of 150,000 gallons capacity.—On a report by the Electricity Committee that "a definite application for electricity supply had been received in a district where, in the near future, there was every prospect of obtaining a large demand," the Council authorised the extension of the distributing mains at a cost of £150. The Committee stated that the applicant for current "occupies an important position in the electrical profession and is prepared to demonstrate the advantages of electricity supply to his neighbours."

OTLEY: *Electric Lighting.*—The Council has before it a notification of an application by private promoters for a Provisional Electric Lighting Order.

OXFORD: *Tramways.*—At a meeting of the City Council last week, it was decided after considerable discussion to affix the seal of the Corporation to a supplemental agreement between the City of Oxford & District Tramways Co., Ltd., and the National Electrical Construction Co., Ltd., and the City of Oxford Electric Tramways, Ltd.; and a deed of assignment between the City of Oxford and District Tramways Co., Ltd., and the Mayor, Aldermen, and citizens of Oxford.

SANTO DOMINGO: *Wireless Telegraphy.*—According to a Consular report, two wireless telegraphy installations are being set up on account of the Dominican Government by an American firm. One is situated on the sea front in this city, and will be of 20 kilowatt power, and the other will be erected at Santiago de los Caballeros, one of the principal towns of the Republic, situated on the Central Dominican Railway, about 40 miles from Puerto Plata. This latter installation is only to be of 2 kilowatt power. When in working order these wireless stations will communicate with San Juan de Porto Rico, Guantanamo, Jamaica, and the receiving station on the Florida coast. If these stations work satisfactorily they should prove a source of gain to the Dominican Government, and will considerably injure the interests of the Compagnie Française des Cables Télégraphiques, which enjoys a monopoly in cable communication with this Republic.

SEVILLE: *Electricity Supply and Tramways.*—According to a Consular Report, the German electric company (Compania Sevillana da Electricidad) still has a monopoly of the electric lighting of Seville and of the tramway lines, but there will shortly be a competitor in the recently formed Co-operativa de Electricidad, which will soon have completed elaborate works in the province of Malaga. Both companies are putting up extensive plant and offer to supply Seville and adjacent towns. The German company proposes to run tramways to two or three places within a radius of 10 miles. The new electric company will obtain power from a waterfall which they have acquired on the River Guadiaro. This project has the support of much local capital.

SHEFFIELD: *Electricity Accounts.*—Mr. S. E. Fedden issues his report on the accounts for the past year. The rapid increase in the consumption of energy for motive power is commented on, especially in the case of the introduction of electric driving in large works. The receipts for the year amounted to £78.554, and the working expenses to £25,344. After the payment of £48.394 for interest and sinking fund charges, a final surplus of £4.796 remains as compared with a surplus last year of £2.555 and a deficit the year before of £1,374. It is pointed out that the price of coal increased by an amount equivalent to 0·06d. per unit sold, and that if the price of coal had been the same as for the previous year, the surplus would have amounted to £7,280.

Report on Financial Position.—A short time ago the Electric Light Committee were desirous of borrowing £250.000, but the Finance Consultative Committee would not consent until a sub-committee had been appointed to ascertain the position of the undertaking, both financially and commercially. As a consequence, Sir Alexander Kennedy was asked to report, and in a statement concerning this report, the special sub-committee state that the sum actually paid by the Corporation to the old company was £268,147 plus £31,176 capital expenditure incurred by the company, whilst they were carrying on the business for the Corporation. Of this amount about 53 per cent. was unrepresented by any tangible asset, and it could only be looked upon as goodwill and the extra price for compulsory purchase. In addition to this sum, which amounts to £143.686, a further £51,554, representing obsolete plant taken over from the company, must be taken into account, and after considering other items, the committee are of the opinion that at least £202,996 of the total sum paid for the company's undertaking is not now represented by productive capital. Dividing the capital account so as to distinguish this sum from what might reasonably be taken as productive capital, and after taking into account sinking fund and depreciation, the productive capital is said to amount to £175,723, which it is thought will be wiped off in 30 years or less. Apart from interest and sinking fund, the undertaking has set aside £28,528, from which £2.200 has been taken for the purchase of motors and £10,000 towards renewals fund, leaving an unappropriated balance of £16,328. The sub-committee are of opinion that a further sum of £10,000 should be transferred to the renewals fund, leaving a balance of £6,628. Further, it is recommended that a sum of £5,000 per annum should be taken for the next five years from the working profits of the undertaking and placed to renewals fund, whilst the sub-committee further expresses the opinion that as soon as the finance of the undertaking permits, a reserve fund should be created up to 10 per cent. of the capital expenditure on the undertaking, as provided for in the Electric Lighting Acts. In his report Sir Alexander Kennedy discussed the question of whether the Sheaf Street station should be abandoned and the whole of the generation concentrated at Neepsend, and on the whole his opinion is in favour of the latter. The Special Committee generally praise the management of the undertaking.

Electric Wiring and Fitting.—A Special Committee of the Corporation recommend that in future the trading results of the electric wiring and fittings department should be published separately, after having a fair proportion of the management expenses debited to them.

SOUTHGATE: *Proposed Supply Schemes.*—The District Council has received a letter from Messrs. Foote & Milne giving notice of intention to apply to the Board of Trade for a Provisional Order for electric lighting. At the last meeting of the Council the General Purposes Committee reported that they had under consideration two schemes for electric lighting—one for taking electricity in bulk from the North Metropolitan Company and distributing same in the district, and the other a proposal by the company for the transfer to the company of the Council's electric lighting order under certain conditions to be agreed upon. The Committee announced that at present they were unable to make any recommendation.

SOUTHAMPTON: *Electric Supply Extension.*—The Electricity Committee have resolved to give notice to the South Stoneham Rural District Council of their intention to apply for a Provisional Order for the supply of electricity in that district.

SWANSEA: *Telephones.*—Notice has been given by the National Telephone Co. of a revision of rates on the expiration of present contracts. The new rate for business purposes and residences is a minimum charge of £5 covering 500 calls, or a larger number of calls may be contracted for at the following rates:—From 500 to 1,000 (in blocks of 250), 8s. per hundred; 1,000 to 2,000 calls (in blocks of 250), 6s. per hundred; 2,000 to 4,500 calls (in blocks of 300), 4s. per hundred. Excess calls, when the number contracted for is 1,250 or less, will be charged for at 2d. each, and over 1,250 at 1d. each. There will also be a special unlimited rate of £8 per annum for residence purposes only within one mile of the exchange.

TONBRIDGE: *Electricity Loan.*—Criticism is being made locally upon the fact that the Local Government Board has been such a long time in fixing the date for the inquiry into the proposed loan for the extension of the electric lighting plant, and it has been decided to ask Mr. A. P. Hedges, M.P., to use his influence at Westminster to help matters forward.

WARRINGTON: *Electricity Accounts.*—The report and statement of accounts of the Town Council's electric supply undertaking for the year ended March 31st, 1908, shows that the result of the twelve months' working, after paying interest and redemption of capital, was a profit of £2,213, as compared with £2,516 for 1906-7. The capital expenditure was increased during the year from £86,522 to £92.085. The total revenue reached £17.234, as compared with £16.238 in the previous year, the amount received from the supply of electricity being £16.652, as compared with £15,616. The cost of generation and distribution totalled just over £9.700, as compared with a little more than £8,528 in 1906-7. The gross profit was £7.533, as against £7.709, and the percentage of costs to revenue 56·28 as against 52·52. The capital redeemed to date increased during the twelve months from £8.545 to £10,913, the percentage of capital redeemed to amount spent increasing from 9·87 to 11·85. The number of 8 c.p. lamps shows increase from 64.711 to 77.878 (excluding tramways), and the number of units sold (also excluding tramways) advanced from 1.839.912 to 2.064.996. The revenue per lamp last year was 4s. 5d. as compared with 4s. 10d. in 1906-7. The average prices obtained were

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as follows:—Public, 1·90d. (as against 2·07d.); private, 1·51d.; traction, 1·50d. (the two last-mentioned figures being the same as for the previous twelve months).

WILLESDEN: *Electricity Accounts.*—The statement of accounts of the electricity undertaking of the Urban District Council for the year ended March 31st, 1908, shows a gross profit for the year of £8,198, and a net profit of £725, the actual surplus on the electricity fund (after allowing for deficiency in previous years) being £182. The Electricity Committee has decided that £337 be written off as irrecoverable, including bad debts amounting to £259, and £32 for provision in respect of outstanding accounts.—The Board of Trade has consented to the Council altering the system of supply from direct to alternating current in part of the area of supply.—Consideration of a communication as to the charges for arc lighting to private consumers has been deferred until after the completion of negotiations with the North Metropolitan Electric Power Supply Company with regard to a reduction in the prices charged for bulk supply.

WORCESTER: *Electricity Accounts.*—The annual report of Mr. C. M. Shaw for the period of fifteen months ended March 25th last gives the total revenue as £20,775. The total working costs were £8,626, leaving a gross profit of £12,149, which, after payment of interest and sinking fund charges, leaves £1,694 to be carried to appropriation account. Of this £192 was used to clear off the outstanding deficit from last year, and £1,149 was applied to capital expenditure, leaving a final surplus of £352. Several new customers have been connected during the year, the total connections now amounting to the equivalent of 10,877 8 c.p. lamps. As will be seen in the Paper by Mr. C. M. Shaw, the City Electrical Engineer, published in our report of the I.M.E.A. meeting, this week, the system has been reconstructed, and the water supply has been augmented by the surrender of two water-wheels by the Worcester Royal Porcelain Co. The result is that the works costs have been reduced from 1·076d. to 0·889d. per unit sold, and the coal costs from 0·53d. to 0·397d., in spite of an increase of between 25 and 30 per cent. in the price of coal.

YORK: *Light Railway Order.*—The Light Railway Commissioners have submitted the York Light Railway Order to the Board of Trade for confirmation, and objections must be lodged by the 16th inst.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Miscellaneous

AUSTRALIA.—The following tenders are required by the dates specified for telephone material:—South Australia, August 26th: 9 tons wire, copper, hard drawn (200 lb. to the mile); 3,000 tapes, copper, for 200 lb. wire and No. 5 insulators; 3,000 binders, copper, for 200 lb. wire and No. 5 insulators; 3,000 insulators, porcelain, No. 5. New South Wales, August 5th: 69 tons wire, hard-drawn copper (300 lb. per mile); 1 ton tape, binding copper (200 lb. per mile); 15,000 insulators, best white porcelain, large. August 12th: Supply, delivery, and erection of a branching metallic multiple magneto switchboard, at the Mosman Telephone Exchange. Western Australia, September 7th: 1 common battery switchboard of nine sections in all (for Fremantle), together with all associated frames, racks, power plant, and parts; 650 telephone wall sets, 150 telephone table sets, 800 protectors, 90 extension switch and bell sets, complete, 30 switchboards for 4 lines, 20 switchboards for 6 lines, 5 switchboards for 12 lines, 5 switchboards for 24 lines, 20 telephone wall sets for party lines, 10 telephone table sets for party lines. Tenders are also required by August 26th for installations of wireless telegraphy. Tender forms, specifications, &c., may be obtained at the Commonwealth Offices in London, 72 Victoria Street, S.W., where also preliminary deposits on tenders may be paid.

COLOMBIA.—The *Diario Oficial* of Colombia contains copies of decrees granting concessions to Señor E. Drescoes, of Perreira (Department of Caldas), and the Bucaramanga Gold and General Mining Company, Limited, and the Francia Gold and Silver Company, Limited, for the construction of telephone lines, the former from Perreira to his property El Tablazo, and the latter between the places named La Tronadora, Francia, Vetus, La Baja, and Libertador in the Province of Soto (Department of Santander).

DERBY.—The Tramways Committee have decided to extend the tram terminus at the Midland Railway Station.

LONDON COUNTY COUNCIL.—The Council invite tenders for six electrically propelled stores transport vehicles. Full particulars from the Clerk (fee, £2 returnable), and tenders by July 21st.

WILLESDEN.—The Council's Electrical Engineer has been instructed to invite tenders for the painting of arc-lamp columns, feeder pillars, and plant, &c., at the electricity works.

Generating Stations, Sub-stations, Mains, &c.

BO'NESS.—In consequence of a report by the National Electric Construction Co. on the increasing demand for electric supply, the Town Council have decided to proceed with extensions at an estimated cost of £6.000, subject to the sanction of the Secretary for Scotland to a loan for this amount.

COVENTRY.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £35,000 in connection with the electric lighting undertaking. This expenditure is necessitated in consequence of the extension of the area of supply granted recently by Parliament, and the first portion of the expenditure will be chiefly in mains.

CROYDON.—Application is to be made to the Board of Trade for sanction to a loan of £540 for carrying out the construction of a single line of tramway connecting two loops in North End. The Borough Road Surveyor's estimate for carrying out the work is 120 yards lineal single track complete at £4 10s., giving a total of £540.

The Corporation is to invite tenders for mechanical stokers to be fitted to two additional boilers at the electricity works. The estimated cost for apparatus, fitting, and necessary alterations is £620.

LEYTON.—A letter has been received from the Chief Engineer of the London County Council to the effect that the necessary arrangements are being made for putting in hand the work in connection with the reconstruction of the line recently purchased from the Lea Bridge, Leyton, and Walthamstow Tramways Company. With regard to the electrical equipment, the Tramways Manager of the L.C.C. has suggested, for the purpose of avoiding unnecessary cost and delay, that the work be carried out by the Leyton Council's electricity department, and this has been provisionally agreed to, the price to be charged being the actual cost plus 10 per cent. for supervision. The Leyton Electrical Engineer has been authorised to obtain quotations for the materials required.

KENDAL.—The Electricity Committee has resolved to recommend the Corporation to apply to the Local Government Board for a loan of £10,000 for the erection of a generating station at the canal head, in conjunction with a refuse destructor. The amount is made up as follows:—Buildings and machinery, £5.250; meters and distributing mains, £1,000; future extensions, £3,750; total, £10,000.

LONDON: *London County Council.*—The Highways Committee recommend that the portion of the Nine Elms Lane to East Hill, Wandsworth, tramways, between East Hill and Falcon Road, be converted to electric traction on the underground conduit system, at an estimated cost of £35,790. The length of the portion of the road in question is $\frac{7}{8}$ of a mile, and details of the estimate are as follows: Track work, &c., including special work and £4,000 for rails, £29,000; cables and feeder pillars, £830; cable ducts, £1,130; sub-station plant, £80; and rolling stock, £4,750.

The Highways Committee also recommend the reconstruction of the tramways from Euston Road via Camden Road to Holloway Road for electric traction upon the underground conduit system at an estimated capital outlay of £173,730. There was an intention of adopting the G.B. surface contact system upon this route, but the Committee state that, in view of the fact that the working of the lines reconstructed on that system from Whitechapel to Bow Bridge has only just been commenced, sufficient experience will not be available to enable them to decide whether they could recommend the adoption of the G.B. system. The length of the tramways from Euston Road to Holloway Road is about $2\frac{3}{4}$ route miles. Details of the estimate are as follows: Track work, &c., including special work and £12,500 for rails, £105,000; cables, £18,600; feeder pillars, £320; cable ducts, £10,220; sub-station plant, £15,840; rolling stock, £23,750.

Battersea.—In order to meet applications for the supply of electrical energy, the Lighting Committee has decided to extend mains and lay services, at an estimated cost of £45.

Islington.—The Council is to provide and lay a distributing main, at an estimated cost of £85, to supply electricity for lighting at premises of the Home and Colonial Stores, Ltd., in Blackstock Road.

Poplar.—The Finance Committee of the County Council recommend that a loan be granted to the Borough Council of £22.180, repayable on the instalment system as to £300 for foundations and boilers, and £887 for erection of a sub-station within 50 years, as to £600 for mains within 30 years, as to £14.493 for machinery within 20 years, as to £250 for house services within 12 years, and as to £250 for meters within 10 years.

Woolwich.—It has been decided to apply to the London County Council for loans for the following purposes:—Mains: Hippodrome feeder, £610; Ray's Wharf extension, £226; Wood Street extension, £680. Plant: Oil-eliminating plant, £309 10s.; motor alternator, £784 10s. Total, £2.610.

ST. ANNE'S.—Mr. A. W. Ducat held a Local Government Board inquiry last week into an application for a loan of £3.500 for cables and extensions.

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YORK.—The Electricity Committee has instructed the engineer to obtain tenders for the supply of carbon brushes, meters, and motor-starters for two years, and stores and coal for one year.

Wiring

LONDON.

E.—Mr. S. D. Adshead, architect, of 46 Great Russell Street, W.C., has prepared plans for the erection of a building on the east side of Betts Street, St. George's-in-the-East.

A building is to be erected in Ben Jonson Road, Stepney, by Mr. E. Jackson, builder, 10 Whitehorse Lane, Whitechapel.

The London County Council has decided to erect a manual training centre in connection with the Woolmore Street (Poplar) School. The architect to the Education Committee is Mr. T. J. Bailey, Spring Gardens, S.W.

N.W.—Messrs. Howell J. Williams, Ltd., builders, 11-17 Bermondsey Square, S.E., are to erect shops, &c., in Hampstead Road.

Flats are to be erected in East Heath Road, Hampstead Heath. Builder, L. E. Hookway, Beaufort Mansions, Chelsea, S.W.

Earges Hotel, 2-3-4 Liverpool Street, King's Cross, is to be rebuilt. Builders, Higgs & Hill, South Lambeth Road.

Mr. H. Shaw, architect, of 60 Nicholl Road, Willesden, has prepared plans of a shop and house in High Road, Willesden, and of a show-room in Craven Park Road, Willesden.

Alterations to the Keble Memorial School, Crownhill Road, Harlesden, are to be carried out for the Rev. Mother Superior. Architects, Keble & Dickie, 466 Oxford Street, W.

Three shops are to be erected in Walm Lane, Willesden Green Station, for the Metropolitan Railway. Builders, J. Grover & Son, 79 Shepperton Road, N.E.

Messrs. Callow & Wright, Ltd., builders and estate agents, of Brondesbury Park, N.W., are to erect six houses in Chamber Lane, Willesden.

It is intended to erect two houses on Shoot Up Hill, Cricklewood. Builders, H. B. Oldrey & Sons, 7 West End Lane.

A new sub-station (£4,950) is to be erected at Camden Town. Mr Maurice Fitzmaurice, C.M.G., the Chief Engineer to the L.C.C., Spring Gardens, S.W.

S.E.—The London County Council will erect a superintendent's house at the Rotherhithe Tunnel. Architect, Mr. W. E. Riley, Spring Gardens, S.W.

Five shops and dwelling houses are to be erected in Old Kent Road, S.E. Architect, Mr. F. W. Foster, 41 Bedford Row, W.C.

Twenty-seven houses are to be erected on the south side of Straightsmouth. Architect, Mr. A. Roberts, 92 London Street, Greenwich.

Additions are to be carried out at St. Ann's School, Greenwich, S.E. Contractors, Messrs. Bendon, Ltd., 48 Chancellor Road, Hammersmith.

The Postmaster-General has decided to establish a post office in the High Street, Plumstead. Plans are to be prepared at H.M. Office of Works, Storey's Gate, S.W.

A vestry and additions are to be made to Christ Church, Shooters Hill. Contractors, Messrs. Kirk & Randall, of Warren Lane Works, Woolwich.

W.—A new residence (£3,600) is to be erected for Sir Lewis McIver, Bart., M.P., by Mr. H. L. Holloway, builder, Church Street, Deptford, S.E. Architect, Mr. R. Gardner Hammond, 16 Essex Street, Strand.

The Lion Brewery Co., Ltd., are to re-erect the "Queen Adelaide" public-house, and also four shops in Uxbridge Road, Hammersmith. Architect, Mr. C. G. Miller, 65 Chancery Lane, W.C.

PROVINCES.

BACUP.—It is intended to erect a school in the Weir district. Architects, Butterworth & Duncan, South Parade, Rochdale.

BIRMINGHAM.—The Corporation are obtaining tenders for the erection of a laundry in Woodcock Street. The estimated cost of the whole building is £1,700.

BRISTOL.—Mr. Edward Gabriel, architect, 42 Old Broad Street, E.C., has prepared plans for the erection of buildings at Southmead, for the Committee of the School of Industry for the Blind.

CARDIFF.—Messrs. T. Owen & Co., Ltd., of Cardiff, are erecting a large paper factory in that town, and also a capacious institute for their employees. Architect, J. William Rodger, 14 High Street, Cardiff.

CHELMSFORD.—Plans have been prepared by Mr. W. Hayne, architect, of Frinton-upon-Sea, for a Baptist Chapel and class-rooms, with a seating accommodation of nearly 600. It has been decided that the buildings be lighted by electricity.

CLEETHORPES (Lincs.).—Additions are to be made to the County Schools, Elliston Street, at a cost of £4,180. Architects, Scorer & Gamble, Bank Street Chambers, Lincoln; builders, H. S. & W. Close, Brayford Wharf, Lincoln.

CROWBOROUGH (Sussex).—The Hon. Mrs. Brougham is having a residence erected at Crowborough, at a cost of £2,770. Architect, R. G. Hammond, 16 Essex Street, W.C.; builders, Connor Bros., of Crowborough.

DARTFORD.—Foundation stones have been laid of a new Wesleyan Church at Greenhithe. Architect, Sydney W. Neighbour, 9 Regent Street, S.W.; builders, Brown Bros., of Grays.

DURHAM.—The North Eastern Railway Co. have decided to carry out extensions to their machine shop at Shildon Wagon Works. Architect, William Bell, Toft Green, York.

ELTHAM.—Additions are to be carried out at the Holy Trinity Church, Southend Road, for the vicar and churchwardens. Builders, J. Dorey & Co., of Brentford.

ENFIELD.—Mr. H. G. Crothall, architect to Education Committee of Middlesex County Council, Guildhall, Westminster, S.W., has prepared plans, &c., for the erection of extensions to Enfield Boys' Grammar School. The estimated cost of the work is about £6,000.

GILLINGHAM.—Tenders are invited for the installation of electric light at Byran Road, Barnsole Road, and Richmond Road Council Schools for the Education Committee. Particulars from Mr. Andrew Johns, Secretary, 4 Gardiner Street, Gillingham, fee 10s. 6d. returnable, and tenders by July 17th.

HIGH WYCOMBE (Bucks.).—The Union Baptist Church is to be rebuilt at a cost of £5,000. Architect, Thomas Thurlow, High Street, Northampton; builder, Richard Cleaver, Wood Street, Northampton.

LEYTON.—The Leyton Education Committee has resolved to erect two-storey block buildings in Sybourn Street, and blocks of buildings in Canterbury Road, or the purposes of school accommodation.—The Leyton Public Health Committee has decided to provide additional hospital accommodation at a cost of £650. Mr. W. Dawson is the Council's surveyor.

LINCOLN.—Additions are to be carried out by the Town Council at the infectious diseases hospital.

LIVERPOOL.—The Corporation has provisionally decided to erect baths at an estimated cost of £5,000. The Clerk to the Surveyor's Department is Mr. W. Hayward.

LUTON.—Messrs. T. & E. Neville, builders, of 30 Castle Street, are erecting Baptist Schools and Institute, Wellington Street. Architects, Messrs. George Baines & Son, 11 Clement's Inn, Strand, W.C.

MANCHESTER.—The Guardians are to erect a block for the accommodation of imbeciles at their workhouse at Crumpsall. Architect, Mr. A. J. Murgatroyd, 23 Strutt Street, Manchester.

MIRFIELD (YORKS).—The Mirfield Reformatory School Committee have decided on a school at Calder Farm. Architect, Mr. Joseph Berry, 3 Market Place, Huddersfield.

NORTHAMPTON.—The County Surveyor is instructed to prepare plans for the erection of St. Katherine's School.

NOTTINGHAM.—The County Education Committee has approved plans for the erection of a school. The estimated cost is £10,000.

OXFORD.—Mr. T. G. Jackson, R.A., of 14 Buckingham Street, Strand, is the architect for a new laboratory at the University.

PORTSMOUTH.—Mr. W. Bates White, architect, 173 Fawcet Road, Southsea, has drawn up specifications and plans of proposed new warehouse, depository, &c., &c.

PRESTON.—The Town Council proposes to erect a school at Deepdale, Engineer and surveyor, Mr. T. Cookson. Cost of work abut £13,000.

RAMSGATE.—A new general hospital and seamen's infirmary has just been commenced in West Cliff Road. Architect, Messrs. Wood and Ainslie.

SLOUGH.—The foundation-stone has been laid of a new Catholic Church in Curzon Street. Architect, Mr. Benedict Williamson; builders, Messrs. Godson & Sons, Kilburn Lane, London, N.W.

SOUTHAMPTON.—A new Council school is to be provided at Ringwood. County Surveyor, Mr. W. J. Taylor, The Castle, Winchester.

SOUTH SHIELDS.—A school is to be erected at Mowbray at a cost of £6,885. Builders, Messrs. Stephen Sherriff & Sons, Back Woodbine Street, South Shields.

STOCKPORT.—A new school is to be erected at Hazel Grove, with a seating capacity of 800, by the Cheshire Local Education Authority. J. W. Bain, Clerk.

SUTTON.—Additions are to be carried out to the Banstead Asylum by the London County Council at an estimated cost of £2,700. Architect, Mr. W. E. Riley, Spring Gardens, S.W.

WORCESTER.—The foundation-stone of a new Congregational Church at King's Norton has recently been laid. Architects, Messrs. Ewen Harper & Brother, Ruskin Chambers, 191 Corporation Street, Birmingham.

Kent Collieries Electrical Plant.—On Tuesday, in the Divisional Court, before the Lord Chief Justice and Mr. Justice Ridley, Mr. Bousfield, K.C., made an application in the case of Messrs. Ernest Scott & Mountain, Ltd., of Newcastle and Gateshead, against the Kent Collieries, Ltd. Counsel applied for a stay of execution, pending an appeal. Judgment had been given on the claim and counterclaim against the defendants for £1,826 (see ELECTRICAL ENGINEERING, Vol. III., p. 987). Mr. C. A. Russell, K.C., for the plaintiffs, asked that the stay should be granted on condition that the money be paid into Court. Their Lordships granted the stay asked for on condition that the amount mentioned should be paid into Court.

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TENDERS RECEIVED AND ACCEPTED

BELFAST.—The following tenders for coal have been accepted :—Mr. John Kelly, 10,000 tons; Messrs. Howden & Charley, 5,000 tons; Messrs. M'Elroy & Son, 5,000 tons; Messrs. J. R. Noble, 2,500 tons; and the Antrim Iron Ore Co., 2,500 tons.

BURNLEY.—The Town Council has completed an arrangement for the purchase of five covered-top electric cars.

At the meeting of the Town Council on July 2nd, Councillor Grey, in moving that the Electricity Committee purchase a 750-kw. generating set at a price not exceeding £6,000, said it was not expected that they would actually spend so much. The resolution was carried.

At the same meeting it was explained that the Klein Engineering Co., of Manchester, whose tender had been accepted for the erection of a cooling tower at the electricity works, had gone into liquidation, and with the consent of the company Messrs. Riley, Ltd., of Fleetwood, would supply the tower for £123 10s.—£6 10s. less than the other. The Council sanctioned the arrangement.

CROYDON.—The Corporation has accepted the tender of Babcock and Wilcox, Ltd., at £143, for the supply of materials for alterations to feed mains.

DARTFORD.—The tender of Messrs. Johnson and Phillips for £159 for house service cable jointing materials and accessories has been accepted.

DERBY.—Tenders for the supply of coal from the Derby Coal Co., Ltd., Messrs. T. & G. Walker, and Messrs. Parsons Bros. have been accepted. The tender of Messrs. E. Morley & Son for fixing a weigh bridge at the electric power station has also been accepted.

HORNSEY.—The Education Committee has decided to accept the tender of F. Cottrell, at £179 2s. 10d., for installing electric light at North Harringay Schools.

LANCASHIRE.—The British Westinghouse Electric & Manufacturing Co., Ltd., have received an order from Messrs. Tweedales & Smalley, Castleton, Lancashire, for one of their latest type tandem vertical gas engines, to be direct coupled to a direct-current generator of a combined capacity of 500 kw. when running at 110 volts, with switchboard complete, forming an extension to the 235-kw. gas-engine sets recently put into operation.

LEYTON.—The Urban District Council has accepted the following tender of Messrs. Venner & Co. for the supply of ordinary meters for the electrical department for the year ending June 30th, 1909 :—

Size.		Price. £ s. d.
1½	amperes	1 13 0
3	,, ...	1 16 0
5	,, ...	2 0 0
10	,, ...	2 5 0
18	,, ...	—
25	,, ...	2 10 0
50	,, ...	2 14 0
75	,, ...	—
100	,, ...	3 3 0

These prices are the same as those accepted last year, and similar prices were quoted this year by Ferranti, Ltd. (who also quoted £2 10s. for 18 amp. and £3 3s. for 75 amp.), and the British Thomson-Houston Co. The latter firm did not, however, quote for 25, 50, 75, and 100 ampere meters. Like Messrs. Ferranti, they quoted £2 10s. for the 18 ampere meter. The Council have also accepted the tender of Myers, Rose & Co., Ltd., for the annual supply of hand-picked, small, hard steam coal (Linby, Newstead, and Annesley) at 16s. 5½d. per ton respectively. The coal is to be taken from either colliery at the contractors' option, subject to the Council having the option to take a supply of slack, in addition to, or in lieu of, the above-mentioned coal, if considered desirable by the Electrical Engineer at any time for use with the mechanical stoker, such slack to be supplied by Myers, Rose & Co., at the following prices :—Bolsover nutty, 12s. 11d.; Creswell nutty, 12s. 11d.; Mansfield nutty, 11s. 10d.; Bentick, 12s. 7d.; West Hallam, 11s. 8d.; Shipley, 10s. 11d.; and Cossall, 11s. 8d.

LONDON: *London County Council.*—The tender of Mr. A. L. Holloway, builder, Union Works, Church Street, Deptford, S.E., for the reconstruction of the engine-house block of the chief fire station, Southwark Bridge Road, has been accepted at £3,653.

The Highways Committee recommend that a sub-station at Camden Town be erected without the intervention of a contractor, and that the wiring and fittings for the electric lighting be also carried out by direct labour. The Works Committee are prepared to erect the building at £4,175, to which is added the sum of £775 for professional and incidental expenses. The wiring and fitting will be carried out at a cost of £150.

An agreement has been entered into with Messrs. Southwood, Smith & Co., to sell the edition of 100,000 copies of the tramways guide which the Council is issuing at a commission of 55 per cent. The total receipts are put at £412 10s., so that the Council will receive £185 12s. 6d.

The undermentioned tenders have been received for the supply of ten hydraulic jacks for use in the pits at the various car sheds :—

National Rail and Tramway Appliances Co. (Recommended.)	£34 4 each.
F. W. Rowlands & Co.	35 10 each.
Watlington & Co.	36 15 each.

The following tenders have been received for the road work and plate laying for the reconstruction upon the underground conduit system of the Dulwich Library to Forest Hill tramways :—W. Manders, Leyton (recommended), £27,431 10s. 1d.; John Mowlem & Co., Ltd., Westminster, £28,120; Dick, Kerr & Co., Cannon Street, £28,126 6s. 7d.; Robert W. Blackwell & Co., Ltd., Westminster, £28,459 8s. 9d.; Fry Bros., Greenwich, £29,992 17s. 2d.; J. G. White & Co., Ltd., Cannon Street, £30,277 13s. 6d.; W. Muirhead & Co., Queen Victoria Street, £31,613 6s. 6d.

For the supply of feeder pillars during 1908-9 the London County Council have received the following tenders :—

	£ s.
J. H. Tucker & Co. (recommended)	1,595 6
Robert W. Blackwell & Co.	1,718 16
Spagnoletti, Ltd., ...	1,762 3
The Edison & Swan United Electric Light Co., Ltd.	1,782 3
British Insulated & Helsby Cables	1,818 16
,, ,, (Alternative tender)	1,841 11
,, ,, ,,	1,896 3
Thomas L. Scott & Co., Ltd.	1,831 3
W. Boydell & Sons, Ltd.	1,877 16
Universal Electric Manufacturing Co., Ltd.	1,897 19
Estler Brothers	1,901 2
Johnson & Phillips, Ltd.	1,911 7
Nalder Brothers & Thompson, Ltd.	1,951 17
Callender's Cable & Construction Co., Ltd.	2,117 19
W. T. Glover & Co., Ltd.	2,445 18
Whipp & Bourne	2,597 16

Battersea.—The Lighting Committee has decided to accept the tender of Babcock & Wilcox, Ltd., at £220, to carry out work in connection with rearrangement of the boiler-house steam-range at the central electricity station.

Hampstead.—The experiment of using a Berry series gear in one of the sub-stations having proved successful, the Council at the last meeting decided to fix similar equipment in all the other sub-stations, and also a number of new transformers, the whole to cost £688.—Only a small quantity of water has been obtained from the artesian well sunk some years ago at a cost of £1,100, and at present £1,000 per annum is paid for water supplied. Messrs. Isler & Co. have made an offer to endeavour to obtain a supply of water from the well by a process of their own. If they obtain two thousand gallons per hour they will receive £321 10s., if four thousand gallons £521 10s.; but if they are unsuccessful only £36 10s. is to be paid to them. This offer was accepted.

Islington.—Necessary repairs to an artesian well pump at the Borough Council's electricity works are to be carried out by the New Calyx Drill & Boring Co., at £88 11s.

St. Pancras.—The Borough Council Electricity and Public Lighting Committee has received the following tenders for a portion of pipe-work in connection with new machinery at the King's Road generating station :—

John Spencer Ltd. (provisionally accepted)	£235 0s. 0d.
Edward Le Bas & Co.	£297 10s. 0d.
John Fraser & Son	£486 0s. 0d.

Westminster.—The City Council Baths and Washhouses Committee has accepted the tender of Belshaw & Co. at £16 18s. for the provision of additional switches to the electric light installation at the Buckingham Palace Road Baths. There were seven tenders received, ranging from the amount of that of Messrs. Belshaw to £34 2s.

MOSCOW.—It is stated that orders to the value of £83,000 have been placed by the municipality with Messrs. Dick, Kerr & Co., and the British Insulated & Helsby Cables, Ltd., for the equipment of the Moscow electric tramways.

PLYMOUTH.—The tender of Messrs. Cory Brothers, Ltd., of Cardiff, for the supply of 7,500 tons of coal at 13s. 1½d. per ton, has been accepted. The price of the last cargo of 1,000 tons was 14s. 1½d. per ton.

PORTSMOUTH.—The tender of Messrs. W. Kennedy, Ltd., of Partick, has been accepted for the construction of the transporter bridge in connection with the electric light railway between Portsmouth and Hayling Island. The bridge will be of sufficient height to allow warships to enter the harbour.

WILLESDEN.—The Electricity Committee of the U.D.C. has resolved to accept the tender of the British Westinghouse Electrical & Manufacturing Co., Ltd., for the supply of a converting plant.

YORK.—The tender of Messrs. Callender's Cable & Construction Co., at £334 16s., has been accepted for a cable to be laid across the River Ouse at Skeldergate Bridge.

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PARLIAMENTARY INTELLIGENCE

LONDON ELECTRIC POWER BILLS.—Our report of the final proceedings before Lord Cromer's Committee, dealing with these Bills, will be found on page 69.

DISTRICT RAILWAY BILL.—This Bill was before a Committee of the House of Commons, presided over by Sir Lewis McIver. The Bill, which has already passed the House of Lords, proposes to authorise the issue of £750,000 prior lien debentures to meeting existing and prospective liabilities. It was anticipated that this amount could be issued at 4 per cent., but the limit in the Bill was 4½ per cent. The first use of the new capital will be to pay off existing mortgages of £478.000, the interest upon which is £20,000. Probably £500.000 or £600.000 will be raised at once, and the remainder spread over a number of years. Recognising that the scheme was in the interest of the company as a whole, it was stated to the Committee that 8 per cent. of the debenture holders had expressed their assent to it. If some such scheme were not carried out, the interest on the debenture stock must fall into arrears, and an application might have to be made for the appointment of a receiver, with results disastrous to the future of the company. The Committee found the preamble of the Bill proved.

INFECTION FROM TELEPHONES.—In the House of Commons on Monday Sir Edward Sassoon asked if the Postmaster-General was now in a position to say that the telephone company should be called upon to adopt the flat mouthpiece, such as was allowed abroad, instead of the present "antiquated" instrument, in the interests of hygiene and cleanliness. The Postmaster-General stated that he had no powers to force the National Telephone Co. to adopt any particular form of telephone. The standard instruments now in use were those considered efficient by all experts in this country and in the United States, and it was an easy matter for a subscriber to keep his instrument in a clean and sanitary condition.

SOUTH WALES ELECTRICAL POWER DISTRIBUTION BILL.—A Committee of the House of Commons, presided over by Mr. Partington, passed the preamble of this Bill last week. We gave full particulars of the measure when it was before the Committee of the House of Lords. Briefly, the Bill proposes to make arrangements with the company's creditors by the issue of £150 of preference shares for every £100 of debt, and also to confirm arrangements with the debenture holders, and further to ratify agreements with regard to the disposal of the generating stations of the company.

PATENTS ACT.—In answer to a question in the House of Commons last week, Mr. Churchill said that representations had been received from the United States and German Governments in respect of Section 27 of the Patents and Designs Act of 1907, which limits the time during which the patents must be worked in this country. His Majesty's Government, however, had no intention of proposing fresh legislation, nor to extend the time limit under the section of the Act in question.

PROGRESS OF ELECTRICAL BILLS.—The Paisley and District Tramways Order Confirmation Bill was read a third time in the House of Commons on Monday.

The Finchley Urban District Council Bill and the Motherwell Borough (Extension) Bill, were read a third time in the House of Lords on Monday.

The Macclesfield and District Tramways (Abandonment) Bill and the Tramways Order Confirmation Bill No. 2, were read a third time in the House of Lords on Monday.

The Bristol Tramways Bill was read a third time in the House of Commons last week.

UNOPPOSED BILLS.—The Nottinghamshire and Derbyshire Tramways No. 2 Bill was before the Unopposed Committee of the House of Commons on Tuesday, and was ordered to be reported for third reading.

London County Council Tramways and Improvements Bill was ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Tuesday.

WIRELESS TELEGRAPHY IN THE NAVY.—In answer to some questions in the House of Commons last week, Mr. Lambert said that the Admiralty had not yet found any system of wireless telegraphy, which could not be tapped by other ships and stations possessing suitable instruments; neither had the Admiralty knowledge of any system which required less horse-power than the one now used to secure reliable communication.

MISCELLANEOUS CITY NOTES

BRITISH ALUMINIUM CO.—Applications are being invited for an issue at par of £700.000 five per cent. redeemable mortgage debenture stock, which will be secured by a trust deed giving a specific charge upon all the freehold and leasehold properties of the company and a floating charge upon the undertaking, except unpaid capital, subject only to £230.745 five per cent. first mortgage debenture stock. The prospectus states that when all the company's undertakings are completed, which it is hoped will be at the end of next year, it is expected that there will be 60.000 h.p. available for the company's operation. During the three years which have elapsed since the Foyers water-power scheme was completed, the profits of the company (after deducting interest on the debentures and debenture stock or depreciation) have been as follows :—1905, £93,296; 1906, £155,023; 1907, £120,481. Works have now been started at Stangfjord in Norway, and also at Kinloch Leven.

CITY OF LONDON ELECTRIC LIGHTING CO.—Warrants in payment of the half-year's interest to the 30th ult., on this company's £400,000 5 per cent. first and £300,000 4½ per cent. second debenture stocks have been posted.

At the meeting held on the 1st inst. the directors declared the following dividends on account of the distribution for the year ending December 31st, 1908. On the company's preference shares, six shillings per share being at the full rate of 6 per cent. per annum for the half-year ended June 30th, 1908. On the company's ordinary shares, five shillings per share being at the rate of five per cent. per annum for the half-year ended June 30th, 1908. The above dividends will be subject to the deduction of income tax, and will be payable on or after August 1st, 1908, to all shareholders registered on the books of the company on July 17th, 1908.

COMPANIES STRUCK OFF REGISTER.—The names of the following electrical companies will be struck off the register, and the companies dissolved at the expiration of three months, unless cause be shown to the contrary: Electrical Appliances Syndicate, Ltd., Electrical Productions, Ltd., Electro-Smelting Co., Ltd., Helios Electrical Construction Co., Ltd., Irish Electric Railways Co., Ltd., North-West London Electric Supply Co., Ltd., Uddingston District Electric Lighting Co., Ltd.

CONSOLIDATED ELECTRICAL CO.—A dividend of 3½ per cent., less income tax, is recommended upon the ordinary shares for the year ended March 31st, 1908.

EASTERN EXTENSION, AUSTRALASIA, & CHINA TELEGRAPH CO.—An interim dividend for the quarter ended March 31st last of 2s. 6d. per share has been declared.

EASTERN TELEGRAPH CO.—A dividend at the rate of 1¼ per cent. has been declared on the ordinary stock, free of tax, in respect of the current year.

ELECTRICAL POWER STORAGE CO.—A 5 per cent. dividend is recommended on the ordinary shares for the year ended May 31st, 1908.

ELECTRIC TAXICAB CO.—Subscriptions are invited by the Electric Taxicab Co., which has been registered with a capital of £300,000 divided into £1 shares, the whole of which is now offered to the public. We give some technical particulars of the vehicles which it is proposed to put upon the streets on page 49, and the prospectus appears in our advertisement columns.

GREAT NORTHERN TELEGRAPH CO.—An interim dividend of 5 per cent. less income tax has been declared for the past half-year.

HASTINGS & DISTRICT ELECTRIC TRAMWAYS CO.—The directors announce that they do not feel justified in making at the present time any payment on account of the preference dividends.

LA CAPITAL TRACTION & ELECTRIC LIGHTING CO. (BUENOS AYRES).—A dividend of 3⅛ per cent. on the ordinary shares for the 15 months to March 31st, 1908, has been declared.

NATIONAL TELEPHONE CO.—Dividends at the rate of 6 per cent. per annum are recommended on the preferred and deferred stocks. £140,000 is to be placed to reserve, and about £10,000 carried forward.

The transfer books of the company in respect of the preference shares and preferred and deferred stocks, will be closed from the 10th until the 23rd of July inclusive.

OKONITE CO.—An interim dividend of 8s. per annum less income tax on the ordinary shares is recommended for the past quarter.

UNITED ELECTRIC TRAMWAYS OF MONTEVIDEO.—The whole of the outstanding balance of the 5 per cent. debentures has now been sold, completing the authorised issue of £800.000.

WEST KOOTENAY POWER & LIGHT CO.—Applications are being invited by the Bank of Montreal for £240,000 first mortgage 6 per cent. bonds of £100 each at 103.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. H. Thompson, Assistant Engineer, Burton-on-Trent, has been appointed Station Superintendent at Carlisle out of 160 applicants.

Lieutenant F. G. Loring, R.N., has been appointed Inspector of Wireless Telegraphy at the General Post Office.

The Electricity and Tramways Committee of the Warrington Town Council has resolved to appoint Mr. H. B. Jackson Chief Assistant Engineer, at a salary of £150 per annum, in succession to Mr. Purse, resigned. After consideration of the suggested re-arrangement of the duties of the Engineer and Tramways Manager, the committee has decided that the charge of car-sheds, upkeep of cars and the engineering work connected therewith, and the control of the men employed on the work, be transferred to the Tramways Manager without any increase of salary for six months; the salary of the Engineer to remain as at present.—The committee has also decided that Mr. F. V. Jordan be appointed Mains Engineer, at £130 per annum, rising by £10 per annum to a maximum of £150.

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COMPANIES' MEETINGS AND REPORTS

BUENOS AIRES AND BELGRANO ELECTRIC TRAMWAYS.—An extraordinary general meeting was held last week for the purpose of confirming the resolution passed on June 11th last, with regard to the voluntary winding up of the company. Mr. J. B. Concanon and Mr. H. S. M. Woodrow were appointed liquidators at the remuneration of £750.

GREENWOOD & BATLEY.—At the meeting last Friday, Mr. A. Greenwood, who presided, said that the amount of work turned out had considerably increased, and that although the prices they had been able to obtain were not high, the profits were almost double those of the previous year. In view of the general depression of the engineering industry, it was proposed to pay a moderate dividend and increase the amount carried forward. The directors had decided to call up the balance of the ordinary shares, on which only £3 had been paid up. The report was adopted.

MARCONI INTERNATIONAL MARINE COMMUNICATION CO.—The balance sheet to June 30th, 1907, shows that the issued capital amounts to £204,056, in addition to £20,000 debentures; outstanding debts amount to £20,269, making a total debit of £247,325. On the other side of the account, plant, apparatus, &c., are valued at £13,163, office furniture at £1,093, license and rights £105,115, contract with Lloyd's Corporation £977, shares in Associated Companies £2,375, debtors £4,397, and cash £34, thus showing a balance of expenditure over receipts from the incorporation of the company to date, £98,831.

NEW GENERAL TRACTION.—The twelfth annual general meeting was held last week, Baron E. B. D'Erlanger presiding. An increase of about £4,000 in the receipts from the securities held in subsidiary companies was reported, in addition to a profit of £913 by way of commission on new contracts at Coventry. The chairman said that the company was now practically a trust company, holding securities in the following different undertakings :—The Coventry Electric Tramways Co., Norwich Electric Tramways Co., the Douglas Southern Electric Tramways, and the Philadelphia Street Railway undertaking. Of these the Coventry tramways had been most satisfactory during the last two years, as they not only showed a large increase in receipts, but had yielded a handsome return on the capital invested. The working of the Norwich Electric Tramways was described as very disappointing. The report and accounts were adopted

UNDERGROUND ELECTRIC RAILWAYS COMPANY OF LONDON.—Meetings were held last week of the holders of unpaid coupons for interest in the profit-sharing secured notes of the power-house debentures and power-house second debentures, and in each case the following resolution was passed :—"That this meeting, having considered the scheme of arrangement dated April 7th, 1908, submitted to this meeting, a copy of which scheme has, for the purpose of identification, been signed by the chairman of the meeting, and the draft trust deed between the Underground Electric Railways Company of London (Limited) of the one part, and the London and Westminster Bank (Limited) as trustee of the other part, for securing the three classes of bonds to be issued pursuant to the said scheme, when such scheme has been approved by the Court, a copy of which draft trust deed has for the purpose of identification been signed by the said chairman, hereby approves the said scheme and draft trust deed with such modifications in the said scheme as may be necessary to make the same conform to the said draft trust deed, and with such modifications (if any) in the said scheme and draft trust deed or either of them as the Court may think fit to approve or impose."

A meeting of the holders of the profit sharing secured notes of the Underground Electric Railway Co. of London was held on Tuesday to consider the scheme of arrangement proposed between the company and the creditors. Sir George Gibb, who presided, said that when the scheme had received the approval of the debenture holders, it would at once be submitted to the Courts. He hoped that the temporary liquidation of the company would be ended in a few weeks. The scheme was agreed to.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars net c.i.f. port of arrival quoted on Tuesday night was £59 to £59 10s. per ton (last week £58 15s. to £59 5s. per ton).

CHANGE OF ADDRESS.—Messrs. J. E. Lea, makers of the well-known Lea water-measuring apparatus, have removed from 46 Brown Street, Manchester, to 28 Deansgate, Manchester. The telegraphic address will remain "Recording, Manchester" as before.

ELECTRICAL CONTRACTORS' ASSOCIATION.—Owing to the great strides made by the Electrical Contractors' Association, they have decided to take larger offices at the same address, 20 Bucklersbury. In future the offices will be at No. 282, on the fourth floor, instead of on the lower ground floor. Telegraphic address and telephone number will remain the same.

MESSRS. G. M. BODDY & CO. inform us that, to meet the conveniences of their numerous customers in the south of England and especially in London, they have opened a branch at 15 Gray's Inn Road, W.C. This is situated near the Holborn end of the road. The telephone number is 4814 Holborn. Mr. E. Slade Templeton, M.A., A.M.I.C.E., who is well known in the trade, has been appointed commercial engineer and manager of the branch.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—At Manchester Bankruptcy Court on Friday last, the public examination took place of Walter Wardle, electrician, of 14 Osborn Road, Levenshulme. The statement of affairs showed a deficiency of £1,097 6s. 3d. on unsecured liabilities £1,117 6s. 3d. In reply to questions, debtor said his failure was due to claims upon him in respect of the debts of a former partnership. In May, 1907, a limited liability company was formed to take over the business, and debtor was appointed manager at £4 a week. Pressure by creditors, however, had resulted in bankruptcy proceedings against the debtor. The company had been worked at a profit.

A petition has been filed re Francis Benjamin Eggington, electrical engineer and contractor, of Wolverhampton. The deficiency is given as £82.

The first meeting in the bankruptcy of T. A. Evans & Co., electrical engineers and contractors, of 14 Heathfield Street, Swansea, will be held to-day at 11 a.m., at the Official Receiver's Offices, 31 Alexandra Road, Swansea, and the public examination will take place at the Town Hall, Swansea, on July 31st, at 11.30 a.m.

Reid's Electrical Co., Ltd., is to be wound up voluntarily. Mr. D. S. Fripp, 90 Cannon Street, London, is liquidator.

The Chipping Norton Electric Light & Power Co., Ltd., is to be wound up voluntarily. Mr. A. Harlow, 8 Maitland Park Road, Haverstock Hill, London, is liquidator.

The Buenos Ayres and Belgrano Electric Tramways Co., Ltd., is to be wound up voluntarily. Mr. J. B. Concanon, 28 Austin Friars, London, E., and Mr. H. S. M. Woodrow, 52 Moorgate Street, London, are liquidators.

Creditors of Messrs. Meldrum Bros., are asked to send in particulars of their claims to T. Gregory, Parr's Bank Buildings, 3 York Street, Manchester, by August 14th. The same announcement is made in respect of the Société Meldrum, Ltd.

Interruption to the Shetland Cable.—A complaint has been received by the Aberdeen Chamber of Commerce that, owing to the breakdown of the telegraphic cable to Shetland, business, and especially the herring business, has suffered considerably. For the last few weeks telegrams have been sent through Kirkwall, involving a delay of from two to four hours in transmission. A letter has been received from the Postmaster-General, stating that the working capacity of the Kirkwall route had been temporarily increased, and that a cable ship was engaged in carrying out repairs to the direct cable to Lerwick.

Telegraph Traffic.—The repairs to cables in the Mediterranean have not yet been effected, and it must be presumed that the breaks are of a more serious nature than was supposed. There are no interruptions to submarine cables to announce, nor restorations to notify. The only disturbance which has taken place is on the lines of the Indo-European Telegraph Co., whose system has suffered interruption between Tauris and Teheran, but it is probable that this is due to the disturbed state of the country where the break has occurred. There may, of course, be other disturbances, but those companies which own duplicate routes are in the habit of keeping them quiet, as the ordinary telegraphic facilities are not thereby impaired or the charges per word altered.

Damage to Cables by Trawlers.—The Postmaster-General, after consultation with the President of the Board of Trade, has appointed a committee to inquire whether the damage done recently to submarine cables in the waters off the south-west coast of Ireland has been caused by the operations of trawlers; and, if so, to consider and report what steps it may be desirable and practicable to take to prevent such injury in future. According to the *Daily Telegraph*, the committee is constituted as follows :—Sir J. C. Lamb, C.B., C.M.G., formerly Second Secretary to the Post Office (Chairman); Mr. W. R. Culley, I.S.O., Submarine Superintendent in the Engineering Department of the Post Office; Commander G. C. Frederick, R.N., professional member of the Harbour Department of the Board of Trade; Mr. C. E. Fryer, I.S.O., Superintending Inspector of English Fisheries; Mr. W. S. Green, C.B., Chief Inspector of Irish Fisheries; and Commander G. M. Marston, of the Hydrographic Department, Admiralty. Mr. F. J. Brown, of the Secretary's Office, General Post Office, will act as secretary, and any applications from persons desiring to offer evidence should be addressed to him. The committee has been requested to report as speedily as possible.

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THE THIRTEENTH CONVENTION OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION

(*Continued from p.* 68.)

THE TESTING AND STANDARDISING DEPARTMENT

(*Continued*).

Regulation of Testing Current and Voltage, &c.—The author considers it an advantage for this to be centralised as much as possible in preference to having switches, resistances, and instruments, &c., scattered about the test rooms.

For the actual control of heavy or main current circuits, rheostat switches connected with wire resistances undoubtedly constitute the most satisfactory arrangement. Water and carbon resistances are by no means so convenient; the former owing to the current fluctuations produced by the evolution of bubbles, &c. (*i.e.*, polarisation), and the latter owing to their high negative temperature coefficient. Wire resistances may be constructed of metal, having an almost negligible temperature coefficient. It should be possible to vary the current by practically infinite steps, and a range of from $\frac{1}{100}$th of an ampere to 1,000 amperes may be obtained with comparatively small resistance frames, if suitably designed. The author prefers resistance frames connected up to the rheostat switches in parallel; that is to say, in such a way that the current is increased by putting resistances into circuit in parallel instead of by cutting resistances out. This serves resistance wire, as all the coils are utilised during the passage of the maximum current. The parallel controllers themselves, as distinguished from the resistance wires, are rather more expensive than the simple series rheostat switches, but are far more reliable in their working, and, moreover, the increased cost is not so great as might be supposed on first consideration, since the fact must not be overlooked that each of the contacts has only to carry a fraction of the full current. A convenient arrangement is to have the rheostats in three groups, as follows:—

One group having 10 approximately 1 amp. Steps.
One group having 10 approximately 10 amp. Steps.
One group having 5 approximately 100 amp. Steps.

These would all be connected in parallel, and also in parallel with them again should be a resistance capable of carrying a maximum current of 1·5 amperes, and having a practically infinite range of variation; about the most convenient resistance of this type is the "Kelvin" drum rheostat, which consists of two cylinders, one with a metal surface, and the other insulated; the cylinders or drums are connected mechanically through spur-gearing to a common pinion. The resistance wire is wound on the outer surface of the drums, and can be transferred from one to the other by rotating them, the proportion of wire on either being varied to any required extent.

Special Alternating-Current Requirements.—Fig. 2 shows an arrangement which has been found to be very convenient for all classes of alternating-current meter and instrument testing. The voltage of the alternator may be varied by almost imperceptible steps, from practically zero up to 450 volts. The fine control rheostat in the alternator field can be used for maintaining the watts in the testing circuit absolutely constant, since by moving it slight variations are produced in both the current and the volt circuits, but not to a sufficient extent to be of any consequence, although quite sufficient to give the necessary adjustment of the watts. The main current circuits are controlled in the same way as in direct-current work, except that the fine control is obtained by a resistance in the primary circuit of the current transformers.

The main current circuits and the volt or shunt circuits are quite distinct, there being no electrical connection between them. The former are fed off the secondary side of step-down transformers, the voltage being about twenty; these transformers are built in two halves, and both the primary and secondary windings may be connected in series or parallel, as shown in the diagram. It is thus possible to utilise them with a large range of alternator volts.

The volt circuit is not connected directly to the alternator, but to the piece of apparatus designated "Phase Shifter" in the diagram. A common method of altering the power factor in alternating-current testing circuits is to make use of choking coils, &c., but this method has the great disadvantages that alteration in power factor also produces changes in the volts and amperes. The "phase shifter" overcomes this difficulty. The amperes and the volts may be set to any required value, and the power factor can then be adjusted to any value from zero to unity, lagging, or leading, without disturbing the current or volt adjustments.

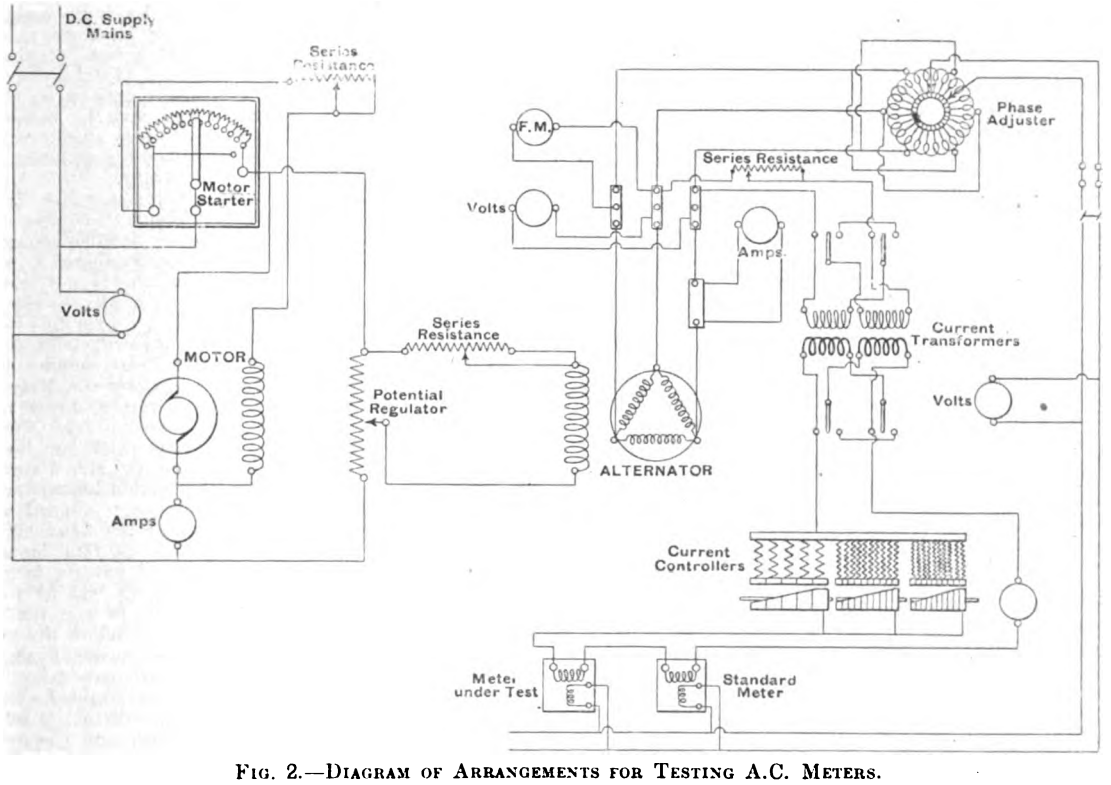

FIG. 2.—DIAGRAM OF ARRANGEMENTS FOR TESTING A.C. METERS.

This principle of utilising a rotating field to produce a difference in phase between two circuits is comparatively old, but there are one or two rather unusual features in the details of construction of the device.

The main portion consists of the armature of a 10 h.p. 400-volt four-pole direct-current motor, complete with windings, commutator, and shaft, &c., the armature being of the toothed core type, with former wound coils. In order to form a closed magnetic circuit, thus avoiding excessive magnetic leakage, and at the same time keeping down the magnetising current, sheet-iron stampings, in the form of annular rings, and separated by paper in the usual way, were pressed over the armature, making good magnetic contact with the iron core stampings. These ring stampings were built up the full depth of the armature, with suitable ventilating ducts at intervals, the whole being clamped between two annular gun-metal end plates by means of four bolts passed through insulated and bushed holes in the plates

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and stampings. The armature being four-pole, the three-phase mains are led in at six points as shown.

The armature and outer ring are fixed with the armature spindle vertical, inside a specially constructed switchboard, the commutator and shaft end only being visible. A loose sleeve is fitted on the shaft, and on the sleeve two arms are clamped. These arms are provided with wooden handles, and support insulated spindles carrying brush-holders. The brushes are made of copper, and are filed to a knife edge, so that they can only touch one commutator segment at a time, and, moreover, cannot cause a short when moving from segment to segment.

It will thus be seen that by loosening the clamping screws the brushes may be moved relatively to each other, and consequently the voltage between them varied by steps equal to the volts between two adjacent segments of the commutator. When the handles are clamped to the sleeve, the combination as a whole may be moved round the commutator, thus producing any desired phase difference between the "pressure circuit" fed from the phase shifter, and the "current circuit" connected to the L.T. side of the step-down transformers.

Measurement of Current, Volts, and Watts.—The author wishes to emphasise the necessity for definite discrimination between standards and sub-standards. Standard instruments should only be used by the senior testers for the purpose of checking suitable sub-standards; and occasionally in case of dispute they may be used with discretion when conducting any special tests. For direct-current work, the most suitable sub-standards are undoubtedly direct reading instruments of the "moving coil type," provided that well-made instruments are used. Unfortunately, during the last few years the market has been flooded with cheap instruments of this type, which are worse than useless for any but the very roughest class of testing work.

For alternating-current work, "hot wire" instruments form most convenient sub-standards, and possess the great advantage of being unaffected by frequency and external magnetic fields; they may also be checked against the direct-current standards. Wattmeters used as alternating-current sub-standards should preferably be of the dynamometer type, and astatically wound, since this type of instrument may also be checked against the direct-current standards.

The most convenient standards for the checking of current, volt, and watt measuring sub-standards are undoubtedly the "potentiometer" and "Kelvin balances." A most reliable method of measuring alternating-current volts accurately is by means of a sensitive multi-range electrostatic voltmeter. The deflection on the voltmeter when connected to the alternating-current circuit is noted, the instrument is then switched over to a direct-current supply, and the previously noted deflection reproduced by suitable adjustment of the pressure which can at the same time be measured on the potentiometer. This method eliminates all scale and zero errors of the voltmeter.

Wattmeters can, of course, only be checked direct-current with the equivalent of unity power factor; this is not a very serious matter, however, as with well-designed instruments of the type referred to above, the error when working on power factors other than unity is very slight, and, in fact, practically negligible under all ordinary working conditions. The accuracy of a wattmeter on low power factors is naturally of much more relative importance when working "three-phase" than when making "single-phase" measurements; since it is possible for the actual power factor of the instrument circuit to be very much less than the figure representing the power factor of the main circuit. For instance, if the power factor of the system is 0·5, then when making measurements by the usual "two-wattmeter method," the power factor on one wattmeter will be zero, and consequently the instrument should not read at all, and if it should fall below 0·5, then, as is well known, one wattmeter will actually have its readings reversed.

The Price Guard Wire.—The guard wire is a very old, and, unfortunately, rather neglected device for overcoming the difficulties which arise in connection with the measuring of high insulation resistances, owing to the leakage from apparatus and

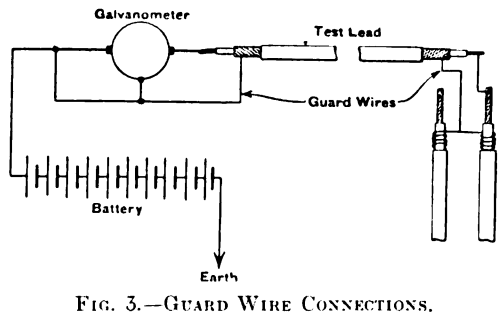

FIG. 3.—GUARD WIRE CONNECTIONS.

test leads, such leakage frequently being greater than the actual leakage through the dielectric of the cable under test. The diagram, Fig. 3, shows a concentric cable used as a test lead, the outer conductor being used as a guard wire. There is thus no necessity for the elaborate paring and drying of the ends. The same applies to the ends of the cable under test, if suitable guard rings are used as shown in the figure. The author has in this way found it possible absolutely to eliminate any leakage deflection on an unshunted galvanometer, having a constant of 1,000,000 megohms when connected to a 400-volt battery, and using a test lead over 100 yards long with damp ends.

Use of Secondary Battery for Mains Testing.—If a secondary battery is installed for the meter and general testing work, there is no reason why it should not be used for insulation testing, &c., provided that a few necessary precautionary measures are adopted. It is necessary to put in series with it a fairly big resistance, in order to guard against short circuit. For insulation testing, one end of the battery will require to be earthed, and it is, therefore, advisable to arrange the circuits in such a way that when the battery is in use for testing purposes, it cannot be connected to the charging circuit, which probably forms a portion of an already earthed network. Banks of lamps are used for the artificial battery resistance, and also act as a potential regulating resistance, thus enabling various intermediate voltages to be obtained.

Chemical Laboratory.—A small room, or a corner of one of the larger test-rooms should certainly be provided with a few of the principal chemical re-agents and a fairly good balance. Such an equipment will be found most useful for testing the purity of mercury, pentane, accumulator acid, bitumen, and box compound, &c., and for various rough tests of a similar nature.

Photometric Work.—The Photometer Room.—This may conveniently be a partitioned-off portion of a larger room. It should be absolutely light-tight, and painted dead black internally, all fittings, &c., being similarly painted. One end of the room should be arranged so that it may be screened off from the main portion, and should also be built higher, in order to accommodate arc lamps, &c., and the dome so formed may also be provided with a horizontal screen or shutter. The vertical and horizontal screens should also be provided with a number of small doors about 8 inches square, so that the rays of light from the lamp under test may be measured at any angle. The atmosphere in such a room soon becomes vitiated and almost unbearable; good light-tight ventilators and a small electric fan will therefore be necessary.

A convenient length for the photometer bar is about 150 inches, and it should for preference have two sets of divisions; one scale being graduated in inches or centimetres and numbered from both ends; and the other scale numbered from the centre to either side, and so graduated as to give the quotient of the square of the two distances of any point on the bar to the lights under observation.

Probably the most convenient standard, both for reliability and durability, is the "Harcourt" 10 candle-power pentane lamp, the authorised standard adopted by the Metropolitan Gas Referees. It is very necessary, therefore, to correct all comparisons made with this standard, for the effect of barometric or hygrometric conditions, which can be easily done by means of the formula established by Mr. Paterson, of the National Physical Laboratory. A reliable barometer and hygrometer will be required for the purpose; a good wet and dry bulb thermometer probably constitutes the most convenient and practicable form of hygrometer. The pentane lamp should be used as a primary standard only, and not for long at a time, and metallic filament lamp sub-standards will be found useful. Before calibration they should, if new, be run for at least "hours, and the volts should be rather below the normal when making the final adjustment of candle-power. Such a calibrated sub-standard will retain a definite candle-power for two or three hours, provided that the current is maintained constant; this should not be done by adjusting the volts at its terminals, but by actually measuring the current taken, on the potentiometer, and regulating it with a resistance having a fine range of adjustment. By this means all errors due to drop of volts in contacts are eliminated. After a set of comparisons with other lamps have been made, the sub-standard should again be checked against the pentane lamp.

There is a considerable difference of opinion as to the best form of "comparison box or photometer head." For comparing lights of different colour, such, for instance, as a mercury vapour lamp and a carbon filament lamp, the author prefers the Simmance Abady Patent Flicker Photometer. For the ordinary work of comparing incandescent lamps with a standard incandescent lamp, excellent results may be obtained with a grease-spot photometer, and also probably with less fatigue to the eyes and in less time than would be possible with the flicker type.

Portable photometers have been brought prominently into notice lately owing to the various discussions, &c., which have arisen on the subject of "street lighting." There is, unfortunately, a good deal of doubt as to what a portable photometer is really intended to measure, one authority contending that it should indicate the intensity of the illumination on a horizontal surface, others consider the vertical illumination should be measured, and one authority that all measurements should be taken on a plane at 45° to the horizontal. The author prefers to use a photometer which, when fixed in any position, can be focussed on any desired light, and permit of measurements being taken of the actual illuminating value of the direct focussed ray from that light in candle feet.

Mains Testing.—A very fair indication of the healthy state or

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otherwise of a cable after laying can generally be obtained by the use of a compact portable "insulation testing set," such as the "Silvertown" or the "Kelvin." For quick work, and when the insulation resistances to be measured are not very high, instruments of the ohmmeter and generator class give reliable results.

Should it be necessary to measure resistances of the order of several thousand megohms, it will probably be found most convenient and satisfactory to have a small hooded handcart fitted with a 300- to 400-volt battery of small dry cells and a simplified form of laboratory outfit.

The periodical testing of the distributing system under working conditions has been very much neglected in the past, but engineers are now beginning to realise the advantages of being able to feel the pulse of the network.

Many suitable methods for conducting tests of live networks have been described at various times. The "Russell" test is a very convenient one to carry out, and has been reduced to its simplest form in the extremely ingenious instrument known as the "Groves" network tester. The only objection to the Groves instrument is the rather limited range of the scale readings. It has been found very convenient to use a multi-range ammeter and voltmeter for this test, since it then becomes practically possible to obtain open scale reading under almost all conditions.

It is also a great advantage to have the combination of apparatus used for this class of test made up in a portable form, so that it can be carted about to various sections of the network, fed, possibly by separate generating or sub-stations. If suitably designed, such a set may be utilised for a great variety of useful tests. Fig. 4 shows a simple arrangement which has proved itself to be most convenient for the purpose. The four-way ammeter switch gives ranges of 5, 10, and 50 amperes, also a by-pass position. The voltmeter has 75, 150, 300, and 450 volt ranges. Should the outer faults be nearly balanced, an artificial fault of 10, 20, 30, or 40 ohms can be thrown on either side of the system by means of the two-way knife switch.

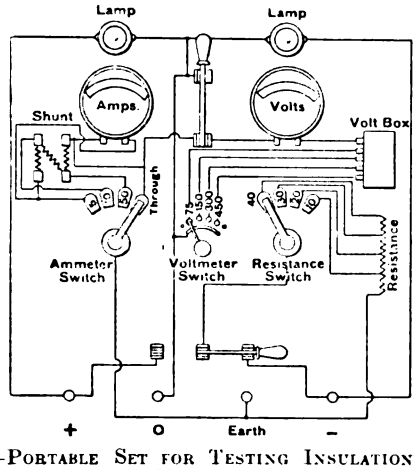

FIG. 4.—PORTABLE SET FOR TESTING INSULATION OF LIVE NETWORKS.

Breakdown tests, when necessary, should, if possible, be conducted from the generating station, the reason for this being that a comparatively large amount of power is required to satisfactorily break down a cable. The most satisfactory arrangement is to have a separate step-up transformer which may be connected to an isolated generator, and the secondary winding to the cable under test; this winding should be sufficiently heavy to carry a current of 5 to 10 amperes, since it is frequently necessary after breaking down a fault to be able to maintain a fairly strong arc in order to produce a permanent short circuit or earth connection suitable for localising purposes.

A portable testing plant is very convenient for carrying out the Board of Trade "double working pressure test" on sections of high-tension feeders before they are joined through to the generating station; or for testing cables which cannot be linked through to the station. In Manchester they have a very complete portable set for making tests of this description, all the necessary machinery and apparatus being installed in a specially-constructed van, which may be drawn by two horses. Briefly, the arrangement is as follows:—A 10-kw. 500-volt single-phase alternator is direct coupled to a 16 B.H.P. direct-current motor. The alternator is connected to the primary of a "Cowan-Still" patent regulating transformer, and the secondary of this transformer is connected to the primaries of three oil insulated and cooled step-up transformers. These three transformers are wound for 500 volts on the primary side, and the secondary winding on each is in five sections of 2,000 volts each. Switches on the tops of the transformers permit of any required number of these sections being connected into the secondary circuits. These switches are, of course, never operated when the transformers are alive. The secondaries of the transformers are connected in series, consequently voltages up to 30,000 may be obtained. The transformation ratio of the regulating transformer may be varied through a practically infinite range from $\frac{500}{0}$ to $\frac{500}{500}$, thus rendering unnecessary the use of regulating resistance in either the motor or alternator field. A small resistance is, however, useful in the motor field for the purpose of maintaining the frequency constant. The direct-current supply for the motors is usually obtained from the nearest point on the low-tension network. Should this not be available, it is generally possible, since all high-tension cables are in duplicate, to utilise one as a low-tension feeder, whilst the other cable is under test.

The chief disadvantages of such an otherwise ideal and convenient set are that the secondary windings of the transformers are wound with a very fine wire, so that it is not safe to take a current much larger than one ampere from them, which is sufficient to indicate a fault, but not to break it down. That it is not possible to test very long lengths of cable, owing to the large capacity currents, which heat the secondary winding. Finally, that owing to the small size of the plant, and the fairly high magnetic leakage in the transformers, it is necessary to exercise great care when raising the pressure on a cable, as the conditions are very favourable for producing resonance effects; and, moreover, the comparatively heavy leading current causes a considerable rise in the terminal P.D. of the transformers and alternator. It has frequently been found that an adjustment of the transformers, &c., which would give a pressure of about 10,000 volts on open circuit, will easily give from 15,000 to 20,000 volts on a long length of cable. When conducting tests of this description, it is therefore essential to have a high-tension voltmeter connected directly to the cable, instead of estimating the pressure from the readings of a voltmeter in the primary circuit of the transformers.

To attempt to describe any particular form or collection of apparatus as being the most suitable for fault localising would probably be a rather dangerous proceeding, as nearly every engineer has his own pet method of carrying out these tests.

It may not be out of place if the author refers to a simple, but little used, method for making a slide wire bridge, used for the loop method, practically direct reading, and at the same time utilising the full length of the slide wire. Fig. 5 is almost self-explanatory. The faulty cable is connected to the terminal *A*, and the loop or return cable to *B*. The other gap

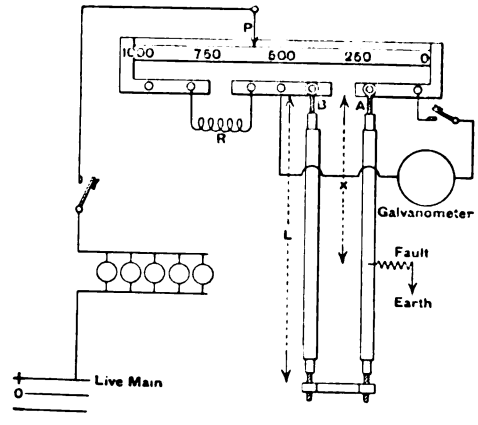

FIG. 5.—MODIFIED FAULT-LOCALISING BRIDGE.

of the bridge is closed by a resistance *R*, exactly equal to the resistance of the slide wire, and preferably constructed of the same size and class of wire. If an ordinary millimetre scale is used, and the full length of 1,000 millimetres is taken to represent unity, smaller readings representing proportionate decimal fractions.

Then if L = length of cable (single), and p = reading on scale, $x = pL$, it will be seen that the available length of scale is exactly doubled, since if the extra resistance was not used, no reading beyond 50 centimetres could be obtained.

Motor Test-room.—These tests are frequently carried out at the manufacturers' works, but the author is rather sceptical as to the reliability of them under these conditions, and prefers to have them conducted in the Corporation's own test-room. Experience has shown the importance of these tests, since about 50 per cent. of the motors delivered require adjustment in some form or other, and it is frequently necessary to reject machines altogether. If the repair work is undertaken by the motor department, as it should be, then, of course, a suitably-equipped test-room is absolutely essential.

It is advisable to make rough efficiency tests on all sample machines, and occasionally on an odd one or two out of a large delivery. Tests made on a large number of motors have shown that in the case of most firms of repute, the actual efficiencies of the machines agree very closely with the maker's guaranteed figures.

The following characteristics of a D.C. motor are the ones which mostly concern the actual users: Speed variation (with

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varying load); speed-variation (with varying temperature); temperature rise; and sparkless commutation under all conditions of load and temperature. All this information is obtained from, say, a six hours' run at full load, combined with short tests at varying loads, both before and after the six hours' heat run.

The motors are most conveniently loaded by belt connecting them to dynamos, the output of the latter feeding back to the supply. The principle is similar to the Hopkinson test, except that owing to the belt drive, and probably considerable difference in size between the motor and dynamo, it is not possible to obtain reliable figures for the efficiency of the machine on test. Some form of test bed will be necessary to accommodate the various sizes and makes of motors, a very simple and efficient one may be constructed out of two sets of large slide rails, placed one set on top of the other at right angles. The loading dynamos should be permanently fixed and have their field magnets separately excited, it is also an advantage to have two or three different size pulleys to fit the shafts, so that the necessary range of speed when driven by motors of different size and make, may be kept as small as possible. All connections for the tests should be absolutely permanent, the necessary control being centred at a suitably-designed switchboard, from which cables are carried to terminal blocks fixed near the test-bed. In the switchboard described in the Paper, the motors or the dynamos may be connected to either a 200-volt or 400-volt circuit by means of links. The motor is run up to speed, and the excitation of the corresponding dynamo raised until its terminal P.D. is equal to bus-bar pressure; it is then paralleled on to the bars, just as in a generating station; and the load on the motor then adjusted to any required amount by altering the dynamo field excitation. It is not necessary that the dynamo should be feeding back on to the same mains to which the motor is connected; the motor might be on 400 volts, and the dynamo on 200 volts, or *vice versa*.

Ammeters are provided in the motor main circuit, field circuit, and dynamo main circuit. The field ammeter readings enable temperature curves to be drawn.

Motor starters require to be tested for correct coil resistance, adjustment of overload and no-volt release coils, &c., also for heating when starting up a motor under the conditions of the specification or guaranteed time limit rating. For testing the coils, some form of direct-reading ohmmeter is most convenient.

This can easily be constructed in the testing department out of any old moving coil instrument. Advantage may also be taken of the equipment of other sections for the necessary high-pressure flash tests, and drop of potential tests on repaired armature and field coils, &c. An ohmmeter and generator will fulfil all requirements of insulation testing.

Workshops.—Most of the work is bench work, and comparatively light; any job necessitating the use of heavy machine tools should preferably be handed over to the generating station construction and repair shops. The actual work of repairing all motors, starters, meters, instruments, &c., can certainly be executed more expeditiously and cheaply than would be the case if it were undertaken by the makers, but, as a rule, it does not pay to construct the more elaborate spare parts.

In conclusion, the author begs to acknowledge his thanks to Mr. S. L. Pearce, Chief Engineer to the Manchester Corporation Electricity Department, for sanctioning the use of drawings, and the various references to the work and equipment of the Manchester Testing Department. Also to his assistants, Messrs. A. E. Jepson and J. S. Westerdale, for the preparation of most of the drawings and diagrams.

DISCUSSION.

Mr. G. WILKINSON (Chief Electrical Engineer, Harrogate) said that, unless an engineer gave very careful attention to the accurate metering of his current, he was very much like the man who was trying to stop a leakage at the spigot of a beer barrel when all the time there was a much greater leakage at the bunghole. Most of the early testing apparatus was more suitable for telegraph engineers, and even in later years many stations had sprung up in all parts of the country, in which the question of standardising and testing instruments appeared to have been almost entirely neglected. Mr. Ratcliff had suggested a method of dealing with these cases by co-operative working of a testing station. He was entirely opposed to this recommendation, because he thought if there was one place where a testing station ought to be, it was in the centre of the area where the distribution and the central station was situated. He was of the opinion that co-operative working would mean greatly increased costs in the shape of fees for testing, there would be very great difficulties in transporting the large number of apparatus that required attention, whilst many of the smaller individual tests which, when taken singly, were of little importance, and yet collectively were of great value, would be entirely neglected. Also, it would be extremely difficult to carry out routine tests, viz., the systematic bringing in to the test-room of the meters, taking street by street, and examining them in a definite and methodical way. It had been a great surprise to him to find what a substantial increase in the revenue had been obtained by these systematic routine tests. In many instances it was found that meters which had been out for two or three years were running slow, especially on light loads, and were quite incapable of measuring the small currents that might be taken for lighting three or four lamps. Sometimes a meter was running fast and counting against the customer, but for one like that they would find dozens that were running too slowly. In reading through the details of the ground which Mr. Ratcliff thought a testing department should cover, he noticed some times which hardly came within the scope of a testing department. For instance, it was suggested that the instruments should be made there, and also that armatures should be rewound or reconstructed there. He found that for a small station such as that at Harrogate, they had, for a capital expenditure of £250, sufficient instruments for carrying out all the other operations mentioned in the schedule of the Paper, excepting, perhaps, where Mr. Ratcliff mentioned high-tension portable testing apparatus capable of giving a primary pressure of 30,000 volts. But this would only be required in a very large station. Any station, however, that could not afford an expenditure of, say, £500 on testing plant would have very great difficulty indeed in justifying its existence as a supply authority, and ought not to have been set up. There was one very good guide as to the accuracy of meter testing, and that was, when they put in meters, they always had a certificate from the makers as to the accuracy. If they found meters from any one special maker varying from their own findings, then they could easily get a reference to some standardising institution. He had done this on several occasions, and had made arrangements with the makers that whoever was furthest from the correct standard should pay the fees for the reference, and he was pleased to say that in every case the makers had had to pay. Reference was made in the Paper to a very interesting piece of apparatus called a phase shifter. This was evidently a home-made instrument, but he would like to know either from the author or from anyone else if any similar piece of apparatus was on the market, and could be purchased. Another instrument which would be very useful to single-phase stations would be a simple and reliable power-factor indicator. He had made inquiries, but had never found a really good one.

Mr. HAYDN T. HARRISON said the paper particularly interested him, because he had been responsible for the lay-out of some of the big testing stations in this country, including the meter-testing department of the City of London about five or six years ago. The phase-shifting device which Mr. Wilkinson had called attention to was very ingenious, but as to whether it could be purchased he did not know. He knew, however, that it was being used by a number of the best meter-makers. He was inclined to agree with Mr. Wilkinson that it was not always possible to rely upon the phase indicators which were purchaseable at the present time. There was little doubt that for street photometry the best basis of comparison was horizontal illumination, and if they took the measurement on a plane at 45 degrees to the horizontal, it was possible to get through the measurements very much quicker. He had had to carry out 200 measurements in the street in a night, and it made a difference of several hours whether he had to adjust his screen or whether he did not. The author obviously corroborated this view in practice, because he mentioned he used a Simmance-Abady head. This measured at an angle which was never horizontal. He always used to use it himself, but not in the way it was intended, but at a fixed angle, and he corrected the readings afterwards. He warned people against following the author's advice and using a Harcourt standard. He had found more errors in photometry in different testing rooms due to the use of a Harcourt standard than anything else. The best way was to have their own sub-electric standard, to send it to the National Physical Laboratory to be checked.

Mr. A. J. CRIDGE (Assistant Engineer, Sheffield Corporation), on the question of alternating-current supply for testing work, said he had recently had an opportunity of going round a large manufacturing works, and in their testing room they had a special motor generator working in conjunction with a special battery. The phase shifting device mentioned in the Paper had attracted his attention, because a month or two ago he had been struck by the necessity for such an instrument, and he had made one, but had not had time to make tests before coming to the meeting. He had just received a telegram from Mr. Beauchamp, the Chief Assistant Engineer, however, to the effect that they had got 160 volts out of it, and some additional turns were necessary to obtain the requisite pressure. This was due to the fact, he thought, that the air gap was rather large. In making this instrument up he had taken the stator of a four-pole motor, and on each of the four poles there were 600 turns of wire. On a special shaped rotor they wound various numbers of turns and brought them out at different terminals, and by putting two phases to the stator and putting the rotor in different positions, he got a considerable phase-displacement. The author had also mentioned cable testing in the Paper, but this was not generally part of the work of a testing department.

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Mr. H. D. BURNETT (Chief Electrical Engineer, Barrow-in-Furness) said that he had recently found that a whole batch of meters did not agree with the maker's certificate, and it was found that in starting their watch they got a slight error. Even in some of the most expensive watches this error was as much as a second, which was of considerable importance when, as usually happened, the tests were for a short time, say 20 seconds. Another important matter was dial testing. He recently had five or six meters which were tested on being received, but unfortunately the dial test was omitted, and it was not until some little time afterwards that they received complaints. He investigated the matter, and found the meters in question were 25 per cent. wrong. The gear-wheel had been altered at the maker's works and the tester had forgotten to make the alteration in the constant, and consequently the meters went out inaccurate. The tester who was responsible for this had since left the service of the makers. The best test that could possibly be adopted for distributing mains in a three-wire system was to remove the central wire from earth, and earth one of the outers. Any system should be capable of standing such a test, and if it was made during the night or early morning the risk was not very serious.

Mr. R. HORNBY (Siemens Bros. & Co.), speaking from the manufacturers' point of view, said that most disputes on questions of accuracy arose from either the standard instrument not having been checked recently, or to some watch troubles, as the speaker had mentioned. If, therefore, it was possible to link up the testing laboratories with the Board of Trade, so that some machinery would exist by which the sub-standards would be sent to the testing laboratory nearest the place of use, a considerable step in advance would be made. With regard to Mr. Wilkinson's remark about phase-shifters, there were several on the market which could be bought in the ordinary way. These were rather expensive, but a rough-and-ready device could be made for 25s. or 30s., which was better than the arrangements in a good many test-rooms where arc-lamp coils and temporary devices were used. Power-factor indicators he preferred to call by this name, because he did not know of any device which could really be called a meter in the sense of a practical indicator, but the best method was to use a wattmeter and simply compare the true watts indicated against the volts and amperes as shown on ordinary commercial voltmeters and ammeters, and in this way a very simple and effective test was obtained.

Mr. RATCLIFFE indicated his desire to reply in the Proceedings.

The Proceedings of the Convention then terminated with a hearty vote of thanks to the President.

REPORT ON THE BIRMINGHAM AND MIDLAND TRAMWAYS ACCIDENT

COL. H. A. YORKE'S report on the fatal accident that occurred on February 22th, near Gipsy Lane, Brades Lock, between Tividale and Oldbury, on the tramways belonging to the Birmingham and Midland Tramways Company, has now been issued. The car in question had just entered a loop at a speed stated in the evidence to be about six miles per hour, when the rear of the car was seen to drop. The car then swung round to the right, and after travelling about 50 ft. from the commencement of the loop, it came to a stand across the two tracks, and then fell over on to its left side. Just before the car stopped conductor McCabe appears to have alighted and to have run alongside the near side of the car, apparently with a view of speaking to his driver, and it was while he was passing along the side of the car that it fell over upon him, inflicting fatal injuries.

After the accident the left-hand trailing wheel was found to be broken, and from the marks on the ground it appears that this wheel broke as it was passing through the points. This caused the left-hand trailing corner of the car to drop and the leading end to slew slightly to the right. The result of this was that the right-hand leading wheel took the wrong side of the crossing where the inner rails of the two tracks intersect. The leading end then became derailed, and the car swerved still more to the right until, as already stated, it was right across both tracks, when it turned over.

The accident is attributed to the breaking of the wheel. The wheel was of cast-iron with a steel tyre, the cast-iron centre being similar in design to other centres that have been in use on these tramways since their opening for electric traction. In the centre of each spoke there was what appeared to be a thin iron rod extending from the rim to the hub. The spokes were rather light, and it was probably for this reason that the manufacturers caused the iron rods to be placed in the middle of the spokes during the casting. Col. Yorke is of opinion that when the car entered the loop points and the wheel had to travel on its flanges for a short distance, as is always the case at such points, the spokes gave way, and the wheel collapsed, with the result already described.

Wheels of a heavier type are now being fitted.

ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY

IN the June number of *Electrochemical and Metallurgical Industry*, Frank D. Easterbrooks contributes an article upon the new tank house and copper furnaces of the Raritan Copper Works. The building in which the copper is refined is 149½ ft. wide and 584 ft. long. It is divided into three bays running lengthwise, each bay having two 10-ton motor Whiting cranes, equipped with special devices for dealing with a tank full of anodes or cathodes at one time. There are 1,188 depositing tanks in the building, which are arranged in 108 groups of 11 cells each, two groups of 11 cells being placed together so that the electrolyte can be circulated in cascade form through two tanks. As a very large amount of current is used, very heavy bus-bars are employed, the size adopted being 12·75 sq. in. A heavy glass plate 12 in. square is placed on the top of the concrete piers which support the tanks, and thus insulates them from the ground. Special tanks for rinsing the electrolyte from the cathodes after they have been removed from the depositing tanks are located in the main aisles, as are likewise the tanks for scrubbing the slimes from the scrap anodes, before these are returned to the anode furnaces. Each tank contains 24 anodes and 25 cathodes spaced 4⅜ in. apart The anodes are 28 in. wide by 36 in. long, and the cathodes are 30 in. wide and 37 in. in length, thus giving an active cathode surface of approximately 369·5 sq. ft. With a current of 7,500 amp., this gives a current density of 20 amp. per sq. ft. The tank room is divided up into three circuits running the length of the building, one being in each bay. Each circuit of 396 tanks forms a load for one of the electrolytic generators in the power-house. As mentioned, the main bus-bars have a sectional area of 12·75 sq. in., but the bus-bars at each end of the groups of cells are so proportioned that the amount of copper employed is only sufficient to carry the necessary current. The surface of the bars used to form contacts with the anodes and cathodes are triangular; thus they form a knife-edge contact, which is easier to keep clean than a flat bar. The circulation of the current is lengthwise of the house, that of the electrolyte cross-wise. For the purposes of circulation the tank house is divided into six units of 198 tanks each. The rate of circulation is about four gallons of electrolyte per minute, the solution entering at the bottom and overflowing from the top, except for a small portion of heavier liquid, which is withdrawn from the bottom. In most circulating plant one of the chief difficulties is to get a pump which will withstand the corrosive liquid. Hard lead centrifugal pumps are employed, the chief feature of which is that there are no stuffing boxes or wearing parts in contact with the solution, the shaft bearings being placed above the level of the inflowing solution. It is considered that this pump has solved the problem of circulating hot sulphuric acid solution. The method for preparing the starting cathode sheets is described. They remain in the bath fourteen days, the anodes twenty-eight days, when they are taken out, washed free of slimes, and recast in the anode furnace. The amount of copper in the form of electrodes held in the tanks at any one time is between 11,000,000 and 12,000,000 lbs., and the amount held in the electrolyte about 240,000 lbs. The rest of the article deals with the anode furnaces, wire-bar furnaces, and certain mechanical details.

Electrical Engineering at Cornell University.—We have received the following particulars of proposed alterations in the electrical engineering course at Cornell University: In accordance with the plan which has been followed for several years, more time and attention will be devoted to the theory of the characteristic performance of electrical circuits and machines. To provide this time in part, the mechanical laboratory practice will cease at the middle of the senior year. The complete electrical course will then consist as follows: (1) Two recitations per week, and one laboratory period per week throughout the junior year. (2) Two lectures, two recitations, two three-hour computing periods, and two laboratory periods with one recitation per week throughout the senior year. The instruction in electrical engineering in the junior year is intended to acquaint the students with engineering practice, and to indicate the main divisions of the field. The theoretical elements are reviewed to prepare the way for more thorough work in the senior year. During the senior year the purpose is to lay a theoretical foundation for future practice, by studying the performance of circuits and machines experimentally, and by predicting their performance from their dimensions and physical constants. During the second half of the senior year the students are provided with optional courses of a more practical nature, with a view to showing them how the theory is applied in particular lines of work, such as electric railways, transmission of intelligence, design of electrical machines, and power generation and transmission. The fortieth commencement of Cornell University occurred on Thursday, June 18th. The occasion was celebrated by a very large gathering of Alumni. Ninety-nine students completed the course in electrical engineering, a number somewhat smaller than that of last year, when 107 completed the course.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published July 2nd, 1908

A full list of these was published in our last issue. The following are abstracts of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

13,190, **Arc Lamp Electrodes.** H. T. HARRISON & HUGO HIRST. Carbon electrodes of large section, and having circular or annular cores of metallic salts or compounds for increasing the brilliancy of the arc. To ensure regular burning, the cores are slowly rotated as they are fed. By putting the salts in as a core or several cores, a large section, and therefore a long life, can be obtained without increasing the proportion of salts. Six claims, eleven figures.

15,367, **Manufacture of Metal Filaments.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). According to this invention, carbon filaments are placed together with oxides of tungsten, such as WO_3 or W_2O_5, in a boat of thorium oxide, which is then heated to a high temperature in a vacuum furnace. The tungsten compounds volatilise and diffuse into the carbon, where they are reduced, and in time the whole of the carbon is replaced by tungsten. The resultant tungsten filament is subjected to the shrinking or sintering action of current passed directly through it in the usual way. Four claims.

18,044, **Single-phase Commutator Motor.** FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. The speed of single-phase shunt commutator motors of the type in which the rotor winding is short-circuited, and an exciting current is supplied to the rotor winding through brushes displaced 90° from the short-circuited brushes, is practically independent of the applied voltage and the excitation on light loads, but is fairly constant for a given frequency of supply. In order to obtain wide variations of speed with such a motor, the rotor winding is not short-circuited, but is supplied with a variable potential. By varying the ratio between the stator and rotor potentials, wide variations in speed can be obtained. One claim, one figure.

20,824, **Oscillograph.** J. T. IRWIN. An electric oscillograph for measuring instantaneous values of potential, current, or power in a circuit. The movement of the mirror is caused by the electrostatic attraction between fixed discs and stretched metal diaphragms. Six claims, ten figures.

28, 29, **Mercury Vapour Lamp.** P. H. THOMAS. To start a mercury vapour lamp, the high resistance at the surface of the negative electrode must be first overcome. According to this invention, an auxiliary positive electrode, normally in contact with the negative electrode, is, on switching on, drawn away either magnetically or mechanically, thus establishing an arc. With the aid of a mercury "shifter" similar to the device described in ELECTRICAL ENGINEERING, Vol. III., p. 916, the circuit is broken suddenly, and the rise in potential, due to the inductance in the circuit, is sufficient, now that the surface resistance of the negative electrode is overcome, to start the discharge between the main electrodes. Three claims, eight figures.

1908 Patent

4,433, **Three-phase Motors on a Single-phase Supply.** SIEMENS-SCHUCKERT-WERKE. A method of starting and running star-connected three-phase motors off a single-phase supply, consists in placing an inductive resistance in series with one phase of the stator winding, and an ohmic resistance in series with another phase, these two phases being connected in parallel between the neutral point of the winding and one of the supply terminals, whilst the third phase is connected in series between the neutral point and the other supply terminal. At starting, however, the last-mentioned phase winding carries the geometrical sum of the currents in the other two phases, and a non-uniform rotary field is produced. To avoid this, the third phase is, according to this invention, divided into two halves, and these halves are conected in parallel, or one half only may be used under certain circumstances. The ampere-turns in the three branches are then more uniform. For running, the two resistances are cut out, and two phases are put in series across the mains. Four claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Summaries of the more important of these patents will appear in our next issue.

1906 Patent

12,257, DAVY. Electric arc lamps.

1907 Patents

6,203, FESSENDEN. Electric signalling.

8,445, GRÖNDAL KJELLIN CO. & HARDÉN. Electric furnaces.

8,947, ALLGEMEINE ELEKTRICITÄTS-GES. Incandescence bodies for lighting and heating purposes.

11,541, HATFIELD. Electrically operating apparatus.

13,760, RATHBORNE, FIELDING, & LATHAM. Automatic control of the points of tramways.

13,761, ELECTRIC CONSTRUCTION CO., BUCHANAN, & MCMILLAN. Automatic voltage regulator.

13,911, HALL. Transmission systems of motor-driven vehicles.

14,255, OPPERMANN. Secondary batteries.

14,519, BOULT (*Zorge Safety Railway Equipment Co.*). Signalling apparatus for railways.

15,151, FYNN. Dynamo-electric machines of the neutralised conduction type.

16,053, HATFIELD & LEWIS. Arc lamps.

16,145, BOWIE & PHELPS. Electric apparatus for lighting miners' safety lamps.

16,188, BEVIS & CHAPMAN. Fixing the terminals and contact pieces of electrical fittings.

16,334, SIEMENS BROS. & CO. & GRIMSTON. Printing telegraphs.

16,501, ALLGEMEINE ELEKTRICITÄTS-GES. Controllers.

18,111, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Insulating material.

18,332, ROSLIN DIVRY. Multiple-contact switch.

18,956, RHODES MOTORS, LTD., & FIELDEN. Control of induction motors.

19,190, FOX, FAWCETT, & FAWCETT. High-tension ignition plugs for internal combustion engines.

19,670, MURDOCH & KERSEY. Friction permeameter.

20,465, FITZGIBBON. High-voltage plugs and sockets.

21,584, BURKE. Dynamo-electric machines.

22,502, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Methods of neutralising induction from alternating current systems.

23,831, FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. Machines for installations subject to short circuits.

1908 Patents

58, EISENSTEIN. Variable self or mutual inductance.

67, EISENSTEIN. Aerial for wireless telegraphy.

145, RANSFORD (*Soc. Anon. Montbarbon*). Sparking plugs.

1,159, THOMPSON. Regulating apparatus for alternating current circuits.

3,204, SUTTON & SUTTON. Fire alarms.

4,845, SCHELLER. Apparatus for receiving undamped electric oscillations.

5,030, AITKEN. Telephone instruments.

5,497, REUTHE & AMALGAMATED RADIO-TELEGRAPH CO. Receiving apparatus.

6,101, CHAMBERS. Teaching instrument for wireless telegraph operators.

6,409, PAULI. Incandescent filament lamps.

7,913, PARKER. Railway fog-signalling apparatus.

8,013, SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*). Transmission of signals.

8,190, Firm of ROBERT BOSCH. Interrupters for electrical ignition.

8,547, RUTHARDT. Field magnets for generators.

9,034, SMITH. Fire and temperature alarms.

9,865, BOON. Switch plate for tramway contact wires.

10,856, COTTON. Electric ignition devices.

Complete Specifications open to Public Inspection before Acceptance.

1908 Patents

8,769, BLUM. Sparking-plug.

12,326. STERN. Regulation of induction motors.

12,487, DUPOY. Distribution apparatus.

12,818, TRIQUET. Primary batteries.

Application for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of July 1st, 1908.

23,977 of 1907. **Telegraph Apparatus.** SIDNEY BROWN seeks leave to amend this application for letters patent for "improvements in telegraph apparatus" by including J. A. L. DEARLOVE, Electrical Engineer, of 4 Great Winchester Street, London, as an applicant for a patent.

Expiring Patents

No patents of electrical interest expired during the current week.

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☞ An Index for Volume III. is given away as a Supplement to this issue of *Electrical Engineering.*

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SUMMARY

A letter from Mr. C. McArthur Butler, Secretary of the Incorporated Municipal Electrical Association, refers to the proposal to form a separate section of the Association for Assistant Engineers, and gives particulars of previous attempts in this direction, which did not meet with very ready response. A letter on the subject is also contributed by an assistant engineer. (Page 90.)

A letter has been sent out by the Committee of the Manchester Electrical Exhibition stating that in order to have things quite ready for the opening day, exhibitors will be afforded facilities for erecting their exhibits on and after September 1st, instead of September 14th, as originally arranged. Attention is also drawn to the fact that cases have come to the notice of the Committee of firms who hope to obtain advertisement out of the exhibition by lending machinery or apparatus to exhibitors. The Committee, therefore, ask for the support of the exhibitors in enforcing the rule which prohibits the display of any other name than that of the owner of the stand. (Page 90.)

An article describes recent developments in the electrical department of Messrs. Sir W. G. Armstrong, Whitworth & Co.'s Elswick works. Power for works driving is obtained from the Newcastle-upon-Tyne Electric Supply Co., and the Newcastle & District Electric Lighting Co., and a large amount of electrical machinery and apparatus is manufactured at the works. (Page 91.)

The Mining Exhibition, opened last Saturday at Olympia, contains a number of exhibits relating to the application of electricity in mining, although it can hardly be called representative of that branch of the electrical industry. Several firms show motors and starters specially constructed for mining work, and seven or eight different types of electric coal cutters are exhibited. Some new forms of electrically driven conveyors for underground and surface purposes are shown, and the applications of electric driving to ventilation and pumping are well represented. An interesting exhibit is the Temple electric air drill, which combines the advantages of electric transmission with those of the ordinary compressed air percussion drill. A number of types of electric miners' lamps are on view, some actuated by primary batteries and others by accumulators. The application of electricity to the re-lighting of the ordinary safety lamp underground is exemplified, and there are a number of other miscellaneous exhibits relating to applications of electricity in mines. (Page 93.)

The Tramways and Light Railways Association held its first of an annual series of Congresses at the Franco-British Exhibition on Thursday and Friday. The Duke of Argyll, President of the Association,

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welcomed the members, and presided over the first part of the proceedings, which consisted of a lecture (largely historical) by Sir CLIFTON ROBINSON. A Paper by Mr. A. H. GIBBINGS on rail joints was then discussed. The Paper included a useful collection of drawings of joints and anchors, and a new adjustable joint support, devised by Mr. Bullough, in which it is understood Mr. Gibbings is interested, formed the subject of some criticism. The discussion also turned on experience with Thermit joints, and on the various causes of joint troubles. A new "mechanically locked" joint which presents some features of interest was exhibited. On Friday morning the proceedings were opened by Mr. A. L. C. FELL, who gave an address on the work of the Association. This was followed by a lecture on "Rail Corrugation," by Prof. CARUS-WILSON. The lecturer confined his remarks to the results of some experiments made on a model, and also on a car at Croydon, and to his own conclusions as to the causes of corrugation. He considers that corrugation is due primarily to the wheels running on unequal diameters, this causing skidding of the smaller wheel. This skidding, if grit is present on the rail, becomes intermittent, the period between the skids depending on the limiting twist of the axle. The lecturer suggested no remedy. A short discussion followed the lecture, and it will be further discussed at a future meeting of the Association. (Page 99.)

THE students of the Institution of Electrical Engineers have just concluded a visit to the Newcastle-upon-Tyne district, when a number of manufacturing works and electrical installations, including an electrically equipped colliery, were visited. (Page 108.)

THE electrical equipment of Horden Colliery is an example of a self-contained continuous-current colliery power installation of moderate size, of which there are a number in the Newcastle district. The generating station also supplies current for lighting the village. Electrical power is used for the screening plant, &c., ventilation, haulage, pumping, and other purposes, but not for main shaft winding. (Page 109.)

Mr. A. M. TAYLOR has sent in some observations in reply to the discussion on his Paper on "The Use of Accumulators for Peak Loads," at the Incorporated Municipal Electrical Association's meeting at Nottingham, and reported in our last issue. (Page 110.)

UNDER "ELECTRICAL SCIENCE," in the British and American Section, is a note on certain obscure points in the electrolysis of water vapour. In the Continental Section, a Paper by JEAN BECQUEREL, in which he announces that he has proved the separate existence of positive electrons in a vacuum tube, is abstracted. (Page 110.)

Mr. A. P. TROTTER has issued a lengthy report on the fire which occurred on the Liverpool & Southport Railway. Some interesting detail is gone into regarding the best methods of wiring the coaches in electric trains, and the practice on the Lancashire and Yorkshire Railway in this respect is compared with that on the North Eastern and London Underground Railways. Although no one was injured, the fire was serious while it lasted, as a powerful arc carrying some 9,000 amperes was maintained for two or three minutes. The direct cause of the short circuit is uncertain, but probably was due to penetration of water during driving rain. The question of modification of the arrangement of the sections and circuit breakers to ensure in a more complete manner the limitation of the current in each section to a value with a reasonable margin in excess of the maximum requirements of that section is dealt with, and it is recommended that the section should be, where possible, of such a size that one train only is likely to start on each. (Page 111.)

Sir OLIVER LODGE has sent us an account of the experiments on the effect of electricity upon growing crops, carried out on an industrial scale by Mr. J. E. NEWMAN, in conjunction with Mr. R. BOMFORD and Mr. LIONEL LODGE. Wires charged positively to a high potential are suspended over the fields, and a sytematic method of observation has shown a distinct increase in both the quantity and quality of the crops obtained. In the case of wheat the increase is in the order of 30 per cent. in the number of bushels per acre. (Page 112.)

SOME particulars are given of the new tungsten lamp which the British Thomson-Houston Company are manufacturing at Rugby. (Page 114.)

A FORM of controller for large motors, which presents some novel features, has recently been introduced. (Page 115.)

A Patent Specification by the GRÖNDAL KJELLIN CO. and J. HÄRDÉN, relating to renewable linings for the fusion chambers of electric induction furnaces, was published on Thursday last. Among the other specifications published was one describing a process for the manufacture of metal filaments by the ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT, and another by J. BURKE relating to the design of continuous-current three-wire generators. THE BRITISH THOMSON-HOUSTON have one for a method of neutralising inductive disturbances in telegraph and telephone circuits adjacent to rails used as return conductor in alternating-current railway systems. A voltage regulator for use on alternating-current circuits is described in a specification by W. H. THOMPSON, and a specification by C. PAULI relates to the suspension of metal filaments. A Patent granted to E. TYER for a system of signalling on a single-line railway expires during the current week. (Page 117.)

AN action was brought last week against the Llandudno District Council for permitting a nuisance by allowing black smoke to be discharged from the generating station chimney, and the Bench made an order for the abatement of the nuisance.—At the Manchester Assizes on Monday the Corporation agreed to pay £125 damages in respect of the death of a pawnbroker who, it was claimed, died from the after-effects of inhaling fumes arising from the fusing of cable belonging to the Corporation.—After meeting expenditure and capital charges the accounts of the Sunderland Electricity Department for the year to March 31st, show a debit balance of £1,908.—A proposal has been made to utilise the arc lamp posts in Worcester for supporting advertisement signs lit by electricity.—Sir Clifton Robinson has informed the Richmond Town Council that unless the overhead trolley system is agreed to for the proposed trams over Kew Bridge, the Bill now before Parliament will be dropped.—The accounts of the Nottingham Corporation Tramways for the past year allow of £17,000 being contributed to the rates, and the allocation of £4,457 to reserve fund.—There has been a profit of £1,723 upon the Oldham Corporation Electricity Department for the past year. At one time the undertaking had a reserve fund of £10,000, but owing to the Local Government Board refusing to pass certain accounts out of revenue, this had entirely disappeared. (Pages 119 to 122.)

SPECIFICATIONS are in preparation for a new storage battery at the Sydney Electricity Works. It is estimated that an expenditure of £32,345 will have to be incurred in new telegraph and telephone works in Australia during the year 1908-9. Extensions to the Bo'ness Electricity Works are contemplated at an estimated expenditure of £6,000. Local Government Board inquiries are to be held at Eccles (£16,270), Fareham (£10,000), Farnworth (£7,000), and Heywood (£16,000). For the information of wiring contractors we give particulars of a large number of buildings about to be erected in London and the provinces. The Stepney Council is purchasing 73 "Gilbert" magazine flame arc lamps. (Pages 122 to 124.)

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THE half-yearly report of the National Telephone Co. to June 30th shows income of £1,452,286, an increase of £137,787 over the corresponding period of 1907. The net result for the half-year, after deducting £139,546 Post Office royalties, is a profit balance of £480,641, an increase of £40,661 over the June half-year of 1907. £140,000 are transferred to the reserve fund, which now stands at £2,804,961; 6 per cent. dividends are recommended on the first and second preference shares, on the preferred stock and deferred stock, and 5 per cent. on the third preference shares. The report of the Electric Construction Co. for the year ended May 31st, 1908, shows a net profit, after deducting debenture interest and adding £25,000 to depreciation account, of £5,932. After paying the dividends upon the preference shares for the year to May 31st, 1907, there is a balance to be carried forward of £1,746. There is a profit of £4,860 shown by the accounts of the Electrical Power Storage Co., for the year ended May 31st, 1908. A 5 per cent. dividend upon the ordinary shares is recommended, leaving £369 to be carried forward. Messrs. Thomas Parker & Co., Ltd., has gone into voluntary liquidation for the purpose of reconstruction; a new company is to be formed, with the title of the Rees-Roturbo Manufacturing Company. (Page 124.)

THE Exhibition now being held at Olympia will naturally turn the thoughts of many engineers in the direction of the applications of electricity in mining, and a little inquiry will show that, although electrical mining engineering has perhaps not made its initial strides as rapidly here as on the Continent, a great deal more has been done in this direction in the English and Welsh mines than is generally realised. The formulation of the Home Office rules undoubtedly gave considerable impetus to the adoption of electrical working in mines, and the most formidable obstacle, the innate conservatism of the British colliery owner, has largely been surmounted. Electrical engineers in their enthusiasm are perhaps a little too prone to regard their precious "juice" as a panacea for use under all conditions, but the matter has been thoroughly sifted in the light of solid experience, and there are many purposes for which the benefits of electrical working are universally acknowledged. Electrical underground haulage presents undisputed advantages in flexibility and economy, and there are possibilities in electric pumping unattainable by other means. Electric power is extensively adopted in screening plants and other surface works, and is fast replacing other forms of power for driving ventilating fans. There is less unanimity of opinion regarding mainshaft winding, but in spite of its critics, heavy electric winders with their unique methods of load equalisation are being installed, if they are not already in some cases at work, in quite a large number of British collieries, especially of the South Wales group. Electrical coal cutting has been another vexed question, but its possibilities, as well as its limitations, are now well understood; here, again, the rapid increase of its adoption, where the quality of coal is suitable, speaks for itself.

MR. GIBBINGS' Paper on tramway rail joints dealt with a vexed and vexing question of which the satisfactory solution is yet to be found, or it should perhaps be said that the solution must be fitted to the surroundings, and herein lies the crux of the difficulty. If one had to build a tramway track for its own traffic alone, there is no reason why railway practice in regard to substructure and joints should not give equally satisfactory results. But the requirement that the rail tables are to be laid and kept level with the paving of the road introduces the double difficulty that the rails cannot be packed, or the joints inspected and tightened, without pulling up some of the paving, whilst relative wear or movement between rail and paving surface soon produces nuisance and even danger. The usual British practice of laying rails and paving alike upon a deep concrete bed would meet the conditions fairly well if the rails took and kept a uniform bearing upon the concrete. This can be assured as the original condition by reasonably careful work, but the passage of every car produces some movement which is accentuated at the joints. The many attempts of inventors to make joints which shall not move under the wheel are illustrated by the examples described in Mr. GIBBINGS' Paper. The majority of these are mechanical devices intended to stiffen the joint vertically, and in most cases simultaneously to anchor it into the concrete; but experience shows that such constructions do but put off the evil day. The main reason is that rail joints cannot be fitted with the accuracy necessary to ensure every member taking its proper share of the stresses and shocks incidental to the rolling loads. The theoretical condition is to have a rail so rigid in relation to the loads that the movement of the table shall be only that due to compression, and that such rigidity and movement shall be equal at all points. Unless such equality obtains, the rail is certain to spring with disastrous results to either (or both) the concrete below and the paving around it. The various welding processes aim at producing a continuous rail, but it is doubtful whether the necessity of making the joint neither more nor less rigid than the body of the rail has been sufficiently studied, and herein lies room for improvement. Experience with welded joints has not been uniformly satisfactory, but there seems good reason to interpret the success of the Thermit joint at Leeds, and the Falk joint at Norwich, as testified to by Mr. HAMILTON and Mr. BANISTER in the discussion on Mr. GIBBINGS' Paper, as proofs that, with proper care, work can be done which will stand the test of years of heavy traffic. Unfortunately, the cost of joint maintenance is very hard to get at, and there are great difficulties in comparing experiences owing to the wide variation in local circumstances. All tramway managers are agreed that track maintenance is far too costly now, but experiment is tedious, and they are not so willing to test new devices as would be the case if a few months' trials would give conclusive results.

THE interest which Sir OLIVER LODGE has taken in the experiments made by Mr. J. E. NEWMAN to ascertain whether the stimulation of plant growth by electricity has a real industrial value has been fully justified. By extending over a wheat field lines of wires charged with positive electricity at a high potential, the productivity has been increased by some 30 per cent., and promising results have also been obtained with other crops. Experiments on these lines made by LEMSTRÖM several years ago gave indications of similar improvements, and the present trials must be regarded as the outcome of the work of this pioneer.

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While, however, LEMSTRÖM charged his network of overhead wires with a Wimshurst machine, Mr. NEWMAN has been enabled to generate the high electrical pressure in a far more reliable manner with a dynamo, induction coil, and Lodge mercury vapour rectifier. The employment of the high-tension rectifier or "valve" at once disposes of all difficulties with regard to the mechanical part of the problem, for it appears that less than 1 kw. has proved sufficient for between 10 and 20 acres of land under cultivation —probably the same machine would have been large enough to keep a far larger network charged. Moreover, the D.C. machine, induction coil, and contact breaker could be replaced by an alternator and static transformer, which would further simplify the apparatus. As the maintenance of the posts, wires, and insulators can only be a trifling annual item of cost, it appears that the method has actually approached the commercial stage of development, although the phenomenon has as yet received no satisfactorily definite scientific explanation. Mr. NEWMAN, who has been working steadily at the subject for five years or more, is to be congratulated on his results.

MANCHESTER ELECTRICAL EXHIBITION

THE following official notices have been issued :—

Erection of Exhibits.—In order to insure that the exhibition will be thoroughly ready and completed on the opening day, October 3rd, the Committee of the Manchester Electrical Exhibition have arranged that those exhibitors having heavy plant to instal or being desirous of obtaining access to the buildings prior to September 14th, the date originally fixed for commencing work, shall have facilities given them for erecting their exhibits on and after September 1st.

Address.—The address of the exhibition is "The Electrical Exhibition, Platt Fields, Rusholme, Manchester."

Foundations.—The committee have made arrangements with the builders on the site, Messrs. J. Davenport, Sons & Co., to put in foundations for exhibitors, who are recommended to make arrangements with them on this matter at once, so that the flooring of the main building can be proceeded with.

Stand Fittings.—For the convenience of exhibitors, Messrs. Barrett & Sons, of 126 Broad-street, Pendleton, Manchester, and Messrs. J. Davenport, Sons & Co., builders on the site, have been appointed official stand fitters to the exhibition, although exhibitors are perfectly at liberty to make whatever arrangements they think fit. In fitting up their stand space, exhibitors must comply with the requirements of the local authorities and fire offices interested in the exhibition, and generally comply with the following conditions :—All stand partitions, counters, &c., shall be specially erected and constructed of wood not less than one inch thick. All material used for covering same shall be of a non-inflammable character or treated with a fire-proof composition. Stalls, staging, counters, or fittings erected by the exhibitors shall not, unless by special arrangement, exceed 14 ft. in height. No exhibitor shall be allowed to display his exhibit in such a manner as to obstruct the light or impede the uninterrupted view along the gangways, project over same, or affect the display of neighbouring exhibitors.

Electricity Supply.—Exhibitors are asked to intimate before July 25th what their requirements are in this respect. As already announced, the price is 2d. per unit for lighting and 1d. per unit for power.

Gas.—Arrangements have been made with the Manchester Corporation for the supply of town gas at a charge of 2s. 6d. per 1,000 ft. for ordinary use and 2s. for gas engines.

Water.—A supply of water at 2s. per 1,000 gallons if metered or, if only a nominal quantity is required, at a price to be agreed.

In both cases the exhibitor must make arrangements with the builder for connecting with the nearest supply mains.

Lent Machinery and Apparatus.—As a number of cases have recently been brought to the notice of the management, of firms who hope to obtain advertisement out of the exhibition by lending machinery or apparatus to exhibitors, the committee have passed a resolution authorising the management to draw exhibitors' attention to this fact, as advertisements thus obtained will obviously be most unfair to those who are supporting the exhibition, and are contrary to the rule which prohibits the subletting of space without the consent of the management, and also prohibits the display of any other name than that of the owner of the stand.

CORRESPONDENCE

ASSISTANT ENGINEERS AND THE I.M.E.A.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Your correspondents, "J. W. B." and "Chief Assistant," are probably not aware that the suggestions made in your issue of July 2nd, to which they refer, have already had consideration. For some years past my Council have given a great deal of time and attention to the problem of how to cater for assistant engineers.

Three years ago a circular was sent from the Association, together with a form of return, to over 800 assistant engineers in municipal electrical works, suggesting that a separate Convention should be held, or alternatively, that shorter periodical meetings should be organised for assistants in various parts of the country, and asking for expressions of opinion with a view of ascertaining approximately what support could be relied upon, before going further into the matter. Only thirty out of these hundreds took the trouble to reply, so that it was impossible to proceed.

My Council then reduced the Associate's annual subscription from 10s. 6d. to 5s., thinking that a nominal contribution, which includes a copy of the "Proceedings," might be some inducement. This was followed by the offer of a £10 Travelling Studentship for the best Paper on some approved subject, which only attracted one entry in two years. It is not that the Association does not endeavour to meet the wishes of the assistant engineers, but the latter are, apparently, too apathetic to co-operate. If we had the support of the assistants in anything like the proportion we have that of their chiefs, possibly some scheme might be evolved on the lines indicated, and I hope that one practical result of this correspondence will be that I shall receive many applications for admission to the Association, as well as such suggestions for its development, as will appeal more forcibly to the assistant than the efforts which have already been made in that direction have done.

Yours faithfully,

C. MCARTHUR BUTLER,

(Secretary of the Incorporated Municipal Electrical Association.)

Staple Inn Buildings (South),

Holborn, London, W.C.,

July 13th, 1908.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—With reference to your editorial note in ELECTRICAL ENGINEERING for the 2nd inst., re the I.M.E.A. Conventions and the Assistant Electrical Engineer, while I certainly think that it would be to the advantage of both the Association and the Assistant Engineer for the latter to attend the Conventions, the solution of the difficulty, to my mind, rests entirely with our superiors, many of whom are members. I should, however, like to point out that just at the time of the year when the Convention is held, many things need attention in the station, *e.g.*, overhauling, periodical extensions, holiday arrangements, &c., which generally keep the assistant busy, and in many cases prevent him from attending.

With regard to the suggestion that meetings of associates should be held three or four times a year, I certainly think this an excellent idea, and should like to see it carried into effect.

Yours faithfully,

"SUPER."

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THE ELECTRICAL DEPARTMENT OF SIR W. G. ARMSTRONG, WHITWORTH AND CO.'S ELSWICK WORKS

ABOUT eighteen months ago we published an article dealing with the electrical driving of Messrs. Sir W. G. Armstrong, Whitworth & Co.'s Elswick Works, and the electrical department of that great establishment generally (ELECTRICAL ENGINEERING, Vol. I., page 155). The recent visit of the students of the Institution of Electrical Engineers to Newcastle gave us, however, another opportunity of inspecting these works, and even in such a short period in the life of a firm notable extensions and improvements have been effected.

The policy of purchasing all electrical power from outside electricity generating companies has so far been adhered to, and a supply is now being taken both for lighting and power from the Newcastle-upon-Tyne Electric Supply Co., Ltd., and the Newcastle & District Electric Lighting Co., both of which companies have sub-stations erected at suitable positions in the area of supply. Three-phase current is adopted for driving shafting and for constant speed requirements, while a three-wire 480-volt system is provided for variable speed motors and lighting. In each of the four D.C. sub-stations balancers sufficiently large to deal with out of balance loads are installed in duplicate. These loads are sometimes considerable, owing to the action of electrically-driven cranes and other intermittent demands. Each sub-station has, under normal conditions, one balancer set running. Should the out-of-balance load exceed 200 amperes for more than 10 minutes another balancer has to be run up. Such a standing rule is necessary to ensure satisfactory balancing.

The low tension sub-stations have now been connected to a central exchange board located approximately at the centre of the works, whereby any shop or group of shops may be connected to and run from any desired sub-station, and balancing may be done from any sub-station. The low tension net work is run solidly so far as balancers and main cables are concerned, fuses being omitted. Owing to the considerable drop which occurred on the low tension system, two double boosters have been built by the electrical department—one of 200 and the other of 300 kw. capacity, and capable of giving 50 volts boosting effect on each side. These have been installed at the power station of the Newcastle & District Electric Lighting Co., Ltd.

In addition to the three-phase and low tension direct-current systems above-mentioned, a comparatively small supply of single-phase current at 1,000 volts is taken from the Newcastle & District Co., and transformed down to 100 volts for purposes of temporary lighting of ships whilst alongside the ordnance works. The temporary wiring and lamps on board these boats as they come from the shipbuilding department happens to be 100 volts, so that this value is adhered to for this purpose in the electrical department. The total horse-power now taken electrically by the firm amounts to 7,822, absorbed by 576 motors, 573 arc lamps, and nearly 3,000 glow lamps.

Probably the most interesting feature at the present time is the lines upon which the electrical department has progressed with regard to the manufacture of electrical goods for the Admiralty and other good class customers. It should be said that to expect cheapness with concomitant nastiness from the electrical department of Messrs. Armstrong, Whitworth & Co. is futile. Their standard designs of motors and other gear, and the precise jig and gauge systems conform rigidly to an exacting Admiralty specification, and it would not pay the firm to manufacture any other grade of production, inasmuch as, besides Admiralty work, its shops are kept full of work for foreign Governments who imitate as closely as possible the requirements of our own. At the time of our visit the engineering strike was in full swing, but nobody would have thought that there was a loss of activity when looking round the electrical shops. At the present time there are over 350 motors and dynamos under construction—operations on some being rather impeded owing to the strike, but nevertheless work is progressing. Among the most interesting specimens are 12 dynamos, each of 132 kw. capacity, destined for two new Brazilian battleships, one of which is

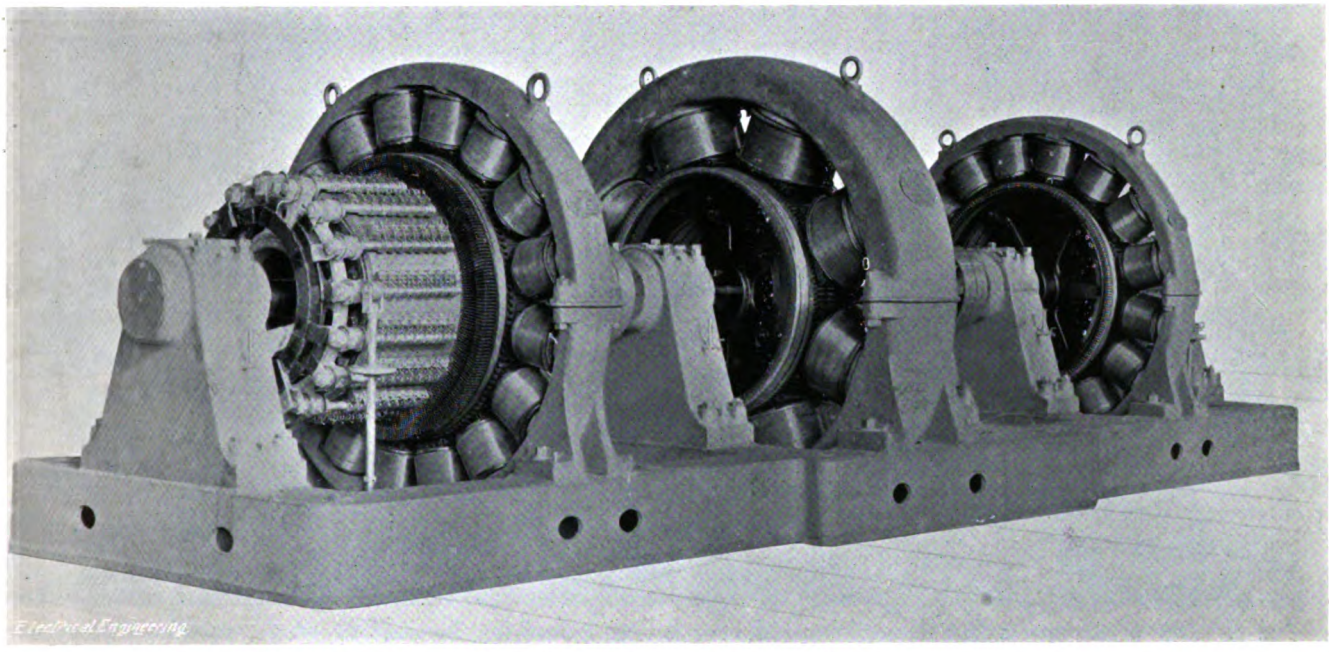

FIG. 1.—LARGE MOTOR GENERATOR SET.

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being built by Messrs. Armstrong Whitworth and the other at Barrow-in-Furness. Two big double boosters, one of which is shown in Fig. 1, have just been completed. The department is also turning out a line of combined engines and dynamos, the smallest size of which—8 kw.—is suitable for tramp steamer lighting, while the largest standard has a capacity of 70 kw. Above that size the engines are made in the "engine works" department, while the dynamos are, of course, under the hands of the electrical department. This department also maintains the telephone oufit of the firm, amounting to 100 to 150 stations, and the fire alarm system. Fig. 2 gives a general view of one of the electrical shops as arranged on the occasion of the recent visit of the Prince and Princess of Wales, showing examples of electrical machinery recently constructed.

In addition to the work under cover of the shops, the wiring of several large ships is going forward, such boats as the *Lord Nelson*, the *Invincible*, the *Superb*, the *Afridi*, and several foreign ships are at present passing through the final stages, while wiring work is just being started on the new Brazilian battleship of 19,000 tons. Some most interesting work has recently been done by this department in connection with the British Government's new "electrical" ship, the *Invincible*. This boat is the first battleship whose turrets are operated electrically.

The electrical department of this firm is almost limitless in its activities. It appears to make everything electrical, from wireless telegraphy plant—a recent and powerful equipment having recently been established near the mouth of the Tyne—to sparking coils for motor-cars. An interesting example is the electric firing gear for ships guns, which is capable, by means of electric connections, of training the guns by the simple movement of the firing pistol. The cables for dynamo "firing" are armoured with phosphor bronze wire for the upper decks, and lead-covered for the lower-deck service.

The equipment of the works for this class of production cannot be without interest. It would probably be noticed by any visitor that the shops are of a somewhat light construction for large dynamo building, and that the range of heavy tools is not very large. The reason for this is that all heavy engineering necessary is at present done by the adjacent engineering shops, the work being charged against the electrical department. This procedure should be a hint to electrical firms who are not of exceedingly great magnitude to avail themselves more extensively of finished magnet parts and other heavy work offered by general engineers, specialising on the electrical work necessary instead of attempting to do big work with small tools. As an example of the size of lathes used, the most recent addition is an "Openshaw" lathe (from the Manchester works of Messrs. Armstrong Whitworth), with an 8 ft. bed and 14 in. from centre to bed, convertible to a gap lathe if chucking is necessary. The chief feature about all the lathes is their rigid construction, making them adaptable for taking heavy cuts at high speeds. The tool steel used is the firm's own "T.Y.R." brand, which appears to be as great an improvement on Mushet steel as that was on ordinary tool steel. Another point of interest is the heavy percentage which the capstan lathes bear to the total equipment—a rather unusual feature in a shop where such exactingly accurate work is required. It should be noted in this connection that every detail part, whether subjected to one operation or twenty, is carefully checked and passed before being submitted to succeeding operations. As an instance of the speed of production obtained, a brass rod about $\frac{5}{8}$ in. diameter was turned, faced, bored, tapped internally, knurled externally, and parted off in a capstan lathe in nine minutes.

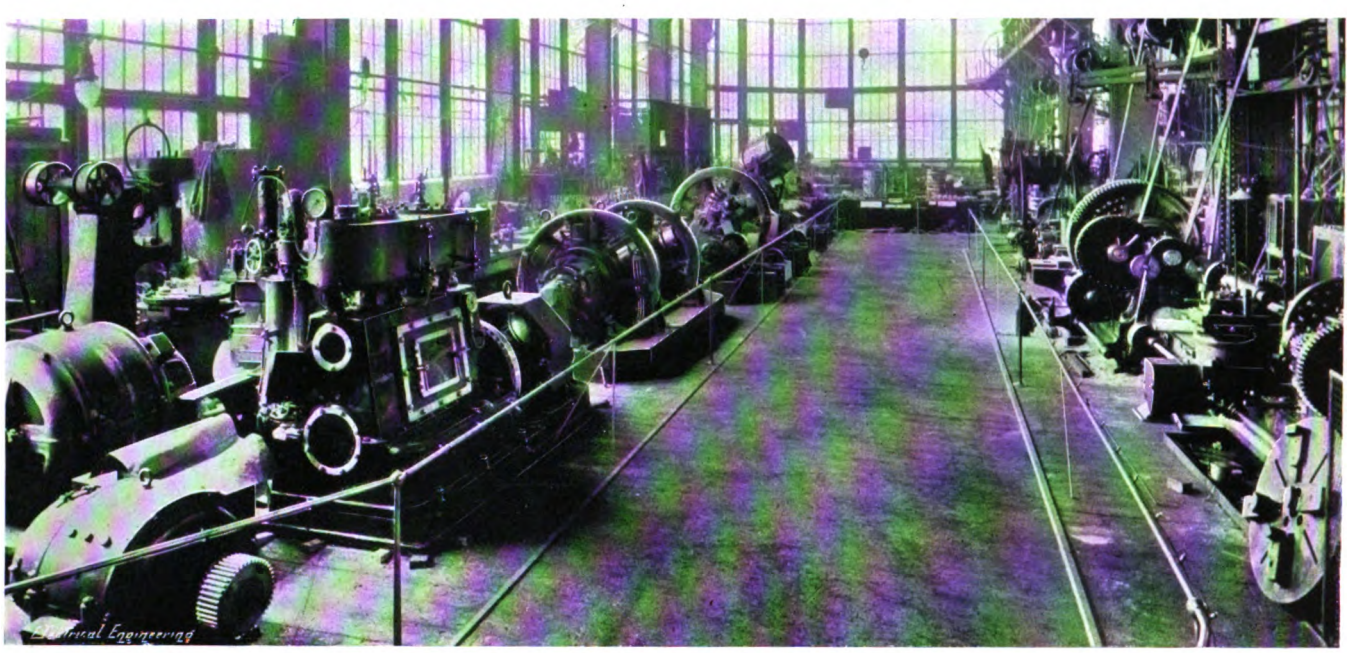

FIG. 2.—VIEW OF ELECTRICAL SHOP AS ARRANGED FOR VISIT OF THE PRINCE AND PRINCESS OF WALES, SHOWING SPECIMENS OF VARIOUS TYPES OF PLANT MANUFACTURED.

The commutator building room illustrates the exactness of production. The wedge-shaped pieces are first ground to a thousandth and tested by gauges, then assembled with gauged mica insulation in such a thorough manner that on our visit a commutator was hammered vigorously for our edification without the slightest signs of starting. Armature and field coils are wound on special machines, and taped by hand, as this gives a tighter binding than that obtained on machines. To fulfil Admiralty specifications they are then armoured with micanite, taped again, and impregnated with varnish in a vacuum-impregnator. One is not surprised to hear that the firm regard the prolonged immersion of these coils in water with equanimity. A further example of their thoroughness is shown in the fact that in squirrel-cage rotors reliance is not placed on sweating. Each rotor bar

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is double-rivetted to the short circuiting band. Again realising that pole tips require less iron than the central portion of a magnet, the laminated stampings are made with a longer projection at one end than the other, and every alternative stamping reversed so as to leave a polar projection on each side alternatively. It is in minor points of this description that excellence of design is obtained.

The whole of the apparatus turned out is tested for a quarter of an hour for insulation at 2,000 volts alternating. Motors are tested either by Prony brake or by the Hopkinson test. Dynamos can be run on a water resistance tank provided for the purpose. To provide a suitable range of voltage a double-ended motor-generator is placed near the test-bed having direct current dynamos at each end and a three- or six-phase motor at the centre. The motor is also provided with an ordinary D.C. commutator, so that a particularly wide range of currents and voltages can be obtained.

The whole establishment affords a remarkable example of the way in which the application of electricity on board ship has brought about a remodelling of engineering works organisation.

ELECTRICAL ENGINEERING AT THE MINING EXHIBITION

IN view of the very rapid increase in the number of collieries and other mines where the advantages of electrical working are being realised, it is not to be wondered at that the Mining Exhibition, which was opened on Saturday last at Olympia, by Lord Strathcona, should contain a good deal of interest to the electrical engineer. We cannot, however, refrain from expressing a slight sense of disappointment in the degree in which some of the heavier branches of electrical mining engineering are represented, and the entire absence from the list of exhibitors of a number of British firms whose work in the provision of electric power equiments to mines, at home, in the Colonies, and abroad is well known. The important subject of main shaft electric winding, which, in spite of its critics, is already taking considerable hold in the collieries of South Wales and other districts, is entirely unrepresented, and of the special forms of switchgear for mining work which have been developed by several of our leading manufacturers, but little is to be seen. The application of electrical power to collieries is a field where much remains to be done, and it is to be regretted that the colliery manager who comes to Olympia to see the latest developments in this direction will find so few of the firms who have specialised in this class of work adequately represented. As we shall see, there are one or two bright exceptions in the shape of exhibits by electrical firms who are more particularly identified with the applications of electricity in mines, and certainly there is a good and representative display by the makers of electrical coal-cutting machines.

The stand of Messrs. DICK, KERR & Co., of Preston and Kilmarnock, contains a considerable variety of electrical material, and has been arranged to show, as far as space will allow, samples of all parts of electrical equipment required or used in connection with colliery, mining and quarry work in general, also some samples of light railway material used in connection with mines, collieries, and quarries. There are a number of samples of the various standard motors made by this firm, including a range of four sizes of direct-current motors up to 35 h.p., one fitted with a reduction gear, with the countershaft compactly arranged in the sub-base underneath the motor. A group of standard alternating-current motors are also shown, including both squirrel cage and slip ring types. Attention should also be drawn to a range of standard designs of crane motors, some of which are fitted with the firm's special design of automatic magnetic brake, which comes into operation immediately current is switched off the motor, and forms an attachment to the motor itself. There are also represented various types of motor starters. Particular attention is directed to the patterns specially designed to conform with mining regulations, including an oil-immersed auto-starter for squirrel-cage motors. The samples of "R" type controller shown are also well worth inspection. These are provided with the very efficient type of magnetic blow-out developed by Messrs. Dick, Kerr & Co., originally in connection with traction work. A specially interesting exhibit is a complete electric capstan, which, while being arranged on the usual lines of this type of machinery, has some novel features. The starter is of the contactor type. After the circuit nas been closed through the starting switch by depressing the starting pedal, the contactors automatically come into operation, cutting out resistance and starting the motor in the usual way; on the release of the pedal, or the operation of the overload device, the switch and the contactors come back to their normal position. With this arrangement it is impossible to start the motor too rapidly, and thus all starting switch troubles, due to carelessness of the operators, are eliminated. The starting switch itself is fitted with an overload and no-load release, and is provided with the blow-out fitting. The drive is through worm gear, and the other operation of the capstan follows the usual practice, with the exception that the capstan case is made watertight by a simple arrangement of the joints. Among the other apparatus shown is a complete standard motor panel, with a starter provided with a special slow movement gear. There will also be noted various contained in a flame-tight cast-iron case at the end of the engineering works at Kilmarnock, including a standard type tipping wagon, small turntable, set of points and crossings, and various samples of light railway track work with iron sleepers.

The HART ACCUMULATOR Co. have a most representative stand near the main entrance, upon which they show examples of practically every kind of secondary battery, from large central station cells down to small ignition accumulators. Several of the cells exhibited are provided with the company's new "Hexite" separator, consisting of a sheet of special material, which is claimed to prevent all possibility of short circuits between the plates, and thereof to diminish the cost both of inspection and maintenance. Among the types of cell shown are examples of portable batteries in lead-lined teak boxes, cells for automobile and marine propulsion in ebonite cases, special telegraph cells and ignition cells in celluloid cases. Attention should be called to a complete battery of 13 of the latest lighting type eleven plate cells, suitable for an installation of 112 10-c.p. 25-volt Osram lamps on a five-hour discharge, or 75 lamps for ten hours.

Messrs. MAVOR & COULSON, LTD., of Glasgow, have a large and interesting stand devoted principally to electrical mining work. Several examples of the firm's well-known "Pickquick" electric coal cutters are shown, as well as a compressed air machine. A particularly compact electrical coal cutter, only 15½ in. overall height is on view, driven by a single 12 b.h.p. continuous-current motor. Like all the coal cutters shown on Messrs. Mavor and Coulson's stand, these machines are of the revolving bar type. This particular machine, which has a cutter bar 3 ft. 6 in. long, is claimed to be the smallest long wall coal cutter on the market. The motor is, of course, entirely enclosed, and is of special construction. Its case forms a part of the frame of the machine. Although of the four-pole type, it is able to be extremely flat by having field coils only on the two side poles. An important feature in the construction is the fact that these poles complete with their coils can be removed from the side even when the machine is in position in a shallow seam and access to the top or bottom is impossible. The point of having every part of the machine accessible from the side has been kept in view throughout the design. The starter is contained in a flame-tight cast-iron case at the end of the machine away from the cutter bar, and is worked by a lever with an insulated handle. There are a number of points of interest in the arrangement of the gearing through which the motor drives the cutter bar. This is of the bevel type, and is entirely enclosed in the circular gear head. It is arranged so that the bar can be turned to any angle and can be easily altered in position for under or over cutting. The gear can be inspected by removing a cover at the end independently of the headroom available. A most ingenious device provides a to-and-fro movement to the cutter bar during its rotation. A cutter of somewhat larger size, driven by an 18 b.h.p. three-

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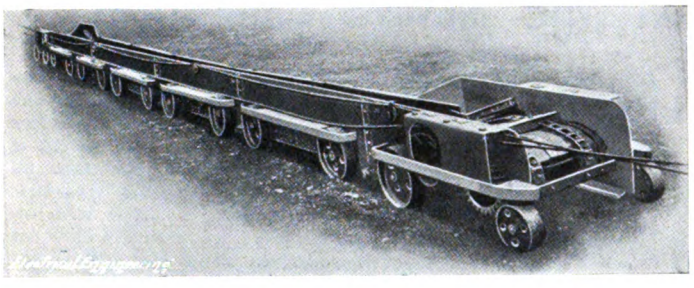
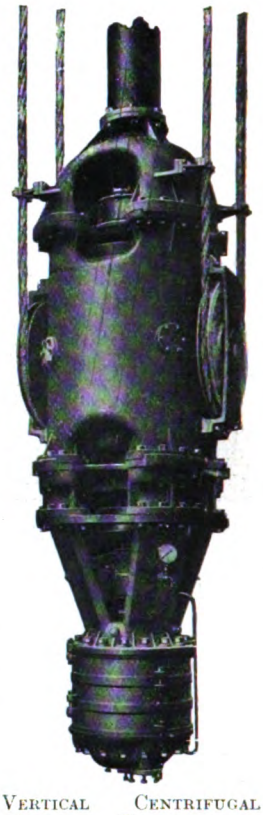
phase motor of the squirrel-cage type, is also shown. This is provided with a self-contained starter on the auto-transformer principle, with a switch of the barrel type, worked by a hand-wheel, and here again the starter handle is carefully insulated. The manufacture of these coal cutters has been standardised to such an extent that with the exception, of course, of the actual motors and starters, all parts, whether in continuous current, alternating current, or pneumatic cutters, are interchangeable. This greatly reduces the number of spare parts required for groups of collieries under the same management, where all these varieties are in use. The three-phase machine is shown adjusted for over-cutting, and, like the smaller cutter, is mounted on skids. It also embodies several improvements in the construction of the haulage gear, the drum of which is larger than formerly, and in general more substantial. One of these cutters is shown in the accompanying illustration.



The Gibb Carriage Conveyor (Messrs. Mavor & Coulson).

Another interesting object on the stand is an example of the Gibb patent carriage conveyor for underground use. This has been particularly designed for use in thin seams for drawing coal from the working face to the haulage road. The apparatus, as may be seen from the illustration, consists of a long, low jointed carriage provided with a mechanical end discharge operated by the same motive power which draws the carriage to and fro along the face. Each carriage comprises a discharging end, as many intermediate sections as may be required, and a back end containing the chain returning gear. The end discharge is effected by scrapers attached to a pair of endless chains returned under the bottom of the carriage. The gear is operated by a rope from an independently situated haulage gear engaging with a rope wheel mounted on the side of the carriage. While the carriage is travelling, the rotation of this wheel is prevented by a ratchet, but on arriving at the discharging position a simple trip arrangement releases the wheel so that it can drive the chains. Several motors specially constructed for mining work are shown, including a continuous-current flame-proof motor, in which special care is taken to seal the bearings. No attempt is made to render the motor gas tight, but a "chimney" is provided, with several layers of metal gauze separated by interspaces. The connections are taken in through pecial sockets filled in with cement. Another motor is a standard 100 h.p. three-phase induction machine with enclosed slip rings and a device whereby the slip rings are short-circuited and the brushes are lifted by a single movement of a lever. A separate continuous-current armature is shown, and also a special type of squirrel-cage rotor for mining work, which has the copper and connecting rings cast on, forming both electrically and mechanically a particularly sound job. The switchgear exhibited includes an enclosed motor panel for underground work, and a special enclosed starter. This is of interest, as being provided with a resistance composed of a number of units each composed of a helix of bare wire sprung into an asbestos tube but with no further insulation. The leads to the various sections of the resistance are threaded with glass beads, which form an excellent flexible insulation capable of standing a considerable degree of heat if necessary.

Messrs. Ernest Scott & Mountain, Ltd., of Close Works, Gateshead-on-Tyne, have some fine examples of electrical machinery for mining work on exhibition. Among these is a portable main-rope haulage gear with an 18-in. by 10-in. drum, suitable for a rope speed of 4 miles per hour. The whole of the gear is machine-cut, and the bearings are gun-metal lined throughout. The bedplate is steel, stiffened with angles and tie-bars, and bolted together. A powerful band brake, operated by a foot lever, and a jaw clutch, operated by a hand lever, are provided. The 5-h.p. motor drives the haulage-drum and gear through a raw hide or forged steel machine-cut pinion. This haulage gear is controlled by the special mining-reversing controller, with quick-make and break on every contact, a larger type of which is described and illustrated on page 115 of this issue. The contacts, which for this size of starter are not under oil, are contained in a water-tight case, with a single hand-wheel for starting, stopping, and reversing. An electrically-driven three-throw horizontal mining pump, capable of delivering 27 gallons of water per minute against a head of 200 ft., is exhibited, and a vertical centrifugal pump, capable of delivering 260 gallons of water per minute against a head of 300 ft., is also shown. The 40-h.p. continuous-current variable-speed motor is shunt wound for 500 volts, and rotates at 1,530 revolutions per minute. The motor and the four-stage centrifugal pump are coupled together and arranged so that the delivery water from the pump passes through a liner round the motor, through a breeches pipe on the top, and into the rising main, supported on this breeches pipe. The whole weight of the rising main, pump, motor, water column, &c., are taken by wire ropes passing round pulleys on the side of the motor. This arrangement has the following advantages:—(1) The weight of the rising main and water column is supported centrally on the motor, and as the unwatering proceeds it is only necessary to lower the pump down on its ropes and put additional lengths of piping at the top. (2) Considerably less space is taken up in the shaft. (3) It is very much easier to handle the rising main, as the ropes lowering the pump can be used as guides. (4) The pump, when the unwatering operations are over, can have brackets put into the foundations, and be permanently fixed on the foundations. The external appearance of the pump described above is exactly similar to that of the 300-h.p. pump illustrated, which is one of two 300-h.p. pumps supplied to the Kent Collieries, Ltd., and which is equipped with a three-phase squirrel-cage motor. Each of the two pumps supplied had its own generator, and the method of starting was to start up both motor and generator together, thus avoiding the necessity of complicated starting gear and slip-ring motors. Messrs. Scott & Mountain also exhibit a double-drum electrically-driven winding gear, designed for lifting an out-of-balance load of 1 ton from a shaft 500 ft. deep at a speed of 350 ft. per minute. Each drum is provided with a jaw clutch, so that the level of the cages may be adjusted, and a powerful band brake operated by a foot lever. In addition, a solenoid magnetic brake is provided so that should the current fail at any time the brake would come into action and hold the load. Depth indicators are provided, for showing the position of the cages in the shaft. The gear is driven by a 40-h.p. three-phase alternating-current motor mounted on the bed plate and driving through a machine-cut pinion. Other machines on the stand comprise a 50-h.p. continuous-current interpole motor of the semi-enclosed type, and a 190-K.V.A. three-phase generator.



Vertical Centrifugal Sinking Pump, with 300 h.p. Water-cooled Motor (Ernest Scott & Mountain).

The Diamond Coal-Cutter Co., of Stennard Works, Wakefield, exhibit a number of their well-known "Diamond" longwall machines, both of the disc and chain types. The two-motor standard "Diamond" disc machine is driven by two motors wound for 500 volts, and each capable of developing continuously 18 B.H.P. A tramway type controller is used with magnetic blow-out and a separate fuse chamber. Both the switch lid, the fuse chamber lid, and the cable plug are automatically locked when the current is switched on, and cannot be opened or removed till the current is off. The 1908 type electrically-driven "Diamond" chain cutter is fitted with a 24-B.H.P. (direct- or alternating-current) motor. The gears are of steel throughout, are enclosed, and run in oil. The overall height of the cutter is 19″ and the length only 7′ 6″. This cutter is particularly suitable for short faces where a comparatively light and small machine is necessary and one that will cut its own way under the coal. A two-motor "Diamond" longwall chain machine is also exhibited, this being of the overcut type to remove a parting at any height, from 20″ upwards, from the floor. This machine is specially adapted for long faces, and will cut equally well in either direction. All the electric coal-cutters shown are fitted

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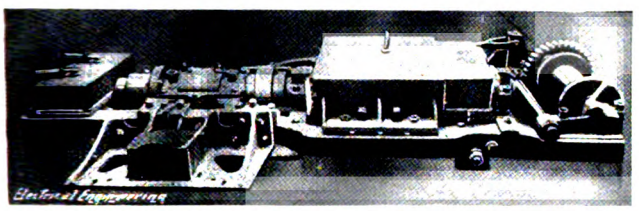
with reversing switches, having magnetic blow-outs, and are designed to cut backwards and forwards. The disc machines are recommended for hard coal, and the chain machines for soft coal. The latter type is also preferable where polyphase motors are to be used as a lower starting torque is necessary. The two-motor disc machine described above is driven by two direct-current series motors connected in series. One motor is situated at either end of the frame. The firm also exhibit a section of their "Blackett" underground conveyer, the 8-h.p. 600-r.p.m. motor of which is concealed under the trough. The motor drives its conveyer through an epicyclic reduction gear, which reduces the speed in the ratio of 16 to 1. This conveyer is capable of discharging from 20 to 25 tons of coal per hour. Examples of the "Diamond" improved electric rotary mining drills, mounted on a patent carriage, are shown, and several types of switches are exhibited. Of these the standard self-locking 60-amp. gate-end switch and fuse-box is worthy of mention. This is fitted in a gas-tight box, and the switch cannot be closed until the lid of the case is closed; moreover, the lid cannot be opened until the switch is off.

Messrs. CLARKE, STEAVENSON & Co., LTD., of Barnsley, have on exhibition an example of the Clarke patent disc type coal-cutter



ELECTRIC COAL-CUTTER, MESSRS. CLARKE, STEAVENSON & CO.

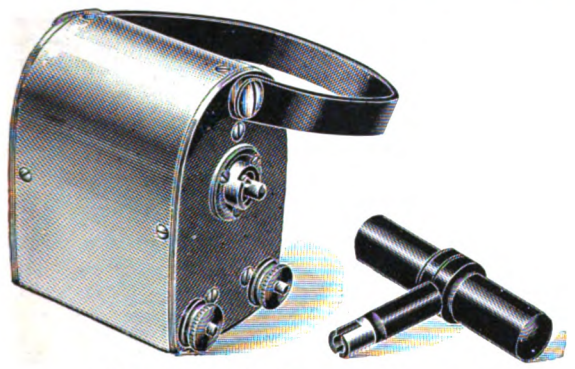
which presents several interesting features. The machine exhibited is driven by a 30-h.p. four-pole gas-tight continuous-current motor, forming part of the machine in the usual way. The cutting disc is driven through a double-thread bronze worm working into a steel worm wheel. The drive is transmitted from the motor through a flexible coupling, so that a certain amount of racking of the frame does not interfere with the alignment. A ball thrust of the Hoffman type is used. The starting switch, which has four steps, is situated at the cutter end of the machine. The feed of the haulage is worked by means of a rocking bar. The machine shown is of the standard size for working in a total height of 20 in.

Messrs. ANDERSON, BOYES & Co., LTD., of Motherwell, exhibit a longwall electric coal-cutter of the chain type, driven by a 30-B.H.P. continuous-current motor of the four-pole enclosed type with field coils on the two side poles only. A special feature of the motor is the provision of means for actuating the brush-rocker externally without opening the case, while the commutator is observed through a glass window at the side. The arrangement of the controller handle, which is sheltered from falling water by a steel roof, and is so constructed that it is impossible to switch on too fast or stop between steps, should also be noticed. A good deal of thought has been paid to the design of the haulage gear, the drum of which is driven through an epicyclic gear put into action by a brake drum, so that a very gradual start can be obtained after the machine is running and the feed stopped and restarted at any time without stopping the cutters. The main gearing is enclosed in a circular head, and is of the bevel type. A machine of the disc type, driven by a three-phase motor, is also shown, and an electric rotary drill mounted on a travelling carriage.

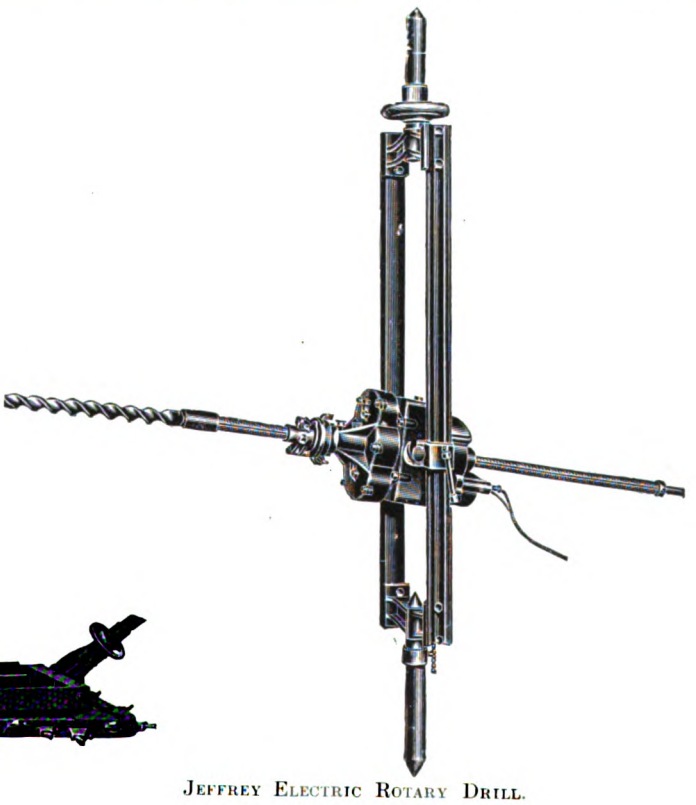
BELHAVEN ENGINEERING & MOTOR, LTD., exhibit an example of the "Clyde" electric disc coal-cutter. This is driven by a 35-h.p. motor through enclosed gearing running in oil. The total weight of the machine is about 45 cwt., and the extreme height from the skids can be kept down to 19½ in. or even 18 in. if necessary. Special care is taken in the lubrication of the centre pin of the disc, which is by forced feed. Ball races are provided to take the thrust of the bevel gears. The haulage feed is of special design, by which any cutting speed up to 4 ft. per minute can be obtained by moving a small lever when the machine is working. On the same stand are shown motors with the "Lacy" patent field winding, in which by a peculiar arrangement of dividing the field coils into sections, wound in opposite directions, a method of speed regulation can be obtained without resistances. Some further remarkable properties are claimed for this system.

An electric coal-cutter is shown by AUSTIN HOPKINSON, of Delta Works, Guide Bridge. The coal-cutters manufactured by this firm are of the longwall chain type, and have the jib so arranged that it can slew round while working to cut its way into the coal. Attention should be paid to the construction of the frame, which is of tough cast-steel, including the lower half of the motor case. The motor cases are split axially to allow of easy removal of the armatures. Worm gearing is used with ball thrusts, and the controller is oil immersed.

JOHN DAVIS & SON, LTD., of All Saints Works, Derby, have a very extensive exhibit comprising electric coal-cutters, drills, and blasting apparatus, and also a large selection of telephones, signal bells, &c., for mining work. The electric coal-cutter illustrated above is driven by a continuous current motor rated at 21 b.h.p. The height of the machine is 21 inches, the length 10 ft. 5 in., and the width 3 ft. 2 in. It weighs 27 cwt. To



"DAVIS DERBY" MAGNETO EXPLODER.



JEFFREY ELECTRIC ROTARY DRILL.

JEFFREY ELECTRIC HEADER.

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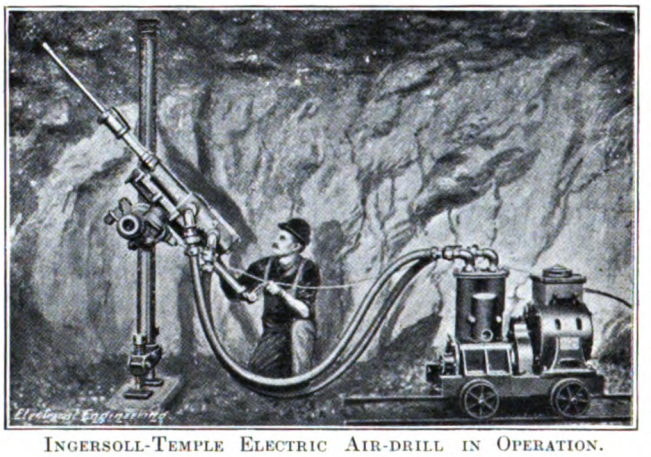
suit the hardness of the material to be cut, a choice of three speeds may be made. With the standard or fast feed, 3½ minutes are occupied in making a cut 6 ft. under; with the medium feed the operation is performed in 7 minutes; and with the slow feed, 9 minutes. The cutter-head makes its return journey in 30 seconds. The cutting chain consists of a number of tool-holders alternately holding the cutters horizontal, pointing upwards, and pointing downwards. The "Jeffrey" electric drill, also illustrated, is designed especially for drilling in hard materials. The drill feed-screw passes through the armature spindle which is hollow. By this means a well-balanced drill is obtained, whereas with other arrangements the motor must be above, below, or on one side of the feed-screw. A pinion with 25 teeth surrounds the hollow armature shaft, and engages above and below with 65-tooth wheels. Mounted on the same shaft with these wheels are the pinions of the second reduction set of gearing. The speed of rotation of the auger may be varied between 106 and 310 r.p.m., and the forward feed may be varied from 10 to 62 inches per minute. The motor is a 3 h.p. 4-pole series-wound continuous-current motor, and is contained, together with the starting switch and gearing, in a damp- and gas-tight case. A friction band is provided, with a wing nut and bolt for adjusting the pressure, to allow the feed bar to revolve with the auger without progressing, should it encounter any foreign substance in drilling, and so avoid unnecessary strains. The supporting frame is constructed of two "channel" bars with cast steel top and bottom yokes. The weight of the drill, with continuous-current motor complete for a six-foot seam, is 288 lb. Each drill is provided with 50 ft. of flexible concentric leather-covered cable. The third illustration is that of a "Davis Derby" magneto exploder for firing shots in mines. These can be obtained for either high or low tension firing. In a high tension fuse the explosion is caused by the ignition of a chemical compound; in a low tension fuse the explosion is caused by heating a fine iridio-platinum wire to a red heat and thus firing the priming. The current, whether high or low tension, is generated by giving the handle of the exploder a half-turn. The circuit is not closed until the half-turn is completed, when the armature has reached its maximum speed. A steel pin comes up against a stop at the completion of the half-turn, and prevents further turning. The handle, which is detachable, works on a shaft supplied with a ratchet in front of the gear wheels. Other types of exploders with revolving handles and press-buttons are exhibited by this firm A large selection of telephones and bells in water-tight and gas-tight cases are shown, and also some electric lighting devices with a magnetic lock for preventing a lamp from being opened underground.

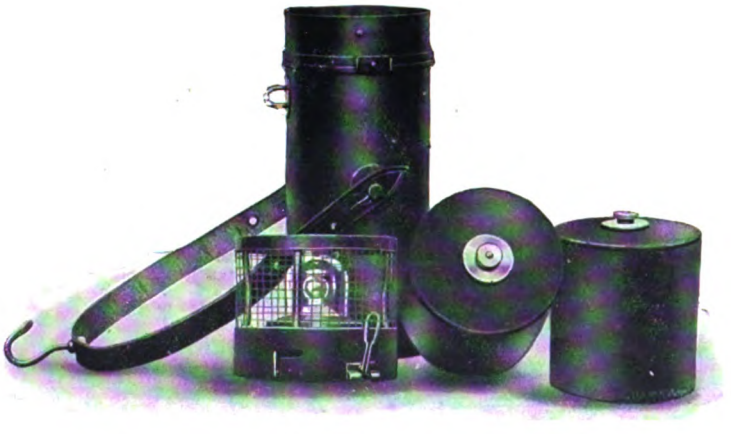
Messrs. BERRY, SKINNER & Co., of Suffolk Works, Birmingham, have an extensive display of various patterns of their pull on and push off switches such as we described in some detail in connection with the collective exhibit of the electric supply companies of London at the Franco-British Exhibition. These are particularly suited for mining work, especially in the form combined with interlocked plugs (see ELECTRICAL ENGINEERING, July 2nd, page 26). A novelty on the stand is an electric miners' lamp, worked by a primary battery, which is arranged entirely without a switch to light up when placed one way up, and be extinguished by causing the electrolyte in the cells to drain off by inverting the lamp. Each lamp contains two of these reversible cells in series. They are entirely non-gassing, and can be sealed up. The battery is capable of maintaining the lamp alight for 12 hours continuously without requiring intervals for recuperation, and does not weigh more than about 4 lb. The whole is strongly made, and is contained in a metal case with the end containing the lamp secured by a bayonet joint. A lamp on a similar principle for surface use is also shown. This can be provided with an extra lamp on a flexible cord with a combined switch and plug.

An interesting item on the stand of the INGERSOLL RAND COMPANY, of 165 Queen Victoria Street, is the Temple-Ingersoll electric air drill, which, although in considerable use in the United States, has not, we believe, been previously exhibited in this country. As will be gathered from the illustration, this apparatus consists practically of an ordinary compressed air percussion drill, actuated by a small electrically-driven compressor on a truck. A section of the drill itself is given in the accompanying drawing. The main advantage claimed for this system of drilling is that it combines the economy of electrical as against pneumatic transmission, with the simplicity and cushioned blow of the air drill, and only requires about 1/5th of the power of the latter. The cylinder is divided into two parts, each with its own piston. Each piston is driven by the air from one air cylinder of a small electrically-driven air pump without valves by means of a separate tube. The two drill pistons run synchronously with the air pump pistons, and



INGERSOLL-TEMPLE ELECTRIC AIR-DRILL IN OPERATION.

ALIGHT.



TAKEN APART.

EXTINGUISHED.

"FLOAT" MINER'S LAMP, WITH PRIMARY BATTERY, SHOWN BY MESSRS. BERRY, SKINNER & CO.

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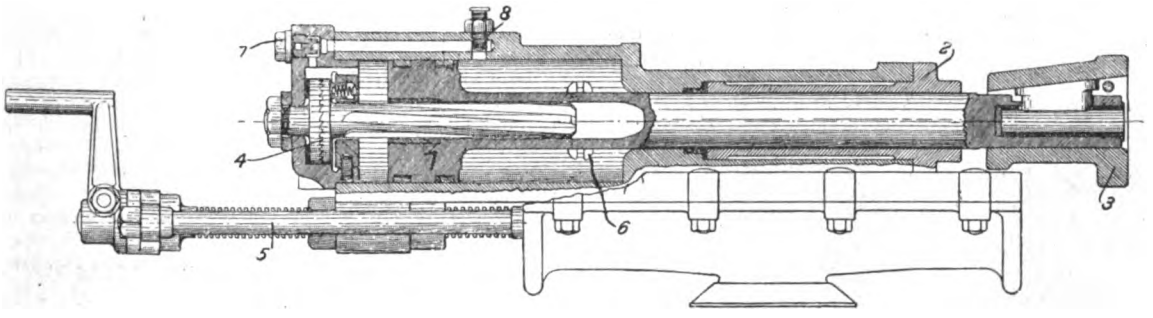
the quantities of air in each half of the drill cylinder act as air cushions at the same time. The air is always the same, and is saturated with oil so as to act as a lubricant. This drill is exceedingly simple, and requires very little repairing. The output or speed of the strokes can easily be varied by means of the motor driving the air pump. It requires, of course, more room than the purely electric drills, on account of the air pump, although this is very compactly arranged, but is quite suitable for large stopes and easy tunnelling work. The outfit shown is driven by a 2 h.p. 3-phase motor, and is intended for holes 6 to 8 ft. deep.



SECTION OF WORKING CYLINDER OF INGERSOLL-TEMPLE DRILL.

The most interesting exhibit on the stand of Messrs. R. H. LONGBOTHAM & Co., of Wakefield, is a complete portable electric haulage gear, shown in motion. This is of a size suitable for lifting a dead weight of 2½ to 3 tons, or as a haulage gear proper, of drawing a load of 14 tons up a grade of 1 in 6 at a speed of 156 ft. per min. The whole apparatus, including motor, controller, &c., is mounted on standard gauge wheels. The drum is 4 ft. in diameter, and capable of holding 1,400 yards of ¾ in. rope; it is driven through treble reduction gear by the motor, and can be thrown in and out of gear by a three-jaw clutch. The motor is of the three-phase induction type of the Phœnix Dynamo Manufacturing Co., and is rated at 30 b.h.p. at 720 r.p.m. on a 550-volt 50-cycle circuit. It is controlled by a Phœnix tramway type controller.

Messrs. HEAD, WRIGHTSON & Co., of Stockton-on-Tees, have an imposing stand, on which is shown a large working example of an electrically-driven screening plant, driven by a 7 b.h.p. induction motor, manufactured by the British Thomson-Houston Co. This apparatus is 34 ft. long, and is part of an order for a Yorkshire colliery, and consists of a "Marcus" patent conveyor. This is formed of a trough which is supported on line rollers, and receives a peculiar to and from motion from the driving mechanism with the advance and return of different speed. The material is thus caused to travel intermittently along the trough. The conveyor shown is of a size to deal with 100 tons per hour, and the main shaft runs at 70 r.p.m.

Messrs. GWYNNES, LTD., have an exhibit chiefly relating to electric pumping. We particularly noticed an electrically-driven seven-stage high lift centrifugal pump, directly coupled to a continuous current motor, running at 1,900 r.p.m., and capable of delivering 180 gallons per minute against a head of 500 ft. This is a particularly compact set, and well illustrates the possibilities of electrical pumping.

Messrs. HANIEL & LUEG, in addition to some other interesting exhibits not connected with electrical working, have on view a beautifully finished scale model of a large slow speed electrically-driven reciprocating twin mine pump. The motor is of large diameter, running at 92 r.p.m., and the rotor is mounted direct on the crank shaft between the two cranks. The actual pump of which this is a model, is for the Prussian Government mines, and has a capacity of 660 gallons per minute from a depth of 2,100 ft.

The stand of Messrs. DAVIDSON & Co., LTD., of Belfast, contains an excellent example of the way in which electric power is applied to the ventilation of mines in the shape of a 49-inch "Sirocco" mine fan, with a capacity of 26,000 cubic feet of air per minute against a head of 3 inches of water. It is direct-coupled to a 20 b.h.p. continuous-current 220-volt motor, manufactured by Messrs. Mather & Platt, of Manchester, which drives it at 420 r.p.m. The switchgear for the motor is all contained in a substantial gas-tight iron case, suitable for use under ground. The panel comprises voltmeter, ammeter, starting switch, field regulating switch, D.P. main switch, and fuses, and is also supplied by Messrs. Mather & Platt. Some other smaller fans are also shown.

Messrs. HEENAN & FROUDE, of Worcester, also devote most of their space to fans of a type specially suitable for electrical driving. A large "Heenan" mine fan, with single inlet, and fitted with Evase chimney, is shown arranged for belt driving, although of a type easily adapted for direct coupling. It is capable of discharging 40,000 cub. ft. of air per min. against 3 in. of water pressure when running at 340 r.p.m. Several smaller fans, both of the Heenan and Shiele types, are also shown.

Messrs. REAVELL & Co., LTD., of Ipswich, exhibit a number of examples of their well-known air compressors specially designed for electric driving, including a novelty in the shape of a very compact compressor intended for use as a sub-station cleaning set. This is arranged with handles so that it can be carried by two men. The weight is 128 lb. The motor is rated at ¾ B.H.P., and is directly coupled to the compressor; a very neat crank motion drives the two opposed cylinders without connecting-rods, and the crank-pin and main bearings are oiled from a single oil well. When carrying, the delivery hose is coiled round a wooden cylinder, the inside of which accommodates the flexible electrical lead. The larger compressors shown are mostly of the four-cylinder type. One of these, which is gear-driven by a 33-B.H.P. motor, runs at 250 r.p.m., and delivers 170 cubic ft. of air per minute against a pressure of 90 lb. per sq. in. A direct-coupled compressor, running at 400 r.p.m., is also shown, which has a capacity of 95 cubic ft. of air against 70 lb. per sq. in. and is driven by a 19-B.H.P. motor. One or two other compressors are shown, and in the centre of the stand is a complete steam generating set, consisting of a single cylinder enclosed Reavell double-acting engine, running at 700 r.p.m., direct coupled to a four-pole generator.

The exhibits of PETER BROTHERHOOD, LTD., of 53 Parliament Street, S.W., of an electrical nature include a very compact generating set, consisting of 12-kw. Siemens continuous-current four-pole dynamo for an output of 150 amperes at 80 volts direct-driven by a single-cylinder Brotherhood engine running at 650 r.p.m. Attention should also be drawn to a small electrically-driven air compressor, suitable for cleaning electrical machinery, &c., in generating stations and sub-stations. This is a single-cylinder water-cooled compressor driven by a Westinghouse motor through a raw hide pinion, which gears into an internal ring of teeth inside the rim of the overhung flywheel. The whole is mounted on a single bed plate, which contains the cooling-water tank.

Messrs. BROWETT, LINDLEY & Co., LTD., of Patricroft, Manchester, exhibit one of their latest standard enclosed forced lubrication three-crank three-cylinder triple expansion double-acting vertical steam engines, arranged to run at 375 r.p.m., and suitable for driving a 350-kw. dynamo as a normal load when working condensing with 150 to 180 lb. steam pressure at the engine stop valve. It is also capable of giving 25 per cent. overload. This engine is fitted complete with a centrifugal shaft governor, controlling the speed by acting direct on a throttle valve, and is provided with forced lubrication to all bearings, &c.

The STIRLING BOILER Co., of 25 Victoria Street, show working models constructed to exhibit the way in which the water circulates in their well-known water-tube boilers.

Messrs. E. GREEN & SON show models of their well-known economisers for applying the waste heat from the furnace to raise the temperature of the boiler feed. These models are very complete, and the scraper gear is driven in each case by a small electric motor.

Messrs. HEINRICH LANZ, of Mannheim, exhibit examples of portable and semi-portable self-contained engine and boiler sets, or "Locomobiles," with Lentz patent valve gear. The engines of these sets are of the horizontal type, mounted on the top of tubular boilers, combined with superheaters, and in addition to the advantages due to compactness and portability, a very high degree of economy of fuel is claimed.

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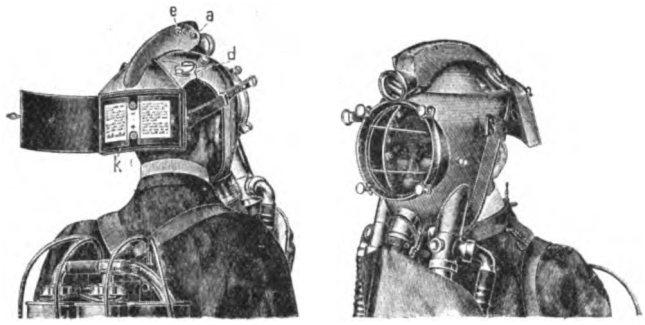
The stand of Richard Jacobson, of 11 Water Lane, Great Tower Street, is devoted to the well-known Draeger rescue apparatus and smoke helmets. A recent addition to the equipment is a special new form of electric head lamp for fixing on these helmets. This lamp is not connected by flexible wires to the battery, but is arranged all in a piece to fit over the top of the helmet, with the accumulator in its metal case forming a neck protector at the back. The advantages of a head lamp such as this over a hand lamp are obvious. The whole apparatus is readily removable from the helmet, and only weighs about 2 lb. It is said this extra weight, rather than being a source of dis-



Back view, showing accumulator case open. Front view.

a—Locking button, fixing lamp to helmet.
d—Screw, attaching lamp to helmet.
e—Switch.
k—Accumulator.

Draeger Electric Helmet Lamp applied to Rescue Dress.

comfort, improves the balance of the helmet. The 4-volt battery consists of two special curved cells, and is easily taken in and out from the back. They are of sufficient capacity to keep a 3-c.p. lamp alight 2½ hours, or a 1½-c.p. lamp for 5 hours. Considering that the breathing apparatus only carries oxygen for about two hours, this capacity should be quite sufficient. The lamps are of the metal filament type. The general arrangement of the lamp on the helmet can be seen from the accompanying illustrations. Special charging boards for the accumulators are supplied. A hand accumulator lamp burning eleven hours is also shown.

E. Thomas & Williams, Ltd., of the Cambrian Lamp Works, Aberdare, have several forms of electric lighters for miners' safety oil lamps on exhibition. The "Cambrian" underground safety relighter is worthy of mention, as it is intended for re-lighting lamps underground in the presence of fire-damp with perfect safety from explosions. There are no batteries or accumulators, the current being generated by a magneto-generator in the base of the apparatus. The method of lighting is as follows :—The lamp is placed on a plate at the bottom of the lighting chamber, and two studs on the plate are brought in contact with two studs on the base of the lamp, which lead to a spark gap placed over the wick of the lamp. When the lid of the chamber is closed the handle of the magneto is given one or two sharp turns, and the spark at the gap ignites the wick. The lighting chamber is of heavy construction to withstand the force of any internal explosion, should this take place. A locking gear prevents the generation of current while the contacts are exposed to the atmosphere of the mine. The lighting chamber is, of course, perfectly gas-tight.

The Wolf Safety Lamp Co., of 37 York Place, Leeds, have several examples of their miners' safety lamps with magnetic locks. They also exhibit an electric miner's lamp. The lamp itself is a 2-volt Osmium lamp, taking about 1 ampere and giving from 1 to 2 c.p. It is enclosed in a strong glass case, fitted to the lamp-carrier in an air-tight manner. The lamp case is made of tinned sheet steel, painted with an acid and rust-resisting composition, and the closing ring is made of an alloy of aluminium. The lamp can be only unlocked magnetically. The single-cell accumulator is enclosed in a celluloid case, and will keep the lamp burning for twelve hours continuously. The lamps last over 800 hours, but the filaments are very fragile when not burning, and it is recommended to keep the lamps alight from the time of handing out to the time of handing in to the lamp-room. The lamp weighs 4 lb. complete.

Messrs. Ackroyd & Best, Ltd., of Morley, near Leeds, have a good selection of their mining specialities on exhibit. Amongst these are their electric relighters, which are fitted with accumulators and induction coils, differing in this respect from other types, which are mostly fitted with magneto generators. The miners' safety oil lamps supplied by this firm are fitted with an automatic locking arrangement. To unlock the lamp it is placed over an electro-magnet, which withdraws a lock-bolt and permits the unscrewing of the base of the lamp. This firm also exhibits a new form of underground relighter, which consists of two heavy cast-iron cylindrical chambers. The lower chamber contains the accumulator and induction coil, and in the upper chamber the lamp is placed. Closing the upper chamber automatically causes the sparking at the ignition gap to take place. The chambers are flame-proof, but there is a narrow space between the cylindrical-revolving walls of the chambers through which the gaseous products of an explosion can harmlessly escape. The passage of the gases between these cold iron walls cools them sufficiently to prevent any danger of explosion outside.

The Grondal Kjellin Co., Ltd., of 20 Abchurch Lane, E.C., exhibit a model of a Kjellin induction steel furnace similar to that illustrated on page 18 of our issue of July 2nd. The model exhibited, however, has not the renewable hearth with which the latest types are fitted. Samples of steel produced in the Kjellin and Röchling-Rodenhauser electric induction furnaces are also exhibited. Samples of electrically-melted steels, including Diamond-Tungsten and Chrome steels are shown by Messrs. Sybry, Searls & Co., Ltd., of Cannon Steel Works, Sheffield, who produce all these classes of steel from the raw Swedish iron by means of the Kjellin furnace.

The Cambridge Scientific Instrument Co., Ltd., have a stand on which are exhibited a selection of scientific instruments used in metallurgical processes. Porcelain-tube pyrometers and instruments for taking readings from the same at regular intervals are shown. Some examples of the latest types of millivoltmeters are also to be seen.

CATALOGUES AND PAMPHLETS RECEIVED

ALMANAC.—Messrs. W. T. Glover & Co., Ltd., have issued their well-known almanac for the twelve months commencing July 1st. The sheet for each day is either embellished with a picture showing applications of Glover cables or appealing to one's sense of humour, or contains an interesting quotation from electrical literature. The almanac is arranged so that it can either be hung on the wall or stand on a table.

BRANCH SWITCHES, PLUGS, &c.—A collection of lists from Messrs. A. P. Lundberg & Sons illustrates a number of patterns of switches and plugs suitable for a variety of purposes. The "Pivot" pattern tumbler switch, both in its single and two-way pattern, is listed in a number of forms, including the locked cover, removable key, and flush types. The "Pivot intermediate" switch is also of the tumbler type, and is used in conjunction with two-way switches in cases where it is desired to control groups of lights alternatively from more than two points, for example, where it is desired to turn all the lights on a staircase on or off from any floor. Another leaflet deals with combined switches and plugs of the two- and three-pin type for special purposes.

ELECTRIC COOKING APPARATUS.—A new leaflet from the Simplex Conduits calls attention to several new patterns of kettles and saucepans which are put on the market at very low prices. One of these is a neat brass kettle, which will boil 1½ pints of water in 9 minutes with an energy consumption of 500 watts. We understand that some reductions in price are made to agents ordering these kettles in lots of not less than a dozen.

ELECTRICAL PLANT.—A booklet has been issued by Messrs. Crompton & Co., Ltd., containing a series of reproductions of photographs of their Chelmsford works, representative examples of plant manufactured therein, and installations equipped with Crompton machinery, showing the wide range of the company's activities.

GAS ENGINES.—A leaflet from Messrs. E. S. Hindley & Sons calls attention to the advantage claimed for the firm's well-known pattern of vertical multicylinder gas engine, running at high speeds, and suction gas plants.

INSULATING VARNISH.—A pamphlet from Messrs. Turners & Manville, Ltd., of 5 Lloyd's Avenue, E.C., describes the purposes for which the preparation known as "Voltax" is suitable. This anticorrosive varnish claims to combine the qualities of transparency and elasticity with excellent waterproofing and insulating properties. A special quality is made for coating armature, field, or transformer coils, and other uses include prevention of corrosion of metal work, both under or above water, and the formation of a water, acid, and alkali proof covering for the interior and exterior decoration of car bodies. The dielectric strength is given as 3,000 volts per mile.

TELEPHONES.—A compact and well-arranged catalogue from the Sterling Telephone & Electric Co., of 200 Upper Thames Street, contains particulars of a number of patterns of the well-known "Sterling" telephone, including direct-acting short-distance sets, without induction coils, battery call telephones for longer distances, central battery equipments, mining telephones, various patterns of magnets, call telephone, and a long series of intercommunication sets. A few typical switchboards are illustrated, and particulars of bells, batteries, and other accessories are given.

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ANNUAL CONGRESS OF THE TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION

ON Thursday and Friday the Annual Congress of the Tramways and Light Railways Association was held at the Franco-British Exhibition. The Duke of Argyll, who is President of the Association, received the members in the Congress Hall of the Exhibition, and after a few words of welcome, in which he explained the absence of the Chairman of the Council, the Hon. Arthur Stanley, M.P., he called on Sir Clifton Robinson to deliver his address on "Tramways of the World." We publish this address in slightly abbreviated form below.

TRAMWAYS OF THE WORLD.

By Sir J. CLIFTON ROBINSON.

Horse tramways, as we all know, have existed in one form or another for half a century or more. Stone or iron tracks offering a smooth surface to the wheel have been used from a remote period, until from those primitive designs we have advanced to the grooved rail tramways now found in every quarter of the globe. The first use of rails and flanged wheels on roads appears to have been in the United States, where necessity evolved them when ordinary roads and streets were non-existent or impassable. In 1860 my old chief, George Francis Train, introduced the pioneer street railway into Great Britain, at my native town of Birkenhead, and followed it with extensions of his system in London, South Staffordshire, and Darlington. All these were failures, mainly owing to the use of the American type of step rail then in vogue, which interfered seriously with other vehicular traffic. The next experiment was made in Liverpool with the so-called crescent rail, in 1865, and this town was the first in England to obtain Parliamentary powers for tramways, which it did after lengthened opposition in 1868. The first section was opened in November, 1869, which begins modern tramway history in England. London, Glasgow, and Dublin followed almost immediately, and Parliament, after an exhaustive inquiry, passed the General Tramways Act of 1870, to "facilitate the construction and working of tramways" in Great Britain. As we know to our cost, the Act has in many ways hindered, instead of facilitated, development. The Act enabled local authorities to promote and own tramways, but expressly denied the right to operate them. It conferred upon them powers of compulsory purchase after a period of 21 years on terms which were subsequently construed as "scrap iron" price. In nearly every case the acquisition of the lines by a local authority has been followed by municipal working. The first real advance in mechanical traction was the invention of the cable system by A. S. Hallidie, and the first line was laid down in Clay Street, San Francisco, in 1873. Other routes rapidly followed, and it was then found that, in addition to working successfully on steep gradients, the cable system was more economical in operation than anything hitherto known. Its adoption in Chicago, New York, and other large cities demonstrated that the system was equally suitable for level roads, and that the heavier the volume of traffic the lower the expense per car mile became. Outside the United States the first cable line was opened in Dunedin, New Zealand, in 1882. I was associated with others in the construction of the first cable tramway in this country—that at Highgate Hill, inaugurated in 1884, with great *éclat*, by the Lord Mayor of London, and which is at length about to be converted to electric traction.

Excellent as the cable system was in practice, it had its drawbacks in the way of large capital expenditure, extensive road excavation, and the movement of dead-load mechanism in the conduits under the street. Where the traffic was of reasonable magnitude, the extremely low working expenses more than offset the capital cost, but the latter rendered it impracticable for suburban and outlying districts. There was also a limit to the length of cable which could be profitably utilised, so that for a large system power houses had to be multiplied indefinitely. Some method combining greater flexibility and power of expansion was needed, and traction engineers longingly turned their eyes in the direction of electricity.

Sir W. Siemens exhibited the first electric railway model at Berlin in 1879, and the first line for public traffic was opened at Lichtenfelde in 1881. Edison and S. D. Field constructed a short electric railway at the Chicago Exhibition of 1883, and in the same year Magnus Volk laid down a short electric line on the beach at Brighton. The inauguration of the Giant's Causeway electric tramway took place also in 1883; the initial electric conduit tramway was opened at Blackpool in 1884, and the Bessbrook and Newry line a year later. In January, 1893, the first electric overhead trolley line in Great Britain was opened at Roundhay Park, Leeds. The poles and overhead construction were pronounced hideous, but the speed and ease with which the cars moved proved a revelation. This demonstration was quickly followed by the conversion of the South Staffordshire steam tramways, but hardly had these lines got under way when the æstheticism of a section of the British public was up in arms at the outrage thus perpetrated, and, as all sorts of dangers were imagined, Parliamentary inquiry, involving tedious delay, was instituted. The outcome was the promulgation in 1894 of Board of Trade Regulations for the protection of existing interests, and these rules, remodelled from time to time, are still in force. They have no doubt increased the construction cost, but on the whole have encouraged a type of installation and equipment unsurpassed if not unequalled in the world, and there is no doubt that it is due in no small measure to the efficient and rational influence exerted by the Board of Trade over our railways and tramways, that we owe our relative immunity from the appalling accidents so frequent in other countries.

About this time the famous decision was given by the House of Lords that the price to be paid by a local authority in exercising its powers of purchase under Section 43 of the Tramways Act was the cost of construction minus an allowance for depreciation dependent upon the condition in which the tramways were when acquired. Something of the kind had been feared, and tramway companies had become chary of investing capital in electrification. When the House of Lords' judgment encouraged a rush of local authorities to enter upon schemes of tramway ownership, all hope of raising capital by private enterprise for the adoption of the new method of traction had to be practically abandoned. A few of the stronger and more progressive companies, in enjoyment of considerable terms of unexpired tenure, and strong in the faith that was in them, came to terms with the local authorities and succeeded in pressing forward the realisation of electric traction.

When I returned to this country, simultaneously with the reconstruction and electrification of the Middlesbrough, Stockton, and Thornaby tramways, I found myself engaged in what for long seemed hopeless, or at least fruitless, missionary efforts in pioneering electrical traction in London. From 1894 to 1901 the struggle waged, and resulted in the establishment of the London United Tramways as you see them to-day, a well-equipped system extending to 56 route miles. When, before the London County Council, I advocated the introduction of the overhead trolley at Shepherd's Bush, I was threatened, in effect, that if the London United Company dared to put up posts in the streets to carry overhead wires, the people would rise and tear them up by the roots. Confronted with that extraordinary attitude, we had perforce, for the moment, to accept the conduit system at Hammersmith. But when the Borough Council realised that its streets were to be used for experiment, resolutions were immediately passed, with the result that in the next Session of Parliament the objectionable conduit clause was rescinded in favour of the overhead trolley, by means of which system the London County Council are to-day successfully conveying thousands of grateful passengers to and from this great Exhibition.

In 1901, on the eve of the opening of the first electrified section, the Royal Observatory at Kew urged the dangers with which our electric current threatened its delicate instruments. The Observatory opposition was disposed of, and for ever removed from the path of electric tramway development. From first to last I have had to negotiate with thirty different public authorities, and the price of their consent to the construction of our tramway—in compulsory widenings, in capitalised wayleaves, and otherwise—has aggregated a round million sterling. That is a heavy handicap, but in spite of it we have earned an average of 5 per cent. in the six years of the electrical development period during which we have carried no less than 300,000,000 passengers.

The largest companies in the country still in the hands of private enterprise are the British Electric Traction, the Dublin United, the Cork Electric, the Lancashire United, and the London United Tramways. Apart from these companies, the whole of the large systems in Great Britain are now worked by municipalities. The development of municipally worked electric tramways came with a great bound, as all the conditions were favourable. Companies could be bought out at a low price, capital could easily be raised at low interest on the security of the rates, and, above all, the tenure was perpetual. Thus, in the closing years of the last century, companies were ruthlessly frozen out, and the lines reconstructed, extended, and electrified. Many of the municipal tramways in medium-sized and smaller towns are in financial straits, because low fares, high wages, interest and sinking fund render it difficult to keep the accounts on the right side. Depreciation allowances, which

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have become a burning question in connection with municipal and private enterprise alike, are frequently inadequate and sometimes non-existent. In the large cities municipal tramways are regarded as prosperous, and with the enormous traffics obtainable in densely-populated communities, it could hardly be otherwise, unless there was gross extravagance or mismanagement.

The London County Council tramways require separate mention. Owing to the extensive adoption of the conduit system a large capital expenditure has been necessary, and to this must be added the price of the old horse tramways taken over from the companies. At present the total cost represents over £60,000 per route mile of tramway, and about half the mileage consists of horse lines still to be electrified. When all these have been converted, the cost per mile over the completed system will be considerably higher. Although the lines are operated through what are probably the most congested districts in the world, and the cars carry about a million passengers per day, there is only a modest surplus for the reserve fund after paying working expenses, and the enormous annual capital charges. It is only fair, however, that two features common to other similar undertakings should be referred to. First, the horse lines, partly owing to dislocation of traffic during reconstruction, are operated at a loss, and this, it may be assumed, will improve concurrently with the work of electrification. Second, the debt charges are not equated as in other towns. The result is that, instead of a uniform charge over the whole period of the currency of the loans, interest and redemption on the whole sum borrowed is paid from the first, and the amount of interest paid per annum diminishes every year as the capital is paid off. Thus, even though matters were not to improve, the financial position should get better every year provided adequate amounts are set aside as a reserve for depreciation and allowed to accumulate, a matter which, as we know, is at the moment seriously exercising the minds of all concerned.

As I have said, the London County Council have recently departed from their strict adherence to the underground conduit, and have now adopted the overhead trolley system. Many millions might have been saved to London in construction cost alone, had that repentance come earlier, but the County Council adhered so long to its antipathy to the trolley that the borough councils followed suit by logically vetoing the overhead system. In the hope of escaping the heavy cost of the conduit and the veto of the borough councils, the County Council is now considering a surface contact system, which they have just put into tentative operation.

There appears no prospect of extensive development of the conduit, or of any surface contact systems, save in places where from æsthetic considerations, real or affected, as in the case of our good friends and neighbours the Richmond Corporation, overhead wires are prohibited. The accumulator system has been dead for years, and for tramway purposes displays little or no symptoms of resuscitation.

I have not mentioned the Light Railways Act of 1896. To a considerable extent it has been taken advantage of for the construction of electric tramways, and the procedure is quicker and somewhat cheaper than that of proceeding by Bill. The veto of local authorities has not to be encountered, but against this an existing railway company may veto a proposal on the ground of competition, and a Light Railway Order will not be granted for a line which would be wholly within the area of one local authority. The Act is gradually becoming a dead letter, and no great increase in the number of applications under it can be hoped for till it has been amended.

I have already touched upon the greatest stumbling block in the way of tramway promotion. That is the power of veto vested in local authorities by the Standing Orders of Parliament. Great hopes were entertained that good results might follow the recommendation of the Royal Commission on London Traffic in 1904, that the veto should be modified if not altogether abrogated. My view put before the Commission may be summarised in the words:—"I saw no reason why rules, regulations, or even Standing Orders that had become out of date should not be scrap-heaped in a similar manner as mechanical appliances that had become obsolete."

Our labours in pressing this very necessary reform have not been altogether in vain, and this session, in connection with the project for linking up our West London, Middlesex, and Surrey lines across King Edward VII. Bridge, the Committee of both Houses unanimously disallowed the veto of the two County Councils, and permitted the Bill to proceed. This is merely an indication, but, to my mind, a hopeful one. Ages ago, I verily believe, the warden of the keys of progress fell asleep in our ancient and Imperial Houses of Parliament, and in his slumber relinquished all of the bunch from his hand but the one key that unlocked the door to those endeavouring to solve the problem of street traction. No one has dared to lift that mighty hand, but there are signs and portents, slight though they be, that the monster is moving in his sleep.

We have every encouragement in the enormous development of tramways in this country within recent years, and I quote here some figures from the last Board of Trade returns, which were published in the spring, giving a comparison of totals with 1902, when electric traction was beginning to get into full working stride.

	1906-7.	1902.
Total capital expended ...	£64,092,091	£31,562,267
Length of route open ...	2,394 miles	1,484 miles
Number of horses	7,378	24,120
Number of locomotives ...	148	388
Number of electric cars ...	10,369	...
Number of non-electric cars	1,377	...
Number of both kinds of cars (not separately distinguished)		7,752
Number of passengers ...	2,454,807,487	1,394,452,983
Board of Trade electric units used...	369,362,473	...
Gross receipts	£11,849,175	£6,679,991
Working expenditure ...	£7,365,762	£4,817,873
Appropriation of net receipts—		
Interest or dividend ...	£1,828,966	...
Repayment of debt ...	£803,325	...
Relief of rates	£297,456	...

The 2,394 miles of route open in 1906–7, reckoned as single track, amounts to 3,850 miles.

These figures for 1906–7 relate to 318 tramway undertakings in the United Kingdom, of which 179, having a route length of 1,571 miles and a capital expenditure of £41,735,547, belonged to local authorities, and 139, having a route length of 823 miles and a capital expenditure of £22,356,544, belonged to companies. Out of the total length of 2,394 miles, 2,195 miles were worked by electricity, 64½ miles by steam, 25¾ miles by cable, 4 miles by gas motors, and 105 miles by horses. Most of the last were in London, and practically the whole of the cable lines in Edinburgh. The horse lines will soon all disappear. The Edinburgh cable lines will probably remain until the local prejudice against overhead wires has been overcome in its last remaining stronghold.

In our modern track, with British standard section rails of 95 lb. or 100 lb. per yard, concrete foundation, rails anchored down both at joints and intermediately, heavy fish-plates or welded joints, we can show work unsurpassed in the world. The great difficulty yet to be surmounted is rail corrugation. We have attained some fair success with an apparatus designed and constructed in our own shops, but I cannot claim that this has proved to be more than an amelioration of the evil. I give here details of the most recent form of permanent way construction on the London United. The foundation is a bed of Portland cement concrete not less than six inches in depth, in which are embedded cross sleepers of old girder rail inverted and bolted solidly to the girder track rails. These sleepers are placed at intervals of nine feet and extend for nine inches outside the gauge line. In addition to the fish-plates, each joint is provided with a girder sole plate consisting of a half-inch plate 10 inches by 20 inches, riveted to a 24-inch length of six-inch girder joist, which is embedded in the concrete. This girder sole plate is bolted to the flanges of the running rail, and forms a very solid and effective support. The result of our experience with this arrangement has been entirely satisfactory. On all extensions constructed during the past three years we have used the rails of the British standard No. 3 size and specification, having a weight of 100 lb. per lineal yard straight track with a depth of 6½ inches and a width of base of seven inches. Practically the whole of our tramway area is paved with Australian Jarra blocks nine inches long, three inches wide, and 4½ inches deep, and close jointed, laid on a floating of sand and Portland cement. All points and crossings are of manganese steel. The cost of construction per mile of double track amounts to £13,000.

Speaking of British tramways generally, I see no reason why they should not enjoy an indefinite period of financial prosperity, skilfully managed, and conservatively financed. There are three points that handicap us in comparison with other countries:—(1) Our tramway cars are not permitted to travel fast enough, the average speed being less than 10 miles an hour. (2) The double-deck tramway car in general use causes much delay, particularly at stopping points. The adoption of this type of car is consequent upon the regulation enforced by the authorities that no car shall be licensed to carry any passenger for whom a seat is not provided. (3) Traffic could be handled more successfully on special occasions were the present licensing restrictions regarding passengers removed or amended. It is undoubtedly the fact that there is no other country in the world where such onerous conditions are imposed upon the operation of electric tramways. In Tokyo, with an electric tramway mileage approximating to that of the London United, 1,000 cars a day are run at an average speed of 20 miles an hour, and the passengers carried number some 300 millions a year, or nearly six times the number carried over the lines of the London United.

THE UNITED STATES.

In America, the growth of electric tramways has been amazing, to a degree impossible in an older and more conservative country. The reasons may be summed up as follows:—Bad roads, cheap and easy grants of franchises and concessions for long or indefinite periods, lack of legislative checks on cheap

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(and sometimes, at first, crude) forms of construction, alertness of the people to grasp new ideas and opportunities, a general desire for rapid transit, the force-pump of enormous manufacturing interests, the activity and insistence of promoters and speculators, and the political doctrine of individual freedom and equality which allowed everybody to go ahead so long as it was not shown that he was unduly and unfairly injuring his neighbours. Much of the work, of course, had to be done over again, and a better permanent way, better overhead construction, and better power stations provided. Cross sleepers were adhered to, but supplemented by concrete cement instead of stone ballast. In large towns the ancient "step and tee" rail was gradually abandoned in favour of the heavy steel grooved girder rail, and attention was at length paid to the maintenance of the paving approximately level with the track rails. Ornamental steel poles have been widely used in conjunction with good rail bonding and return feeders. Series-parallel control solved the motor difficulty before electric traction development began in this country.

In the early 'nineties nearly every town in the United States with a population of over 10,000 had its electric tramway, and then the construction of inter-urban electric lines feverishly began, partly on roads and partly on private land. In default of restrictions on obtaining franchises, competition with steam railways led to the protective electrification of many of the latter in and near the large towns, but with the railway part of the subject I do not propose to deal. The use of single-deck box cars has been maintained all along, the public finding top seats too hot in summer and too cold in winter, but the cars are largely convertible from close to open by letting down or pushing up all the windows. Strap-hanging is popular, and regarded almost as an institution, there being practically no restriction in the number of passengers carried on any car at one time. Speeds are higher than with us and accidents possibly more numerous. The fare indicator system instead of the bell punch and ticket system is still in use—on inter-urban lines, where there are differential fares in proportion to distance, tickets are necessarily used, but for town lines with the uniform five-cent fare for any distance the indicator remains.

There is little prospect of tramways being worked by municipalities in America. In New York the city authorities have constructed the whole of the latest underground electric railways and then leased the line to the operating company. The people who have anything to lose have a wholesome distrust of local authorities, and too often there seems to have been ample cause for it.

The electric conduit system was first developed on a considerable scale in Washington, where a long line was opened in 1896. A good deal of trouble was experienced with experimental lines of the sort before this date, but the experiments well established the best form of construction. It should be clearly understood that the only reason why the conduit system is employed in New York and Washington is that overhead wires for any purpose whatever are prohibited by the Legislature. In Chicago, San Francisco, and elsewhere, the overhead trolley has been largely substituted for the cable system. In the latter city the change was hastened by the destruction of the tramway system in the great earthquake. A considerable proportion of the American tramways are less prosperous financially than ours, but, so far as engineering and traffic management are concerned, the present-day American administrator deserves unbounded praise for his enterprise and almost consuming energy, and the various departments appear to be most elaborately and efficiently organised.

I quote some figures published in the *Street Railway Journal* of New York, in September last. They represent the state of matters at the end of 1906, and include all street railways and all electric elevated and electric inter-urban railways. The number of companies was 1,164, and the total length of single track of electric railways was 36,212 miles—nearly ten times the single-track mileage of tramways in the United Kingdom. The figure for the preceding year was 32,517 miles of track. The number of motor-cars was 66,206, against 63,391 in the previous year; and of trailer cars 15,442, against 13,059. Adding a track mileage of 719 for cable, steam, and horse lines, with 3,084 cars, we get for all kinds of street railways, and for elevated and inter-urban electric railways, a total track mileage of 36,932, with 84,732 cars. The latter figure compares with 11,746 cars in the United Kingdom; but to make a just comparison the mileage and cars of electric railways in this country should be added to the Board of Trade figures. The single track mileage of electric railways in this country at present, as distinguished from electric tramways and electric light railways, is 353, and the number of cars in stock is 2,074. Adding these to the Board of Trade tramway and light railway figures, we get a total of 4,191 miles of track and 13,820 cars.

The total capital liabilities of the United States street railway companies and elevated and inter-urban electric railway companies is returned at $3,765,317,875, or over £750,000,000—equal to fully £20,000 per mile of single track.

British Colonies.

To Canada I have not turned special attention. The style of construction is similar to that in the United States, but the population is relatively small, and the number of undertakings in 1906 was only 48. Electric power is almost exclusively used. The total length of lines, measured as single track, was 1,150 miles, and growth is rapid, as in the preceding year the length was only 956 miles. The number of cars was 2,920, against 2,697. The capital liabilities were $82,155,671.

Australia has no extensive systems of mechanical tramways outside Melbourne and Sydney. The Melbourne cable tramways, which are very successful, are worked by a company under arrangements with a joint board of municipalities. The Sydney tramways, mostly electric, are worked by a department of the State, and the voluminous reports issued are well known. Tramways in other towns are electric, except in Adelaide, where a large horse system has been taken over by the local authorities, and is now being extended and electrified. In New Zealand there are only a few tramway systems, mostly electric; they await further population in order to develop, but, in proportion to the existing population, they do a remarkably large business. The construction and equipment, both in Australia and New Zealand, are similar to those in this country. The same remarks apply to South African tramways, which, unfortunately, are suffering from the trade depression there.

I was much struck during my recent journey with the development of electric tramways in Tokyo, Yokohama, Shanghai, Hong-Kong, Singapore, Colombo, &c. These follow Western models; indeed, most of them have been built and equipped by British engineers. In Japan, however, they are run by native officials; but in China Europeans are in administrative command, as in those towns in India where tramways have been installed. The natives take well to the innovation. The cars are usually divided into two classes. The main obstacle to greater development in eastern cities is the narrowness of the streets. This is particularly noticeable in Tokyo, the capital of Japan. The city is a network of electric tramways, either in operation or proposed, though there are several important main arteries of traffic too narrow to admit of even a single line of rails. The greatest possible impetus is given to the promotion of important lines of electric railways extending from Tokyo and connecting with the large, and in some cases far distant, provincial business centres.

Europe.

On the Continent of Europe electric traction secured early recognition, and it was in Budapest that the first extensive conduit system was constructed. It was designed by Siemens and Halske, and the conduit is under one of the track rails, which has a slot for the current collector instead of a groove. Germany was the scene of many experiments with the electric accumulator in towns where the local authorities were slow to allow the use of overhead wires. These trials were not financial successes, though they hardly appear to have been so disastrous as the experiments in this country. Speaking of purely street lines, the greatest developments are in Berlin, in the hands of the Great Berlin Tramway Co., and in Paris under a number of companies. There has been a bewildering variety of systems, but the overhead trolley rules in most places. Track construction has also presented many varieties, but is gradually conforming to standards like our own. It is difficult to get details in regard to installations in a number of countries, but an effective bond of association is provided by the Permanent International Tramways Union, of which practically every tramway company of importance on the Continent is a member.

I have spoken at some length on the adaptability and elasticity of the overhead trolley system, and, though time precludes my dealing with the important electric tramway developments in Russia, I may perhaps refer to an extraordinary little trolley line in that country which is equipped afresh and put into operation for five months of every year over the River Neva, at St. Petersburg. Climatic conditions are, in some other lands, comparatively even, though it is difficult for us to conceive it possible; and the company are able to anticipate with certainty the freezing of the river. Sleepers and rails are laid down, standards put up, trolley wires run across, and a system one and a half route miles in extent is running electric cars over the delta of the river, until the approach of the warm season warns this enterprising company to dismantle the line until the following winter.

Conclusion.

Electricity utilised for the purposes of traction has resulted in enormous and world-wide benefits, and we may confidently anticipate further great development in the future. Too often in this country have we lagged behind in the race with other countries, not from any backwardness in our capitalists, inferiority in our engineers, or lack of enterprise in our business men, but because we have been bound by legislative restrictions and innate conservatism. I said in the Paper I read before the Royal Society of Arts in 1902, "Senseless and archaic obstacles to legislation should be ruthlessly set aside, and all personal and vested interests should be made to give way before the clamant cry of London."

My hope is that the public, having tasted the sweets of rapid transit in urban streets, and the pleasures of penetrating cheaply and quickly to such lovely resorts as can now be reached

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from London and other large cities, will give Parliament "Moving Orders" to substitute for "Standing Orders" that throttle business, inducing class or special legislation and conferring upon certain vested interests a monopoly of roads which should be equally at the service of all.

After Sir Clifton Robinson had delivered his address, the Duke of Argyll proposed a vote of thanks to him, and said that he was obliged to plead guilty not only to being a member of the "inert monster" to which Sir Clifton had referred, but also to having been on some of the Committees which have had to deal with electric traction. He had, however, on most occasions sided with the civil engineer who had been poking up this "inert monster." The monster would, however, still have to keep its hand upon some of these enterprising civil engineers, who were people of such ambition that they had sometimes to be restrained. Sir Clifton had also told them that the Houses of Parliament were senseless and archaic, and he presumed that he meant the former epithet to apply to the lower House, and the second one to the House of Lords.

After a short adjournment, the meeting resumed under the chairmanship of Sir Clifton Robinson, and discussed a Paper by Mr. Alfred Gibbings on "Tramway Rail Joints."

TRAMWAY RAIL JOINTS.

By ALFRED H. GIBBINGS.

The modern permanent way in this country has become almost of standard construction, owing to the great similarity of the conditions under which tramways have been inaugurated. These conditions have their origin in the requirements of Acts of Parliament, the Local Government Board, the Board of Trade, and Local Authorities. The track is usually formed by laying girder rails directly on a bed of concrete, but there are some exceptions, notably at Sheffield and Hull. At Sheffield several experiments have been, and are being, tried with various forms of wooden sleepers laid longitudinally under the rails, to which the rails are anchored down by bolts and plates, and this sleeper forms a good support for the joints. It appears, however, too soon to say whether this method, in addition to forming a cushion for the rail, also results in a satisfactory joint. It would seem that any initial irregularity in the rail ends forming the joint would ultimately result in the well-known knocking, and would produce holes where the wheels jumped forward. At Glasgow, during the last three years, heavy cross timber sleepers have been adopted on all extensions and renewals of track. For the purpose of this Paper, however, the ordinary concrete track will be assumed.

The rails now employed with the electric trolley street railways are of the grooved girder form. Considerable divergence exists, however, in design, width of groove, depth, and composition of metal. In most of the principal towns the rail weighs from 90 to 105 lb. per yard, according to the section. Figs. 1 and 2

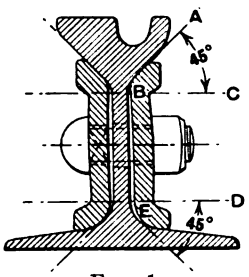

FIG. 1.

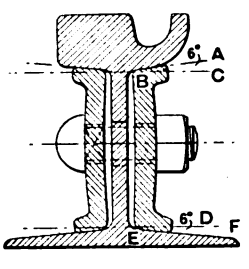

FIG. 2.

illustrate forms of grooved girder rail in section, Fig. 1 being a type employed up to fifteen years ago, and Fig. 2 being the type used recently by the writer on two large tramway undertakings. The illustrations have been chosen to indicate the difference in the angles under the head and over the flange of the two types. With the inauguration of steam and electric street railway systems, deficiencies of jointings were quickly apparent, and all the trouble with bonds and fishplates, through pounding, began to be experienced. The effect of this pounding was, of course, the re-design of the rail section and fishplates, and the introduction of special devices to prevent the destruction of the rail at the joint, and to obviate the damage to rolling stock and the annoyance to passengers in the cars. Many hundreds of patents have been taken out during the last thirty years, improvements in rail joints and fishplates.

FISHPLATES.

In explanation of Fig. 1, it must be pointed out that the angle which the bearing portion of the fishplate makes with the web of the rail is 45°, and with the flange of the rail the angle is 45°. In the modern section (Fig. 2) these angles are respectively 6°, that is, just sufficiently out of the parallel to admit of properly and efficiently tightening up.

The simplest method of comparing the lateral thrust upon the fishplates due to the various fishing angles would seem to be to consider the angles A B C, D E F, as wedges tending to force the fishplates apart, the driving action on the wedges being produced by the weight on the car wheel, when passing over the joint.

If we assume that the fishplates are perfectly rigid, and thereby neglect the effect of the rail web, the formula for the resultant of the top and bottom wedging action becomes :—

$$x = \frac{y}{\text{Tan}\,(a_1 + \phi) + \text{Tan}\,(a_2 + \phi)} + \frac{y}{\text{Tan}\,(b_1 + \phi) + \text{Tan}\,(b_2 + \phi)}$$

where

x = Tension on bolts due to wedging action.
y = Weight on car wheel.
$a_1\ a_2\ b_1\ b_2$ = Angles from centre line of web.
ϕ = Angle of repose (approx. 10°).

Assuming the weight on the car to be 3 tons,

then, for Fig. 1, $x = 2\left(\frac{6720}{2\ \text{Tan}\ 55^\circ}\right) = 4704$ lbs.,

while for Fig. 2, $x = 2\left(\frac{6720}{2\ \text{Tan}\ 94^\circ}\right) = 468$ lbs.

Hence the strain on the bolts in the first case is more than ten times that in the second case. As it is absolutely essential that a tramway joint, when once screwed up, should remain tight, it follows that the rail should be so designed as to relieve the bolts as far as possible of any tensional efforts tending to loosen the fishplates. The formula by no means represents the total strain on the fishplates, but it serves to demonstrate the effect of the varying angles. The difference is really more in practice, for the stress is in the nature of repeated shocks. The angle of slip has also to be considered, which is approximately 10°, so that the angles of the fishplates should not appreciably exceed this.

If the modern type of fishplate for tramway track is compared with the fishplates on steam railways, which fishplates are much lighter and smaller, it may seem strange that no appreciable or serious trouble occurs in this latter case. The reason, of course, is that there is no difficulty in keeping the railway fishplates quite tight, as they are above the surface of the ground, and they receive constant attention.

Experience proves that in all cases joints have a tendency to become loose and "spring" through the continual passing over of the cars, and, however slight this springing may be at first, it is rapidly increased by every car which passes over it. Hence, when the joint is badly worn, it appears that the only remedy is to cut out and renew either the joint or the concrete beneath it, or both. This becomes a very expensive operation, and necessitates removal of setts and paving. It seems to follow, therefore, as a natural deduction from the foregoing remarks that fishplates should not be required to take a vertical thrust.

The function of fishplates should be confined to jointing the web, and the vertical thrust should be taken by some other means.

In order that the latest practical experience might be brought to bear upon this subject, the writer submitted a list of inquiries to several tramway managers, and they very kindly responded to the request for information. Their replies are embodied in the following paragraphs, and they record wide and diverse experiences.

SOLE PLATES.

The original and simplest method of taking the vertical thrust at the joint was by means of sole plates and fishplates. Sole plates are now in use at Hull and Darwen. In the case of Hull the rail ends are cut to an angle of 45° in plan, and the rails are laid on continuous-creosoted sleepers. At Darwen they are apparently being discarded in favour of other types. In neither case has any account been kept of the cost of renewals.

WELDED JOINTS.

The principal welds are the "Falk," the "Thermit," and the electric. One or other of these welds is in use in many towns, including Glasgow, Leeds, Southampton, Nottingham, Liverpool, Brighton, Darwen, and West Ham. The replies from Brighton and Darwen are both favourable to the welded joint, but it does not appear that welds have been extensively used in those towns.* In addition to these places, there are, of course, many others where the welded joint has been adopted.

The advantages which are claimed for the welded joint may be summed up in the statement that it should constitute a continuous rail, both as regards wear and tear and electrical conductivity. There can be no doubt that when two rail-ends are thus fastened together with a close joint, the result will appear theoretically and practically perfect. As a matter of fact, however, the rail-ends in some portion of the rail and rail-head always remain severed, and this occurs principally near the running surface or point where the real wear takes place. All three processes also tend to alter the temper and nature of the rail-ends, and so produce a new fault while remedying an old one.

* These statements were controverted in Mr. Stutz's remarks in the discussion (see p. 105).

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The opinion at Glasgow is that the welded joint is the most satisfactory from every point of view, except in the case of renewals; at Leeds and Southampton a similar opinion is expressed, but at West Ham no comment is made. It must be noted that in each of these instances the experience with these joints has been only for about three years.

At Nottingham the City Surveyor puts the life of a welded joint at about three years, as at the end of that time fractures begin to occur and renewals are necessary.* It seems to be the practice there, when a renewal is required, to cut out the weld for a distance of about 18 in. on each side of the joint, and then to insert a new piece of rail, thus getting two joints in place of one. In Liverpool the same difficulty of fractures has arisen.† The foregoing remarks apply to new track welds, and it seems to be the general experience that the process is not well adapted to old track. The important question, therefore, with regard to this method is what is going to be the result in a few years when large renewals become imperative.

One of the striking features of the replies received from tramway engineers is the statement in nearly every case that no separate accounts are kept of the cost of renewals or repairs to joints.

ANCHORS.

The more prominent types of anchors in use in this country are illustrated below: The "Winby" anchor (Fig. 3), the "Kirkland" anchor chair (Fig. 4), the "Bull Dog" (Ames-Crosta) anchor (Fig. 5), the "Positive" (Walker & Grant) rail anchor (Fig. 6), and the "Cooper" anchor (Fig. 7).

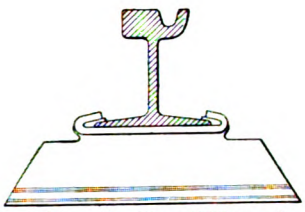

FIG. 3.—THE "WINBY" ANCHOR.

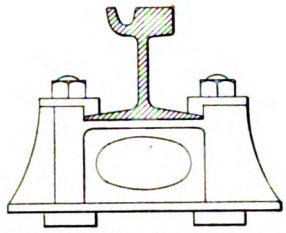

FIG. 4.—THE "KIRKLAND" ANCHOR CHAIR.

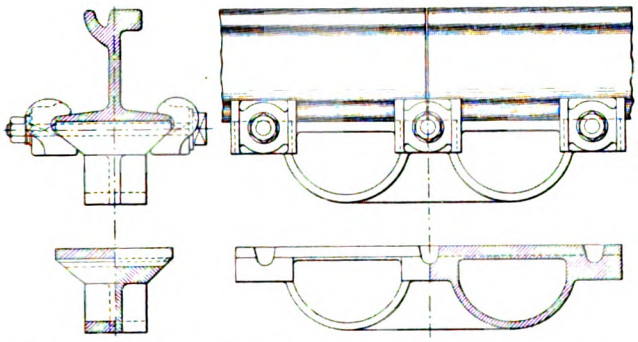

FIG. 5.—THE "BULL DOG" ANCHOR (AMES-CROSTA).

The anchor joint, in one form or another, appears to have appealed to a great number of engineers, and may be found in use on the majority of tramway undertakings. Anchors are preferred or are used in Burnley, Huddersfield, Bournemouth, Wolverhampton, Birmingham, and Darwen. The writer has also put them down throughout a 25-mile system of tramways.

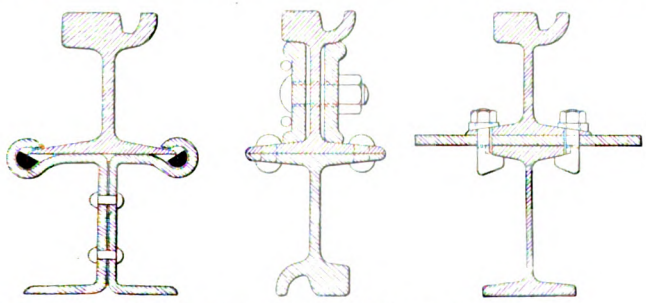

FIG. 6.—THE "POSITIVE" RAIL ANCHOR (WALKER & GRANT).

FIG. 7.—THE "COOPER" RAIL ANCHOR.

FIG. 8.

The Cooper anchor (Fig. 7), or piece of inverted rail, may be fastened to the rail, either by bolts or rivets. Bolts are hardly likely to be satisfactory, as, like fishplate bolts, they tend to work loose.

In all cases of anchors at joints the ordinary type of fishplate is used, the function of the anchor being merely to prevent springing of the rail-ends.

The success of this method of jointing depends absolutely on the stability of the concrete in which the anchor is buried, the nature of the soil beneath the concrete, and getting a true alignment on the running surface, without grinding. From the insufficiency of one or both of these conditions many anchors have failed.

On the London County Council tramways the joint adopted, known as the girder joint, is constructed as follows (Fig. 8),* viz., a piece of steel H joist, 30 in. long by 5 in. wide and 8 in. deep, weighing 30 lb. per foot, and a steel plate 30 in. long by 12 in. wide by ½ in. thick, are fastened to the rail by 2½ in. by ¾ in. hook bolts. The attachment is made by the hooks of the bolts fitting into slots made in the top of the flange of the joist and fastened through holes in the plate and bottom flange of the rail, and the nuts are screwed down to a bevel washer. The bolts are made of mild steel, and are threaded for a length of 1½ in. from the nut.

The experience at Burnley is interesting, and tends to bear out entirely the dependence on the condition of the soil and concrete. It is there claimed to maintain a good joint, but that hammering develops after two or three years, when the rail has to be ground. It is further stated to be bad for the rolling stock, and that rigid foundations and hammered joints break the car axles. With regard to anchor joints generally, it is found here again that their application has been confined to new track work. The expense of excavation and fixing to old track is too great, to say nothing of the problematical satisfactoriness. It would also involve grinding down the surface of the rail, and that, in addition to being expensive, is never satisfactory.

COMBINATIONS.

A combination joint consists of a device in which an attempt is made to distribute the forces and counteract the effects of the hammering and pounding. Several types (illustrated below) have already been tried with considerable success.

Booth's rail joint differs from the "Continuous" rail joint in the separate soleplate which extends entirely under the flange. It

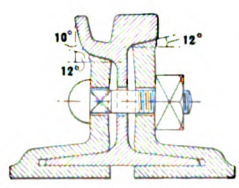

FIG. 9.—THE "CONTINUOUS" RAIL JOINT.

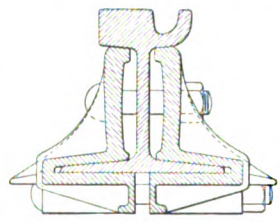

FIG. 10.—THE "ATLAS" RAIL JOINT.

is difficult to see what different effect in practice there can be between the two types, provided that the fit to the rail section is equally good in both cases. It is just this qualification which is likely to constitute the chief difficulty and obstacle in practical application. An examination of the section (Fig. 11) will indicate more clearly than any written description, the absolutely accurate fit which is required. In this respect it seems that Booth's joint would have the better chance, as the fishplates can be bolted into place before the soleplate is rivetted on.

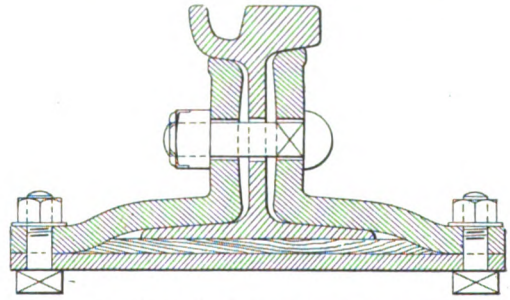

FIG. 11.—BOOTH'S CONTINUOUS RAIL JOINT.

On the Cavehill and Whitewell tramways "Positive" rail anchors are fixed at each end of the "Continuous" rail joint. It would be interesting to know what is the cost for joints and anchors on that line per mile of single track, but, apart from that, the solidity of the joint, if laid on concrete, must be rather more than the rest of the rail.

Reverting to the question of the fitting of these joints, no absolutely accurate fit between the head and flange can be assured, because in practice no two rail-ends which are brought together

* This statement is corrected in the letter which Mr. Gibbings read before the Paper was discussed (see p. 105).

† Mr. Stutz said, in the discussion, that this was incorrect.

* Mr. Welling corrects this statement in the discussion (see p. 106).

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to form a joint are rolled exactly to the same section. It is this slight difference, either in depth of rail, thickness of head, or variation in the dimension between the under side of the head and the top of the flange, which gives rise to the trouble of knocking and hammered joints. The usual design of fishplates, whether uncombined or in combination with soleplates or anchors, keeps the under sides of the head of the rail in alignment (where it is obvious alignment is not required) and not the top or running surface. Hence this prevents a true surface alignment in the majority of cases.

With regard to the "Dicker" joint (Fig. 12), these have been put down in several towns, and particular reference to them is made by Preston and Darlington. Some experience of these joints has been obtained at Liverpool, and also on the Tooting lines of the London County Council.

Mr. Alexander Millar, in his Paper on "The Electrical Reconstruction of the South London Tramways on the Conduit System" (Inst. Civil Engineers, January 12th, 1904), remarks that "the ordinary track rails are laid at all parts of the line, except the sharp curves, junctions, and crossings, where a slightly heavier rail is used. They weigh 102 lb. per yard, and have a tensile strength of 42 to 49 tons per square inch. The joint formed by cutting a sleeve ¾-in. wide out of the track-rail head for a short distance at the rail-ends, and replacing the metal cut away by a deep fishplate, the upper surface of which is flush with the rail-head, breaks the rail-joint, and provides a continuous-running surface for the car-wheels. This form of joint has been extensively used of late years in tramway undertakings in this country, and the author's experience of it on this and other lines has been favourable. Care must be taken in securing the correct height of the fishplate, and in gauging the extent of cut in the rail-head. A 15° fishing-angle is used, and it will be observed that at the bottom the fishing-angle does not extend to the tip of the flange, as, had it done so, the amount of metal of the flange would have been needlessly increased. At sharp curves a slightly heavier rail, weighing 104 lb. per yard, with wider groove and broader lip, has been employed. It was considered safer to have longer fishplates here, owing to the greater liability of rail-joints to work loose on sharp curves and at crossings, &c."

Mr. Rider, in a discussion on Mr. Alexander Millar's Paper, says:—"The joint used was called the Dicker joint," shown in Fig. 12. "Part of the head of the track-rail was cut away, and one of the fishplates was carried up to the head of the rail, so as to form a running-surface for the car-wheel. That particular fishplate had absolutely nothing to do with taking any

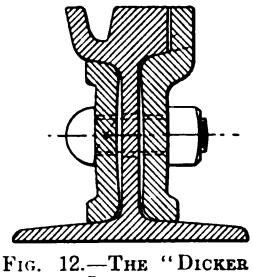

FIG. 12.—THE "DICKER" JOINT.

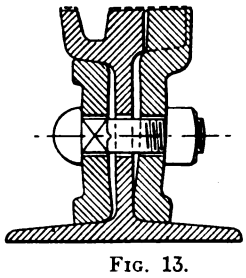

FIG. 13.

of the weight of the rail, because the whole of the fishplate was carried up through the head of the rail, and it was only a four-hole fishplate about 2 ft. long. One of the results of that type of joint was that the fishplate which, under normal conditions was tightened up by the bolts, and lay against the head of the rail, was now showing signs of leaving the rail at the top. It was not so noticeable on the surface, as apparently the hammering effect of the wheels burred the edges of the rail and the fishplates. It was caused by the bolts giving, and the effect was something like what is illustrated in Fig. 13. If those fishplates had been extended under the head of the rail, with an ordinary fishplate on the other side, the joint would have been better. On the new lines that type of fishplate had been given up, and the ordinary pattern had been adopted on either side of the web, an anchor plate, consisting of an inverted piece of rail rivetted to the bottom flange, being put under the joint. Such a joint was quite rigid, but even with it a difficulty had arisen. On account of the variations in the rolling of the rails, it was not possible to get lengths taken indiscriminately which were exactly the same depth. When the soleplate was put under the joints and rivetted to the flanges the bottoms of the adjacent rail-ends were brought exactly into line; consequently, the least variation in the depths of the two rails, due to difference in rolling, showed itself at the head, and was enough to start a slight hammering action under the traffic, which became worse. The only remedy was to grind the heads perfectly flat with a portable grinding-tool after the joint had been made and the soleplate put on; that gave a perfectly good running joint."

It will be observed from the foregoing extracts that the fishing angle on the "Dicker" joints is here stated to be 15° or 5° over the angle of slip. This may account to some extent for the trouble mentioned by Mr. Rider, as he distinctly refers to the giving of the bolts.

FORGED RAIL-ENDS.

Several years ago an attempt was made to forge out the fishplate and rail-end in one, by means of a portable hydraulic press and furnace. The rail-end was formed in such a manner that the joint faces were at an angle of about 30° with the rail edge. The idea was never successful in practice for several reasons. First, the cost was prohibitive; and, secondly, the rails were much shortened in the process. The re-heating also had the effect of softening and injuriously affecting the steel.

ADJUSTABLE JOINT.

This device differs in almost every particular from those which have been described herein. It consists of two plates of rolled mild steel, one being superimposed on the other. In the upper plate are two steel screws, having gas threads, and on each screw is a combined protection and lock nut. The apparatus is shown in cross-section, with the rail, in Fig. 14. The arrangement is

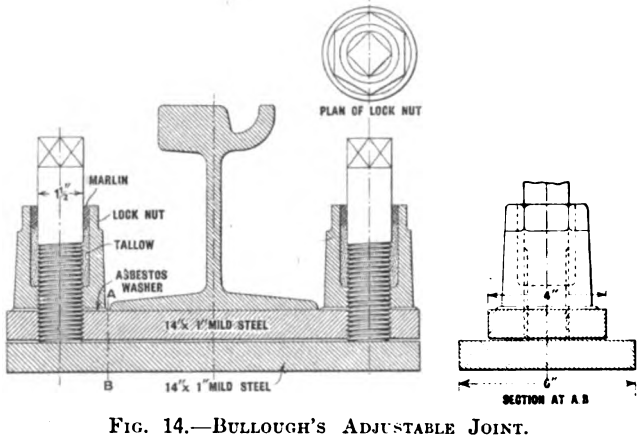

FIG. 14.—BULLOUGH'S ADJUSTABLE JOINT.

simple, and by slightly turning the screws, the upper plate is raised, thereby raising the rail-ends and "supporting" the joint. Any subsequent depression due to the rolling load or any other cause is readily adjusted by the use of a box-spanner without any disturbance of the paving.

In the case of old track or repairs the disturbance of the paving setts in fixing is reduced to a minimum. The heads of the rails are raised and maintained at one level, thereby giving a perfectly true joint, thus preventing the lifting of the setts or paving. Where the rail-ends differ slightly in depth, the fault can be remedied by placing a "skim" or liner of the required thickness on the supporting plate under the flange. This liner must be placed close to the end of the rail, so as to place the weight on the centre of the bolt. It will be observed that this joint-support provides for the natural and inevitable expansion and contraction of the rails.

In order to obtain the absolute and correct adjustment of the support when first put in, and after the concrete has set, several cars should be allowed to pass over the joint, and observation made of any slight knock or spring which may exist; the screws are then given a slight turn, say, a quarter turn at a time, until it is certain that no sound whatever can be detected as the cars pass over. The lock nuts are then tightened, and the joint is complete. The lock nuts are hollow, and the space around the screws is filled in with melted tallow. These supports have been put down on several systems during the last three years.

An interesting "mechanically-locked" joint, illustrated below, was exhibited. In it an eccentric bolt is employed for the fish-

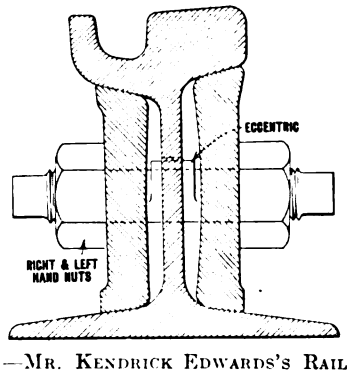

FIG. 15.—MR. KENDRICK EDWARDS'S RAIL JOINT.

plate instead of a circular one, so that the bolt may be turned by a forked spanner to bring the rail-ends tight against one another before the nuts are screwed up. The threads of the bolt

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and nuts are right- and left-handed, and it is claimed that any tendency for the rails to come apart results in a tightening of the nuts. The joint is the invention of Mr. Kendrick Edwards, of Belfast.

Mr. Gibbing's Paper was taken as read, but before the discussion was commenced, he read the following letter which he had received from Mr. Arthur Brown, City Engineer of Nottingham.

DEAR SIR,—The Thermit Co., Ltd., have sent me a copy of a Paper to be read by you before the Tramways and Light Railways Association on Thursday, the 9th inst., and I enclose for your information a copy of the correspondence which has taken place between the Thermit Co. and myself. Confusion appears to have arisen regarding welding on *new* track and welding on *old* track. I have a quantity of Thermit joints which have been in use over four years, and which are now quite perfect. I believe that the Thermit joint makes the best joint, providing the work can be done in suitable weather. As you will see from the letter I have written to the Thermit Co., I should very strongly object to doing any Thermit welding in very hot weather, as if this is done when the air is at a high temperature breakages are bound to occur.

(*Letter from Mr. Arthur Brown to the Thermit Co., Ltd.*)

GENTLEMEN,—I am in receipt of your letter of the 1st inst., enclosing copy of the transactions of the Tramways and Light Railways Association.

I cannot trace having given any information to Mr. Gibbings as regards my experience of Thermit welding. The paragraph would be correct if it read, "The Nottingham City Engineer puts the life of the welded joint at about three years, as at the end of that time fractures begin to occur and reconstruction of the joint becomes necessary. The practice is to cut out on either side of the weld for a distance of about 5 ft. and put in a closure 10 ft. long. The foregoing remarks apply to the welding of *old* track." This is where I think Mr. Gibbings has made a mistake: he has evidently obtained his information from some other source and not directly from me, and has confused work on new track with work on *old* track.

I should certainly never again weld joints on old track. We did about a dozen of these and over 50 per cent. broke. I have, however, still a firm belief that the Thermit weld for new track work makes the best joint, but I must qualify this by saying that I should never again lay down a track with Thermit welded joints in very hot weather. If it was absolutely necessary for the work to be done in hot weather I should put down ordinary fishplate joints with long H iron anchors under the joint.

Mr. Gibbings also explained that the information upon which the Paper was based was obtained two years ago, and that therefore some slight inaccuracies were inevitable.

DISCUSSION.

Mr. J. R. SALTER (Lancashire United Tramways, Ltd.) pointed out that Mr. Gibbings had said nothing in his Paper upon the very consideration which made the subject of rail joints of such importance, viz., the question of paving. He contended that rigidity in the construction of tramways and in the points was required for the purpose of maintaining the level of the paving to the level of the rails, and that, were it not for this fact, the more we could approximate to the flexible or yielding track construction of our main-line steam railways, the better would it be for smooth running. He pointed out that on his own system he had seven miles of track laid on longitudinal wooden sleepers, and with no concrete, this method of construction having been necessary on account of the tramway being over a 56 in. water main, which burst throughout its length on an average 250 times a year. He also directed attention to the method of construction adopted in Moscow, where no concrete was used, and in this instance also smooth running was obtained; but, of course, the paving suffered and great expense was involved in maintaining it. In Moscow the question of paving was not so serious, as for seven months in the year the roads were covered with snow, the ordinary vehicular traffic being in the nature of sleighs. He recollected a remark made by the Hon. Arthur Stanley, M.P., to him, which was very much to the point, namely, that the present system of constructing tramways was "right in the abstract but wrong in the concrete." In referring to the adjustable joint illustrated in Fig. 14 of Mr. Gibbings' Paper, Mr. Salter pointed out that water would accumulate in the gap between the two soleplates, and, in consequence, the paving around the joint would soon give way. He next criticised the empirical mathematical formula given in the commencement of Mr. Gibbings' Paper, and stated in strong terms that this formula was absolutely inapplicable to the question under consideration, and was based entirely upon a wrong supposition. He contended that there was no wedging action with fishplates, and that it was impossible in considering the action of fishplates to eliminate the web of the rail. The action of the fishplate was an oscillatory one in a vertical direction round the joint as a centre, and that this was so was evident from the fact that it was quite unnecessary for the fishplate to come up under the head or lip of the rail at all. The reason the fishplate was extended to fit closely between the head and lip and bottom flanges of the rails was to overcome the oscillation. With all these new proposals, an "angle of repose" was certainly desirable, but not of the sort that need be designated by ϕ or any other Greek character.

Mr. J. B. HAMILTON (Leeds City Tramways) suggested that it might have been good for the writer of the Paper to have brought it up to date, as, particularly in its remarks about welding, it was obviously quite inaccurate. The remarks with regard to the short life of welded joints must be a clerical error; they could not apply to new track. It was unfortunate that a more careful examination had not been made into the general experience and results obtained from the use of thermit as a welding process. Under the heading of anchors, the writer had referred to five different kinds, all of which were patented, but he had overlooked the very best arrangement of all, which had a further advantage of not being patented, and that was the use of old rails for this purpose. The adoption of anchors for the purpose of keeping rails steady was of the first importance in tramway construction. Experience showed that rails laid on a rigid foundation, such as was used in all streets which are open for general traffic, cannot be maintained in a satisfactory condition to keep the setts firm and maintenance costs low without efficient anchoring. In tramway undertakings, therefore, which have been worked, as in the case of Leeds, for ten or twelve years by electric traction, it had been found absolutely necessary to anchor all rails on new construction or where renewals had been carried out. The standard type of construction adopted in Leeds for the last six years had been to anchor at close intervals, particularly at the rail joints, to weld all joints by the thermit process, and to float them with a strong composition of concrete well up over the base of the rail. Many miles of track which was only half worn out had had to be taken out in Leeds and throughout the country because they were not anchored and welded when put down, and it was found impossible, hammering having set in at the joints, to maintain them in a rigid position.

Mr. A. N. BANISTER (Norwich Electric Tramways Co.) said that Norwich and Coventry were the first two towns in England in which experience had been gained with the Falk joint. They had about 4,500 to 5,000 joints in Norwich; their experience extended over eight years, and had been very satisfactory. Only one joint had broken during that time. Hammered joints were few, and, in fact, it was difficult to find a joint at all. Four years ago, however, they had adopted the Thermit joint, as they found it considerably more economical for renewals and repairs, for the cost of each joint was no more if made one at a time, than if made in batches of fifty or more. With the Falk process, on the other hand, unless there could be a run of 20 or 30 joints at one time, they were very expensive to make. He did not approve of any of the mechanical joints which required accurate fitting, as it was difficult to get the ordinary platelayer to do work of this character efficiently. He believed it was claimed for the joint shown in Fig. 14 that in the event of any settlement, the joint could be raised by means of the screws without touching the paving. But directly the screw was tightened up so as to lift the joint, the adjoining paving must be sprung, cracking the joints and allowing water to get in. Also the rail would be sprung from its seat for a greater or less distance from the joint, admitting water under the rail. Once that happened, both joint and paving were bound to work loose. One great advantage of welded joints was the excellent rail return which was obtained. In Norwich the average drop over the whole system was $2\frac{1}{2}$ volts, and they had no boosters or return feeders. The highest drop was on a route about three miles long, with a ten-minute service, on which the drop averaged about five volts.

Mr. R. STUTZ (Thermit, Ltd.) said that Mr. Gibbings, in talking about the welded joints, had placed the Falk on the same level with the Thermit and electric welds, but the Falk joint was not a weld; a large quantity of liquid cast iron was poured round the joint, but, although there might be adhesion at points, there was no actual amalgamation. Mr. Gibbings had explained that, by reason of his Paper having been written some time ago, some of the information was not quite up-to-date, and this applied specially to what was said about Thermit welding. He (the speaker) had with him a letter from the Borough Engineer at Darwen, stating that out of a total of $7\frac{1}{4}$ miles of track, six miles had been welded by the Thermit process and had given complete satisfaction. The West Ham system was completed before Thermit welding was thought of by them to any extent, and the few joints made were experimental ones. For Liverpool Mr. Gibbings' information was again incorrect. No joints made by the Thermit Company in Liverpool had given rise to any trouble, nor had there been any fractures. Moreover, the process had been used in a great many other towns since Mr. Gibbings' Paper was written.

Mr. E. BENEDICT, speaking as a railway engineer, and not as a tramway engineer, said that the difficulty with sleepers on tramway routes was, in his opinion, entirely a question of inadequate draining around them. He also hazarded the suggestion that a layer of compressed felt under the rails might prevent the joint from working loose.

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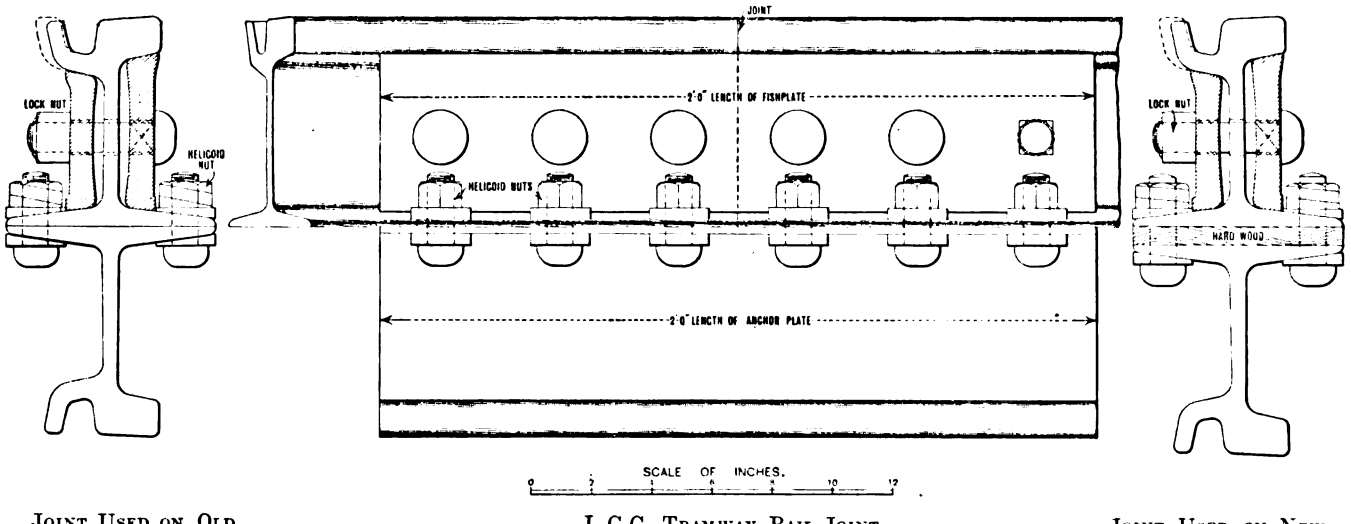
Mr. H. M. SAYERS said that the chief desideratum was that the rails should be equally rigid or equally elastic at all points. The question of a rigid line as against an elastic line did not really come in when considering the question, but it was differences in the rigidity which promoted the troublesome knocking. Pointing to a specimen of the joint used on the London County Council tramways which was exhibited, he said that a weak point in this was that a large amount of the concrete had to be sacrificed to make room for the anchor which would consequently only be resting on a very thin layer of concrete. He thought that a welded joint was the most promising one, the only thing against it appeared to be that there was a certain softening of the rail on either side of the joint, but apparently this caused no increase in wear. A great advantage of a welded joint was its conductivity, for if copper bonds were used of a greater section than corresponded with 50 per cent. of the conductivity of the rails themselves, they became too expensive, and it was difficult to find room for them under the fish plates.

Mr. JOHN WELLING (Track Superintendent, L.C.C. Tramways) said that rigid foundations were ideal if all bearing surfaces were wide; they prevented destruction of foundations through hammering, but were expensive and almost impracticable to maintain in good condition after repairs and renewals had been made during continuance of service. Elastic foundations, if too elastic, were not good, but a small allowance of give was desirable so as to render repaired joints as good as the original. frequent cause of bad joints, as this difficulty was partly eliminated by filing away the rail surfaces until a level or the same plane is obtained. This, Mr. Welling explained, is now almost universal practice, but its full benefit cannot be maintained long unless the fishing surfaces of the fishplates to the rail are also an absolute fit for each of the rail ends, a result to be only obtained by the "fitting" of each pair of fishplates. The conditions under which hammering joints develop, seeing that an unyielding soleplate and a level surface is easily obtained, seemed, he thought, to point to the varying composition of rails as the chief cause. Many rails, he pointed out, are easily bent, while other rails from the same batch, and possibly made from the same cast, break when being bent under the same conditions; and some again are more easily cut with the cold chisel than others. The welded joint, said Mr. Welling, also hammered after a time. The unequal wear of adjacent rail ends set up a depression on the softer rail (whether the foundation was rigid or elastic), and this became the more accentuated as time passed, and appeared again after repairs had been made. If more care was taken in the mixing of the rail materials, and in the careful and more extensive cropping off of bad and spoilt ends, together with more exactness in the fit of fishplates, defective joints might be very greatly diminished in number. The L.C.C. experience was that bolted joints were as efficient as, and certainly more convenient than rivetted, especially if the bolts had lock nuts embedded in the



JOINT USED ON OLD CONTRACTS.

L.C.C. TRAMWAY RAIL JOINT.

JOINT USED ON NEW CONTRACTS.

This effect might be obtained by bearing rail ends on a thin layer of, say, very hard wood of only sufficient thickness to make it useful and strong enough as a packing or bedding piece, without being so thick as to allow play of the rail ends, owing to the blow of the passing car. Longitudinal sleeper foundations would most probably give too much elasticity for ordinary roads. They were employed in the L.C.C. subway (where there was no wet), but not on the Council's main lines. "Hammering" and "knocking," Mr. Welling continued, result from very minute beginnings of movement in the rails. It was worth considering if there was an even sufficient compression of the rail metal due to the weight of car to cause the slightest depression in the running surface, which would start the hammering. The lateral pressure was also very severe, causing enormous and sometimes sharp vibratory tension on the joint fastenings, and tending to loosen them; and these drawbacks might be avoided or diminished by a thicker and thus stiffer vertical web than the present 7-16 in. or ½ in. for 7 in. rails. The deflection of the usual rail section under the car weight, upon an ill-fitting soleplate would be sufficient to initiate "knocking." Mr. Welling then said that the joint, illustrated in Fig. 8 of the Paper, was not the L.C.C. joint. The figure above shows the actual form employed. The rails weigh 105 lb. per yard, and have fishplates ¾ in. thick and 2 ft. long, weighing 56 lb. per pair. There are six fishbolts per joint, 1 in. diameter, with helicoid locknuts. The soleplates are 2 ft. long, and are of inverted girder rail, fixed by 12 bolts (6 each side), with lock nuts. The whole is embedded in 3 to 1 cement concrete. As to the satisfactoriness of anchor joints, the L.C.C. experience is quite the opposite to Mr. Gibbings'. Anchored tracks cost one-half to maintain than unanchored. Although anchored joints might not be perfect, they enabled tracks to be kept in good order, as otherwise the expense of maintaining after three or four years would be well-nigh prohibitive. Grinding the rail surface on the L.C.C. system had been found satisfactory in the sense of prolonging very considerably the life of joints, and of making the repair of joints effective. The higher rail tread should be ground at least for 12 in. to 18 in. from the joint. Difference of section of adjacent rail ends was not the most concrete; the bolts were rendered practically immovable by this means. Mr. Welling exhibited a joint taken from the Camberwell New Road section of the L.C.C. tramway after a few years' service, in which the hammering had been so serious as actually to embed the flange of the rail in the top of the anchor rail. There is a two-minute service on this route.

Mr. STEPHEN SELLON said that Mr. Salter had put the question in a nutshell. Everybody would have an elastic rail bed were it not for the difficulty of the paving. In consequence, they had to offend every engineering law in the design of tramway track, and yet obtain a satisfactory result. The whole thing depended on the cost of breaking up the road for repairs and remaking it. He was strongly opposed to an elaborate system of anchor joints or anything of that nature, and there were many systems still working quite satisfactorily without these. He referred to the exhibit of the London County Council tramways joint as a "monstrosity," which, he said, would never have been put in except by a Corporation like the London County Council, with whom money was no object. Presumably, as this was the case, they would increase the depth of the concrete below the joint so as to obviate the difficulty which Mr. Sayers had pointed out. The trouble with the various new mechanical devices was that they were new, and that it took five years to ascertain if they were any good. It was, however, of no use to follow a set rule in designing a tramway track, as there were always particular circumstances to be taken into consideration on every route.

Sir CLIFTON ROBINSON, who was in the chair, said that his experience in London was that the more rigid the joint the better. He might suggest a modification to the Hon. Arthur Stanley's saying, and put it that it was all very well in the concrete, but wait until you get to the asphalt. Finally, he suggested that it was advisable for tramway companies to lay their own track and not employ contractors; for it was preferable not to have to follow a rigid specification, so that alterations from the general scheme might be adopted in particular instances.

Mr. GIBBINGS stated that he would reserve his reply, which he would communicate to the official circular of the Association.

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On Friday morning the proceedings were opened by Mr. A. L. C. Fell (Vice-Chairman of the Association and Chief Officer of the London County Council Tramways), who gave a short address on the work of the Association.

Mr. A. L. C. FELL, referring first of all to the growth of the tramway systems in the United Kingdom, said that the total mileage of track, which in 1878 amounted to 269 miles, had, last year, reached the figure of 2,349 miles. The passengers carried annually had risen from 146,000,000 in 1878 to 2,454,000,000 last year, and the amount of capital invested from £428,139 in 1878 to over £64,000,000 for last year. Turning then to the work of the Association, Mr. Fell said that it was unfortunate that the report of the two sub-committees on brakes was not complete, as it would have provided matter for a good discussion. It was hoped, however, that it would be submitted to the Board of Trade before the end of the recess. The subjects of "Brakes" and "Rail Corrugations" were both suitable subjects for combined action on the part of the two Tramway Associations (namely, the Municipal Tramways Association and their own), and a report signed by the leading members of the Associations would have been more desirable than the separate reports now being framed. Although the headquarters of the Association must of necessity be in London, it was proposed, he said, to hold the Annual Congress in a fresh town every year. This matter would, however, be discussed in the official circular of the Association. With regard to the work of the various committees, that of the Income Tax Assessment Committee had been particularly successful, there being every hope that the Income Tax Commissioners would meet the views of the Association in this matter. After some appreciative remarks on the work of the secretary, Mr. de Turckheim, Mr. Fell called upon Prof. C. A. Carus-Wilson to deliver his lecture on "Rail Corrugation."

RAIL CORRUGATION.

In Introducing his subject, Prof. Carus-Wilson said that it was hardly necessary to explain what rail corrugation was, so he would commence by drawing attention to two facts connected with rail corrugation which seemed to indicate how the problem should be tackled. Firstly, the corrugation seemed, as a general rule, to take place only on one side of the track at a time; and, secondly, corrugation on one rail was generally accompanied by wearing of the check on the other rail, especially on curves. In the latter case the corrugations were to be found on the outside rail, while the check of the inner rail was cut or worn. With new wheels there was generally a clearance of about ¼ in. between the flange and the check, as shown in Fig. 1; but after some

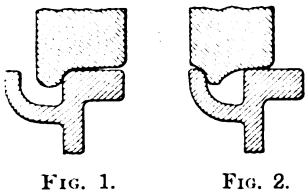

FIG. 1.

FIG. 2.

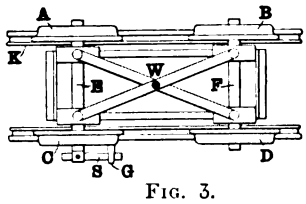

FIG. 3.

amount of wear, the flange could come in contact with the check, as shown in Fig. 2, and cut it.

To see what effect this grinding of the flange on one side of the rail had on the motion of the wheels, Prof. Carus-Wilson had constructed the model shown in Fig. 3. This consists of a three-foot length of 3½ in. gauge brass rail, on which runs a rigid four-wheel truck. A weight is so suspended from the centre of the truck *W* as to be distributed equally over the four wheels. The wheels *A* and *B* are keyed to the axles *E* and *F* respectively, while *C* and *D* are loose. If, now, the flanges of the wheels *A* and *B* are caused to grind against the check *K*, these wheels will run on a larger diameter than the wheels *C* and *D*, and for a given distance the latter wheels will rotate a certain number of times more than the former wheels. By rigidly coupling the wheel *C* to the axle *E*, by inserting a bar *S* through the slots of the axle and the stud *G*, the wheel *C* is forced to rotate the same number of times only as the wheel *A*, and so long as the rail is smooth, the wheel *C* will skid uniformly over the whole of the travel of the truck. With the aid of the model, the lecturer showed that this was the case, and he also described some experiments made on an 8-ton tramcar, with the permission of Mr. T. B. Goodyer, Manager of the Croydon Tramways, which gave evidence of a skidding action of 3 per cent. If, now, a spring is substituted for the rigid bar *S*, so as to allow a slight relative movement between the wheel *C* and the axle *E*, the following will take place. At first the wheel will not skid, but the spring will be bent. When the tension in the spring is sufficient to overcome the force of adhesion, the wheel will skid slightly, but so long as the rail is smooth and clean, the skidding will again be uniform, the spring being kept at a constant tension. The lecturer demonstrated this with the model, but then pointed out that the conditions under which the model was working differed in one important respect from actual conditions, namely, the rails were clean and smooth. Fine sand was then sprinkled on the rails, and on running the truck along the track a difference in behaviour was at once apparent. The skidding was no longer uniform, but intermittent; the spring was put in tension as before to a certain maximum amount, but then, instead of a uniform skidding taking place, the tension was entirely relaxed by a sudden twist of the wheel, and the skidding thus took place at intervals determined by the critical tension of the spring. The presence of grit on the rail has therefore the effect of preventing the uniform skidding which takes place on the clean rail, and of causing intermittent sharp skids of the wheel.

The lecturer said that he had, therefore, come to the conclusion that corrugation was due primarily to the wheels running on unequal diameters, which, combined with the presence of grit on the rail, would produce this intermittent skidding. To bear out this conclusion, the lecturer mentioned that corrugation was exceptionally bad along the Boulevard de Waterloo in Brussels which was flanked by sand-covered avenues; again, in Norwich, where the lines were frequently covered with the hard flint dust, the lines were badly corrugated, whereas in Coventry, where the equipment was exactly similar, no serious corrugation had been noticed. The distance between the corrugation marks, said the lecturer, depended upon the percentage skid and the limiting twist of the axle. If the limiting twist was represented by 1/16 in. at the rim of the wheel, then 3 per cent. of the distance between corrugation marks must equal 1/16 in. The car tested at Croydon had a weight of 4,000 lbs. per wheel, an axle diameter of 3¾ in., an axle length available for twisting of 48 in., and the coefficient of friction was 0·4. The twist estimated from these particulars was 0·073, and this, combined with the measured skid of 3 per cent., corresponded to a corrugation pitch of 2·4 in. The pitch of the actual corrugations varied between 2·25 and 2·75 in. Considering the matter from another point of view, a different value of the pitch was arrived at; thus the system, consisting of the two wheels and an axle, had a natural period of vibration, and a constant period of time would elapse between each swing. If this were the only determining factor, the pitch of the corrugations would be directly proportional to the speed of the car. Thus the pitch of the corrugations will vary under different conditions. The corrugation at Philadelphia, which had been stopped by stiffening the web of the rail with fishplates, was, the lecturer thought, due to the fact that side pressure caused the wheel to run on the throat of the flange, the head of the rail being deflected, as noticed, some 3/32 in. By stiffening the web, the deflection was prevented, and the wheel ran on the tread of the rim. If a groove is choked with dirt, this may also cause corrugation, as the wheel will run on its flange. Referring to the rail corrugation on the Eastern Bengal State Railways, the lecturer pointed out that a very hard brick ballast was used for the boxing between the sleepers on these railways. In some cases this had been replaced by a softer material, and the corrugations had disappeared. On the open girder bridges the corrugations were present only when the approach to the bridge was boxed with brick, which seemed to show that the corrugations were caused in the way suggested, the dust being sucked by the train from the approach on to the rails.

In conclusion, Prof. Carus-Wilson stated that there were four conditions which must exist at the same time to produce corrugation, namely, (1) a defective track producing grinding and check cutting; (2) defective rolling stock, *i.e.*, bad wheel section as shown in Fig. 2; (3) the presence of grit on the rail; and (4) the critical speed. The lecturer suggested no remedy, but stated that the first step towards a remedy was that all should be agreed upon the correct diagnosis of the disease.

The chairman, Mr. Fell, then announced that the lecture would be discussed at a meeting to be held at 4 o'clock on Friday, July 24th, at 35 Parliament Street, when the model shown by Prof. Carus-Wilson would again be on view one half-hour before the meeting. The country and out-of-town members present, who would not be able to attend that meeting, however, were asked to speak at once.

Mr. J. DALRYMPLE (Manager, Glasgow Corporation Tramways) stated that corrugations on the rails at Glasgow cost the Corporation from £10,000 to £15.000 annually, and that any remedy would be most acceptable. With the exception of a couple of

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miles of rail the whole system was badly corrugated. He thought the lecture was an important contribution to an important question, but regretted that Prof. Carus-Wilson had suggested no remedy. Although the causes of corrugation might be what the lecturer had stated, he was doubtful if a remedy could ever be found. If a remedy was found, he hoped it would cost less to carry out than what the corrugations were costing them at present.

Mr. A. N. BANISTER (Norwich Electric Tramways Co.) said that after the first three years of running the corrugations on the rails at Norwich were very bad, extending over three to five lengths of rail; since getting rid of these in the usual manner, they had reappeared only in short patches of from 5 to 15 feet long. Corrugations had appeared on a slight curve laid in wood paving; at first they were on the outside rail only, but now they were on both. There had been an enormous amount of check cutting going on, but on the Newmarket road, their fastest, it had not been necessary to repair the check, although corrugation on this road was bad. Thus his experience did not agree with Prof. Carus-Wilson's theory.

Mr. G. M. GIBSON (Mountain & Gibson) suggested that the application of a differential gear might prove a remedy. There were trucks running with such gear already. Not only would much wear and tear on curves be saved, but corrugation and the breaking of axles might be prevented as well.

Mr. E. BENEDICT said that during his 22 years' experience on the Eastern Bengal Railways he had never heard of rail corrugation, and that he could not understand how it was that so much was made of it now. He had known cases when men had to be told off to sweep sand off the rails to allow the train to pass, but there had been no trouble with corrugations.

Mr. C. W. SHEPHERD (Edinburgh & District Tramways Co.) hoped that Prof. Carus-Wilson would inspect their tramway system in Edinburgh, as they had no signs of corrugation.

Prof. CARUS-WILSON, in reply, further explained the actual part taken by the grit in causing corrugation, stating that he thought that the presence of grit was essential, but that grit alone would not cause corrugation.

A vote of thanks was proposed by Mr. STEPHEN SELLON and seconded by Mr. J. DEVONSHIRE (Metropolitan Electric Tramways, Ltd.). The proceedings concluded with a vote of thanks to the chairman, Mr. Fell.

THE SUMMER VISIT OF THE INSTITUTION OF ELECTRICAL ENGINEERS, STUDENTS' SECTION

THE annual tour of the students' section of the Institution of Electrical Engineers was this year directed to Newcastle-upon-Tyne and the surrounding neighbourhood. The party numbered about twenty from London, while a considerable number of local students joined them at Newcastle.

Starting at St. Pancras on Monday, the 6th inst., a visit *en route* was paid to the works of the Midland Railway Company at Derby. The first visit in Newcastle on Tuesday was to the works of Messrs. R. W. Hawthorn, Leslie & Co., Ltd., where a considerable amount of marine work is passing through the shops. Probably the most interesting thing to electrical engineers to be seen here was the wire-core method of blading turbines.

These shops afford an excellent example of electric drive applied to heavy marine engineering. The nature of the work requires machines of a massive nature, and individual motor drive is considerably used. A three-phase supply is obtained from the mains of the Newcastle-upon-Tyne Electric Supply Co., Ltd., at a pressure of 6,000 volts, from which it is transformed down to 440 volts for power, and 240 volts alternating, to neutral for lighting. Two complete sets of oil-cooled static transformers are installed on the high-tension side, the low-tension board only being under the control of the works' staff. The lighting and power boards are separate on the low tension side, the latter being divided into five circuits, each having an oil-switch, a fuse in each phase, and an ammeter operated by a Reyrolle current transformer. The motors installed range from 5 to 50 h.p., and the circuits are, wherever possible, aerial, carried in pot insulators. This equipment is typical in general details of a large number of installations on Tyneside, operated by the supply company mentioned.

In the afternoon the works of Messrs. Ernest Scott & Mountain, Ltd., at Gateshead, were visited. One of the most interesting features is the recent addition of a high-tension three-phase supply solely for testing purposes by means of transformers which, operating normally at 6,000 volts from the mains of the County of Durham Electrical Power Distribution Co., Ltd., have tappings whereby voltage reductions of 1,000 volts at each tapping may be made.

On Wednesday morning a section of the extensive Elswick works of Messrs. Armstrong, Whitworth & Co., Ltd., were visited, comprising the electrical department and the gun shops. The principal features of the electric works of Elswick are described in a separate article on page 91 of this issue. In the afternoon Messrs. J. H. Holmes's works were visited, and here, again, the number of items of interest were considerably in excess of the space limits of these notes. The "Lundell" motor, which was amongst the first of the "round-frame" machines, still retains a position as favourite as evidenced by the number of machines passing through the shops. The testing room for small motors is most admirably arranged for the rapid testing of small motors, four benches supplied with special rapid-connection cables from a main test board being used either for direct or indirect Hopkinson testing. For speed tests a standard seconds pendulum operates through a relay into a single-stroke bell every quarter-minute, giving time to each testing assistant and dispensing with the second man usually necessary. A very fine collection of historic lamps was here shown to the students, including an old Maxim high-power lamp, whose filament was made from Bristol board, and an interior-screw Edison lamp. Holnies's original quick-break switch was also shown—interesting, because at one time thirteen firms were licensed to make switches under that patent.

On Thursday morning, Messrs. Clark Chapman's works were visited, where a large variety of electrically-operated winches were shown. Attention may be drawn to a type of motor-starter for ordinary duty, but constructed to the requirements of the Admiralty with an exclusion of slate. The system of electrical supply to the works is a mixed three-phase and direct-current equipment. In the afternoon the visitors emerged from the sphere of influence of the large power companies operating in this area by visiting the Consett Iron Works, where a 400 kw. Parsons turbo-set, running at 2,800 r.p.m., gives 800 amperes at 500 volts. It is assisted by two 350 kw. "Tyne" type Scott & Mountain generators, driven by three-cylinder compound engines. Electricity is used for arc and incandescent lighting, pumps, and small motors. In the pumping station are three sets of eight-pole Scott & Mountain 143 b.h.p. motors, running at 475 r.p.m., driving 3-throw plunger pumps, 16″ diameter by 22″ stroke. Water is used for cooling the rolls of the mills, and for passing round the nozzles on the blowers. To supply 220-volt current for the offices, a motor-generator and battery are installed in the pump room.

On Friday morning the shipyards of Messrs. Swan, Hunter & Wigham Richardson were visited, and also the mines of the Horden Collieries, Ltd., described on page 109. The final visit on Saturday morning was to the Carville Power Station of the Newcastle-upon-Tyne Electric Supply Co., Ltd. The chief feature of interest is the transfer of the distribution panels from the main switchboard in the power-house to a special "control room," where a chart of the whole system, extending in some cases to points 35 or 40 miles distant, shows at a glance the state of every trunk cable. Every operator on the system has to telephone to the control room before moving a trunk switch.

Electrically-propelled Ferry-boat.—According to the *Elektrotechnischer Anzeiger*, an electrically-propelled ferry-boat has been built recently at the Berninghaus Dockyards at Duisburg. The boat contains a battery of 160 cells, and can carry 645 passengers. This boat will take over the ferry service between Codesberg and Niederdollendorf on the Rhine.

The Census of Production.—Evidently the department of the Board of Trade which is carrying out the "Census of Production," is aiming at obtaining very complete statistical returns, far more complete and detailed than the ordinary general census. In our issue of July 2nd, we published particulars of the information that is being asked from manufacturers and others in the electrical and engineering trades, and we have now before us a copy of the form which is being sent out to the building and contracting trades. Information is required with regard to the total capacity of engines that are used, and this is to be divided up into the capacities of reciprocating engines, steam turbines, internal combustion engines, water-power, and other power. The capacity of dynamos used for generating electricity is also asked for, and the number of Board of Trade units which are generated during the year. In this case, also, separate totals are required of machines driven by reciprocating engines, steam turbines, and other power. The amount of electricity purchased during the year is also asked for—the capacity of dynamos to be given in kilowatts and of engines in horse-power, and the information is given in the instructions for filling in the form that a horse-power is 0·746 of a kilowatt, to assist estimates being made. As in the return for the electrical trades, there is both "compulsory" and "voluntary" information. All the questions mentioned above come in the former category, as do also questions relating to the nature of the trade or business, and the output during the year. Included in the details of output, the value of constructional and repair work, on railways, light railways, and tramways, telegraphic lines, telephonic lines, electricity lines, &c., are all to be given. The iron, steel, and fuel used during the year is desired as "voluntary" information.

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THE ELECTRICAL EQUIPMENT OF HORDEN COLLIERY

ONE of the most interesting features of the recent visit of the Students' Section of the Institution of Electrical Engineers to Newcastle-upon-Tyne was the visit to a typical colliery, one of the many which abound in that district. The installation was interesting from the point of view of its completeness and self-contained nature, the electric generating plant for power purposes consisting at present of two high-speed compound direct-coupled engines and dynamos of 250 kw. capacity, manufactured by Messrs. Ernest Scott & Mountain, Ltd., of Gateshead, giving at 360 revolutions per minute a potential difference of 500 to 550 volts at the bus-bars. In order to compensate for increased line drop on the distribution system throughout the colliery at full load the generators are slightly over-compounded, and each machine is protected by means of overload and reverse current release circuit-breakers, situated on the switchboard.

The lighting installation consists of two Siemens and Crompton rope-driven generators of a not very modern type, delivering current at the bus-bars at 230 volts. One of these sets supplies the whole of the surface lighting of the colliery during the day shift and the other the street and private lighting of the village, as well as the colliery. The underground lighting is taken from the power set. In connection with this it is interesting to note that throughout the Northumbrian and Durham coal field area it is becoming customary, since the introduction of electric power into mines, to light up the streets of the pit villages adjacent to the mines, and in many cases to provide electricity for the interior lighting of the miners' cottages.

Power on the surface is supplied for the creepers, Zimmer screens, raising and lowering gear and coal belts, each of these being driven through worm-reducing gear running in an oil-bath by a 15 h.p. totally enclosed shunt-wound motor of Messrs. Mather & Platt's make, running at 600 revolutions per minute. Although this is kept going continuously for 20 hours out of the 24, the temperature rise is exceedingly low. The starters, which are of the wire-resistance type, are fitted with double-pole switches, fuses, and overload and no-volt releases. Messrs. Mather & Platt's motors are also installed for running the tiplers, jiggers, &c., which are driven through friction and bevel gearing by 30 h.p. shunt-wound partially enclosed motors running at 600 revolutions per minute, the necessary speed reduction being obtained by various size pulleys on the belt drive. These motors are placed in a special motor-house fitted with a distribution switchboard, on which are placed, besides the main double-pole switches, fuses for every motor and sub-circuit, the whole being protected by a circuit-breaker of the B.T.-H. pattern. The motor starters and overload and no-volt releases for the tipplers and jiggers are placed on panels at the bottom of the switchboard.

One of the most important functions of electricity in coal mines is the ventilation of the system, as by Board of Trade regulations, a current of air has to be kept continuously in circulation under heavy penalties. At the Horden Collieries ventilation is secured by means of a Sirocco fan, driven by two Scott & Mountain multipolar shunt-wound motors, each of 160 h.p., and coupled one at each end of the fan shaft by means of flexible couplings of the interwoven belt type. These motors can be run either singly or together, either in series or in parallel, according to the speed or load required, through the medium of a series parallel switchboard, fitted with automatic circuit-breaker having a no-load release, and also non-inductive resistance to take up back E.M.F. As these motors are of the 10-pole construction and the ampere turns on the fields are heavy, great care has to be taken to deal with the E.M.F. on breaking circuit, necessitating the insertion of non-inductive resistance. Liquid starters are used for these motors, and on an eight weeks' non-stop full load run the temperature rise is quite normal, the field being only slightly warm.

The endless rope haulages are driven by 100 h.p. motors, compound wound and fitted with commutating poles, made by Messrs. Crompton & Co. The speed and torque are varied by means of B.T.-H. controllers permitting of reversal and a good range of speed. The motors run at 620 revolutions per minute, the necessary reduction being obtained by belt-drive and spur gearing. In order to operate each motor a specially enclosed watertight and gas-proof switchboard is provided, containing an automatic circuit-breaker, double switch and fuses, ammeter and voltmeter, and non-inductive resistance frames. In order to prevent any danger from electric shock, the motors, with their resistance frames and other accessories, are well earthed.

Pumping is undertaken, both for the water supply to the colliery and town, and for the removal of drainage water from the shafts and workings. For the former purpose motor-driven turbine pumps are installed, capable of pumping 200 gallons per minute to a 400 ft. head when running at a speed of 1,000 revolutions per minute, while the drainage water is pumped to the surface by means of a 35 h.p. Scott & Mountain motor-driven three-throw pump, situated down the mine in the five-quarter seam. The speed of the motor is 800 revolutions per minute, a belt drive being used for the pump. In the Hutton seam is another three-throw pump capable of delivering against a 1,020 ft. head, having 9 in. rams, and being rope-driven by a Scott & Mountain shunt-wound variable speed motor of 160 h.p.

Among the minor applications of electricity in this mine may be mentioned the operation of the granary, workshops, &c., which are all motor-driven by 15 h.p. and 30 h.p. shunt-wound Mather & Platt motors, whose switches are operated from distributing boards in the shops, and whose starters are fitted with overload and no-load releases. The lamp-cleaning machines are also motor-driven, and the miners' lamps are lit by electricity on bank and below ground by specially designed air-tight igniters, operated by induction coils and accumulators. The lamp is lit in the secondary circuit of the coil, and the accumulators are charged on bank by means of a motor-generator. The lighting below ground is obtained from the 500-volt circuit by means of two 250-volt lamps in series. The top and bottom decks and pass-byes are illuminated by two light gas-tight oyster fittings at every 12 yards, while the staples and haulages are fitted with single light air-tight ship fittings, each circuit being protected by a fuse in each pole, and all conduits are sufficiently earthed. The shaft signalling is done by bells from each seam to bank and winding engine, on the Morse system. The signalling underground is accomplished by simple bell circuits, the wires extending right in-bye.

In order to secure continuity of supply, the current is conducted down the shaft by means of bitumen insulated double steel armoured cables, 61/12 size, supported in clamps at intervals of about 20 fathoms, the ends terminating at specially designed change-over junction boxes, allowing the current to be changed over through the seams and down the other shafts in the minimum of time in case of breakdown of a section. The main gas-proof switch-boxes underground are very massive, and fastened about three feet from

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the ground. A brick cabin is built around them and the door locked, a danger plate in red letters being very conspicuous at the shaft bottom. The switches are let into the wall, and the door plates in front of them locked as before, these collieries being worked strictly on the basis of the Mining Acts. We are indebted to the management of the Horden Collieries, Ltd., for their courtesy in giving us the particulars of the well-arranged and up-to-date electrical equipment of their colliery, which is of considerable interest, in view of the rapid extensions in the application of electricity to mines.

THE USE OF ACCUMULATORS FOR PEAK LOAD

MR. A. M. TAYLOR, replying to the discussion on his Paper, reported on pp. 65–67 of our last issue, says that Mr. Wilmshurst, Mr. Watson, and Mr. Raphael had evidently gained the impression that he had based his costs on a one-hour basis. The Fig. 1 of his Paper, which we published, he now explains, was a purely hypothetical curve upon which none of his deductions were based. For his estimates, he states, the kilowatt capacities were based on a three-hour rating. He has analysed dozens of load curves, with a view to introducing batteries, and says that, fogs excepted, the estimates in his Paper will hold for towns having large power and tramway loads, such as Manchester, Liverpool, Glasgow, and Birmingham, provided that only some 33 per cent. of the peak is taken up by the cells. In such towns, he maintains, the fog load rarely exceeds the equivalent of 66 per cent. of the peak load (maintained over eight hours), and consequently the steam plant is capable of meeting it, with very little, if any, assistance from the batteries, so that these need be no bigger than those considered in his estimates.

"While on this question," Mr. Taylor adds, "I may point out that if the batteries are put in for 50 per cent. of the peak, a 'fog load' *averaging* 75 per cent. of the mid-winter peak, maintained over 7–8 hours, can be dealt with by the combined plant without *any* extra expenditure on battery power. I know of no towns out of London where this demand is exceeded, and think the above will show that I have carefully considered the question of 'fog loads,' and have not, as some critics appear to think, ignored it."

He has authority to state that responsible makers will maintain cells at their full initial capacity for ten years on a 9 per cent. basis. The watt-hour efficiency, he argues, is really hardly material "with current at 0·2d. per unit (including repairs)."

In reply to the demand for figures and further information as to the American batteries, he states that he has first-hand information that the first battery in Chicago was put down absolutely in place of new steam plant, and to give 11,000 amperes for 1¼ hours; and he has every reason for believing that subsequent batteries were put down for a similar purpose. For New York, Sir William Preece recently published a curve showing a distinct proportion of the immense peak taken up by cells. [Reference to this curve, published in ELECTRICAL ENGINEERING, Vol. III., p. 462, will show, however, that the cells supply only about 5,000 kw. of the total peak load of 117,000 kw., which hardly supports Mr. Taylor's argument.—ED. E.E.] As regards the cost of working in Chicago, he thinks Mr. Parshall recently stated this to be only 0·25d. per unit in his evidence before the London Committee.

Electrical Coalcutters in Staffordshire Mines.—From the report of Mr. H. Johnstone upon the inspection of mines and quarries in the Stafford inspection district, abstracted in the *Iron and Coal Trades Review*, it appears that 17 electrical coalcutters are in use in that district, as compared with 32 worked by compressed air. The amount of coal cut during 1907 by the electric cutters is, however, more than double the amount cut by compressed air, being 286,507 tons against 130,225 tons. The electrically-driven machines are classified as follows:—13 of the disc type, three of the bar type, and one of the chain type.

Tungsten in Queensland.—A report to the *Queensland Government Mining Journal* states that a large amount of tungsten is present in the quartz seams of Noble Island, situated about 80 miles north of Cooktown. The veins have been worked on the surface only for about four years with good results. There is, however, no permanent water supply and no serviceable timber for mining purposes on the island.

ELECTRICAL SCIENCE

British and American

Electrolysis of Water Vapour by Sparks.—In the year 1861 Perrot showed that if sparks from an induction coil be passed through water vapour, the decomposition into hydrogen and oxygen occurred all along the spark and not merely at the electrodes. He found also that the gas collected at the electrodes was a mixture of hydrogen and oxygen, an excess of oxygen occurring at the anode and an excess of hydrogen at the cathode. J. J. Thomson, on repeating these experiments, found that the length of the spark had some influence, for with short arc-like sparks hydrogen appeared mostly at the anode and oxygen at the cathode, while with long sparks the gases changed places. In 1902 Chapman and Ledbury noticed that the separation of the products of electrolysis had something to do with the position of the inflow of the vapour into the spark. The excess of oxygen occurred, they found, at the pole furthest from the point of inflow of vapour. In the *Philosophical Magazine* for July, A. Holt and E. Hopkinson inquire experimentally whether the separation of the gases is a diffusion phenomenon. One of their experiments consists of arranging the spark between platinum wires sealed into the leg of a T tube, and making a stream of water vapour at 15 mm. pressure enter the tube at one end of the cross-piece, divide, and leave the tube at the end of the leg and the other end of the cross-piece. Of course, only the vapour passing along the leg of the tube is submitted to the spark, yet a large proportion of hydrogen is found in the vapour stream emerging from the end of the cross-piece. An excess of oxygen appears, of course, in the stream from the leg of the tube. This shows that the hydrogen diffuses against the stream of vapour much more rapidly than does the oxygen. By analogous means the decomposition of carbon-dioxide was examined; and as carbon-monoxide and oxygen have much the same rate of diffusion, neither gas preponderates at any place. This does not account, however, for another observation of Chapman and Ledbury: that the total amount of water vapour decomposed when the vapour enters the tube near the cathode is very much greater than when the vapour enters near the anode. The present authors suggest that the vigorous disintegration of platinum cathodes, which is well known to be greater than the disintegration of platinum anodes, is the chief cause of this phenomenon. To test whether this metallic spray from the anode can affect—catalytically or otherwise—the total amount of decomposition, the authors made parallel experiments, in a special form of tube, on electrodes of platinum and aluminium. The latter metal disintegrates very slightly, and is, besides, not affected by water vapour at moderate temperatures. The tube resembled an ordinary vacuum tube, but was provided with an inflow pipe at one end, and with an outflow pipe at the other. The figures given by the authors show that with platinum electrodes the decomposition when the inflow of vapour occurs near the cathode is four times as great as when it occurs near the anode; while with aluminium electrodes the difference is one of only three per cent.

Continental

Positive Electrons.—Jean Becquerel has got one step further in his attempts to prove the separate existence of positive electrons, *i.e.*, positively charged particles having numerically the same ratio of charge to mass as the negative electrons hitherto known. His method is described in the *Comptes Rendus* for June 22nd. Two vacuum tubes, A and B, communicate through a capillary portion. An anode is mounted in A, and a perforated cathode in B, so that B contains canal rays. On approaching the finger or an earthed wire to the tube B, a new cathode is formed, which attracts the positive rays and produces a whitish patch inside the tube. This is best seen at a pressure of 1/500 mm. of mercury. The patch follows the finger, and may be made fairly small and well-defined. If now a magnet is brought near the tube, the spot is displacement with exceptional ease, and the displacement is always in the sense indicating positively charged particles. Now an easy displacement in a magnetic field has hitherto only been obtained in the case of cathode rays, which are negatively charged particles. The author isolated a beam of these new rays by attracting it out of the tube B by means of another cathode placed at the further end. The beam colours the gas in the third tube blue, and the glass orange. When a screen of willemite is used, the beam colours it a greenish yellow. This beam behaves much like an ordinary canal-ray beam, so long as the cathode rays are not prominent in the region of the second cathode. But when the pressure is made so small that cathode rays are freely developed in that region, the beam is easily deflected in the sense which indicates a positive charge. This action of cathode rays in eliciting positive electrons is made evident by directing an independent cathode stream on to the second cathode, so as to cross the path of the canal rays. As soon as that takes place, the positive electrons are freely produced. The author supposes that negative electrons, impinging upon positively charged atoms, are capable of extracting some positive electrons from them. If positive electrons are produced without such special facilities, they probably have a very short free path, and rapidly re-enter into combination. In doing so, they may possibly build up the same species of matter from which they were extracted, or perhaps a new species of matter.

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THE FIRE ON THE LANCASHIRE AND YORKSHIRE RAILWAY

MR. A. P. TROTTER has now issued his report to the Board of Trade on the fire which broke out in a "trailer" coach on the Liverpool and Southport Railway, on April 30th, soon after the train left Freshfield Station, on the down line. There were but few passengers, and no one was injured. The fire may be divided into two kinds, (*a*) the primary fire due to and supported by and in the immediate neighbourhood of the electric arc which started it, and (*b*) the secondary fire which spread by ordinary combustion when inflammable woodwork had caught fire. The cause of the primary fire may be divided into two considerations: (*a*) the defect, undoubtedly a short circuit from a positive cable to "earth," that is, to the underframe of the carriage, and (*b*) the persistence of the electric current after it had been automatically cut off. The effects of the electric arc were confined to a distance of a foot or so from the spot where the fire broke out below the floor, at the extreme corner of the under-frame, where the cables turn to rise up and pass through the floor. The cable which probably was the cause of the fire is called, on this railway, the "main trolley cable," and consists of 37 strands of No. 13 S.W.G., insulated with pure and with vulcanised rubber, and is taped and braided with fire resisting braidings. This and other cables are run "bunched" in a wooden casing lined with thin uralite. Where they bend upwards the uralite is cut away, and the braiding of the cable lies against the wood. After passing up through the floor they are well taped and compounded, but such protection against the descent of moisture is of a highly inflammable nature.

Mr. Trotter continues:—If I had been asked to make a critical comparison between the wiring of this carriage and those of the London lines and of the North-Eastern Railway lines before I examined this accident, I should have said that (1) the "bunching," that is to say, the running of several cables side by side in a common trough or casing, (2) the cutting away of the uralite and the exposure of bare wood at the upward turn, (3) the number of bunched cables and wires between the panel and the end of the carriage, compare unfavourably with the practice elsewhere of running each cable in a separate iron pipe, these pipes in the case of the North-Eastern Railway being carefully arranged not to cross each other and all carefully "earthed" to the frame. The woodwork of the Underground Railway Company of London is treated with chemicals which render it non-inflammable. The exact nature of the defect which resulted in the short-circuit is not ascertainable. There had been much rain, and a defect such as a stab through the insulation of a cable by a chisel, which would give no trouble and might escape detection under insulation tests while everything was dry, would certainly develop in the presence of moisture.

When cables are run in iron piping, moisture sometimes condenses in them and may accumulate in considerable quantities. It has been suggested that drain holes should be provided. While these would prevent any accumulation of water they would leave the cables subjected to damp air in wet weather or under the conditions, whatever those may be, of condensation or sweating. I recommend that when cables are run in iron pipes, they should be sealed by wooden ferrules, parallel inside, slightly tapered outside, split in two or perhaps three parts, and driven well into the pipes. Uralite, while capable of standing the temperature of ordinary red heat, will melt when close to an arc, and is not an insulator. It is quite incapable of resisting the primary fire of an accident of this kind.

In this case, the arc was more severe than any that I have known in London. This is no doubt because it was a dead short from positive to negative. It is estimated that it lasted not more than two or three minutes. Its intensity was shown by the considerable amount of iron which was melted. A stout knee, a diagonal, and the headstock were fused. Several pounds of iron were melted from these.

The report then dealt with the persistence of the electric current after it had been automatically cut off. The part of the line where the accident occurred is supplied with current from the Formby Power Station and the Freshfield Battery Station. Automatic circuit breakers are provided between the three converters and the bus bars at Formby, each breaker being set to open at 1,800 amperes. Breakers are also provided between the bus bars and north and south feeders, set at 3,500 amperes each. Each breaker has a knife switch in series with it. At the Freshfield Battery Station one breaker, set at 2,800 amperes, and its knife switch are placed between the battery and the bus bar, and between the north section (the up and down conductor rails being coupled together at a section pillar), there is a breaker set for 2,800 amperes, and a knife switch, but for the south section, that is, the section between the battery station and Formby (the up and down rails being connected together at a section pillar) there is a knife switch and no breaker. It appears that at 1.8 p.m. the converter breakers opened at Formby and on being replaced they stayed in. Two minutes later they opened again. Simultaneously with the first opening of the breakers at Formby the battery breaker opened at Freshfield with a loud report. They were replaced and opened two minutes later. It must be assumed that the short-circuit started after the train left Freshfield Station, since nothing was noticed at the stop at Freshfield. Formby could supply 3,500 amperes through the north feeder, Freshfield could supply 2,800 from the battery, and could pass another 2,800 amperes from a sub-station further north at Birkdale, reverse way through its line breaker, bus bar and knife switch, making a total of 9,100 amperes. It is not improbable that a current of 2,000 to 8,000 amperes, insufficient to open the breakers, did most of the mischief of the primary fire, and the apparently simultaneous opening of the breakers, and the explosive opening of the one at the battery sub-station, indicate that at a certain stage it quickly increased and largely exceeded 9,000 amperes. During the two minutes after the breakers were replaced the fire started again, and reached the same point, again opening the breakers. Had the sub-station attendants, after the current had been cut off by the opening of the automatic circuit-breakers, guessed that there was something wrong, and kept them open, it is probable that the fire would not have spread, and it certainly would have been less severe and easily controlled. But circuit-breakers frequently open, and it is the practice on this line to put them back at once, on the supposition that they have come out in consequence of a momentary over-load. The practice about replacing circuit-breakers differs with different companies. The rule of the Lancashire and Yorkshire Railway is that:—"If the rotary circuit-breakers alone open without opening the line circuit-breakers, the attendant then trips one line circuit-breaker, and replaces the rotary circuit-breakers, and then replaces the line circuit-breaker which he has tripped. If a line circuit-breaker blows, this is always accompanied by the blowing of the rotary circuit-breakers: in this case the rotary circuit-breakers are replaced and then inquiries are made from the adjacent sub-stations and signal-boxes as to whether anything has been noticed wrong; if the reply is satisfactory, the line circuit-breaker is then closed again. If the rotary circuit-breakers blow violently (even if a line circuit-breaker does not blow) it is probable that the attendant would make some inquiries before replacing. In any case, if a circuit-breaker blows on its first replacement, full inquiries would be made before it is again replaced. The sub-station attendant is guided to a certain extent by the manner in which the circuit-breakers blow."

Meanwhile, the driver of the train put his short-circuiting bar across the rails and prevented any further supply. The fire was then subdued by chemical extincteurs, and the train started again after a total delay of only eighteen to twenty minutes.

The current fed to a line may be of three kinds, first, the ordinary working current used by the motors; second, general leakage current, and third, current due to such an accident as this. To these may be added the current used for lighting the trains, but this is perhaps insignificant. It would be an advantage if attendants at sub-stations could discriminate between these currents. It might be worth while trying if a telephone working on an induced circuit in shunt to such a length of conductor as is available in a sub-station would indicate (1) a hum due to the motors, (2) comparative silence due to leakage, or lighting, disturbed perhaps by the sliding of the shoes, (3) a possibly characteristic roar due to an arc. It appears that while attention may be given with advantage to details of wiring and to gradual alteration of the carriages, most careful consideration is immediately necessary as to the arrangement of the circuit-breakers, their time limits, and length of line controlled by each, and to the procedure to be adopted by sub-station attendants in replacing them. Shoe fuses appear to be of minor importance. They must be so rated that two can easily take the maximum starting current of a train. Should a short-circuit occur between a shoe-fuse and a bus-line, that fuse may go, but the other three in parallel with it will pass a serious current The severity of this fire was the result of the heavy current which passed. The feeders at Formby and at Birkdale, though supplying the up and down rails through separate knife switches, are controlled by a single circuit-breaker, and the rails are cross-connected at the section pillars. If each feeder were provided with a circuit-breaker, and the switches at the section pillars were kept open, except for emergency, repairs, or tests, the breakers could be set at a much smaller current. This alteration would not increase the number or length of the feeders. Any one section of up or down line would then be limited to the current (with reasonable margin) required to start a train.

The report concludes with the following recommendations:—(1) In construction of new rolling stock, and in alterations and repair of the present stock, care should be taken to protect cables, not only against water under ordinary conditions of weather, but under conditions of high wind or driving snow. (2) The lay-out of feeders, circuit-breakers, and section switches should be arranged with the view of limiting for each section the current distributed to that section, with a reasonable margin in excess of the maximum requirements of that section, and the sections should be, where possible, of such a size that one train only is likely to start on it.

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ELECTRICITY IN AGRICULTURE*

By Sir Oliver Lodge

Results of Experiments on an Industrial Scale

INTRODUCTORY.

SOME thirty years ago a Swedish professor named Lemström sought to elucidate the aurora borealis by trying to imitate its appearance by electrical experiments. For this purpose he produced high-tension discharges of various kinds, and sent them through vacuum tubes until he got an appearance very like those of the Northern Lights. Some of these experiments he conducted in his greenhouse, and he noticed incidentally that the plants seemed to thrive under the treatment, and that the electrification thus produced in their neighbourhood appeared to do them good. He also noticed, as remarkable, the flourishing development of plants in Arctic regions, where the sunlight was very weak; and he attributed part of this growth to the influence of electric discharges.

He says that when the plants in the North of Norway, Spitzbergen, and Finnish Lapland have resisted the frequently destructive night frosts they show a degree of development which greatly surpasses that of plants in more southern regions, where the climatic conditions are more advantageous. This rich development appears principally in the fresh and clear colours of the flowers, in their strong perfume, in the rapid development of the leaves on the trees, and their scent, but particularly in the rich harvest which different seeds—such as rye, oats, and barley—will produce when, as before stated, they are not destroyed by the frosts. From a bushel of rye sown they will often produce 40 bushels, and from barley 20 bushels, and so forth. It is the same with grass. These results are attained although the people cultivate their soil very imperfectly, using only ploughs and harrows of wood.

He pursued the matter by careful observation, taking test plants in pairs or groups, electrifying one group—that is to say, discharging some electricity into the air above them—and keeping a similar group away from the electricity, in order to be able to compare them. Then he photographed the two groups side by side, and found in nearly all cases a marked improvement as the result of the electrical treatment. He concluded that the needle-like shape of the leaves in fir trees, and the beard on the ears of most cereals, have the discharge of electricity as their function, and finds that they do act in this way.

This observation and these experiments of Professor Lemström were not, indeed, the beginning of the application of electricity to plant growth, because pioneer attempts had been made long before, as will be mentioned directly, but it was the beginning of a thorough and scientific treatment of the problem. Attempts of a different kind had also been made. Plates had been sunk in the ground, and a current passed between them among the roots of plants; but whatever effect is thus caused is of a totally different kind to that excited by high-tension electricity supplied to the air above them. Both in a manner are natural processes. There are natural earth currents, and these must flow among the roots of plants, though whether they produce an appreciable effect may be doubted.

There is a natural atmospheric electrification, and this must be playing an important part in many phenomena. Atmospheric electrification is responsible for the formation of rain and hail. During fine weather the electricity in the air is usually of one sign, mainly positive. When wet weather sets in, the electricity in the air usually changes sign, becoming negative. The whole subject is a large one; a great deal is known about it, and vastly more remains to be known; but meanwhile it can hardly be doubted that the electrification of the air has some effect on growing plants. For it is found that, under the influence of sunshine, electrified plants can give off electricity into the air from the leaves; and the fact that the air is electrified relatively to the soil requires that the plants shall be electrified too, so that in all probability they are in a constant state of slow electrical discharge, which becomes more rapid when the sun is up. In what way this discharge of electricity from the growing tips, and hair, and surface generally, really acts must be studied and reported on by physiological botanists; but it is natural to suppose that it cannot be without influence, and reasonable to think that that influence must be beneficial—a hypothesis which direct experiment confirms.

Possibly in some sunny countries the effect is excessive, and might with advantage be moderated; but in this climate it turns out that artificial supply of electricity does increase the rapidity and assist the amount of growth. At any rate, the experiments of Lemström, which were repeated and extended by others, clearly pointed in that direction. So when, after some preliminary experiments at Bitton, Mr. J. E. Newman, of Gloucester, acting in conjunction with Mr. R. Bomford, of Salford Priors, determined to try the phenomenon on a really large scale, and came to me to see if I could help them electrically, and enable them to maintain a continuous high-tension discharge for hours together each day over ten or eleven acres by means of power furnished by an oil engine and dynamo, I very willingly assented, and set my son, Mr. Lionel Lodge, upon the job.

Those interested in the experiments are much indebted to the enthusiastic co-operation of Mr. Bomford. It may be interesting to note that it was at a farm belonging to Mr. Bomford's father that the first steam ploughing in England was done.

Professor Lemström was undoubtedly the pioneer in this sort of work, though circumstances connected with the natural electrification of the atmosphere, and with the discharge of electricity from various surfaces, have been pertinaciously examined by Professors Elster and Geitel

THE ELECTRICAL ARRANGEMENTS

The method is to stretch over the field to be treated a number of wires on poles, something like low telegraph wires, but high enough for loaded waggons and all the usual farming operations to go on underneath the wires without let or hindrance. The wires are quite thin, and are supported by elaborate high-tension insulators on posts. They extend over all the acreage under experiment, a "control plot" of similar land under similar conditions being, of course, left without any wires.

The overhead system of wires covered about 19½ acres of ground. The wires were mounted on insulators placed upon larch poles, some 15 ft. high, which were placed in rows, the rows being separated by a distance of 102 yards, and the poles in a row being 71 yards apart. Stout telegraph wire carried the current along each row, while thin galvanised iron wires, placed some 12 yards apart, were stretched between the rows, and acted as the discharge wires. In this way 22 poles were sufficient to support the wire over the 19 acres.

Roughly, only one pole per acre is required; therefore, the inconvenience is practically nil. Owing to the flexible suspension, risk of breakage to the wires is very small. (During the two years the wires have been up at Bevington, apart from a few wires broken at harvest time by catching in top of extra high waggon load, only one wire has fallen.)

The system of conductors is connected at one post with a source of positive electricity at a potential of something like a hundred thousand volts, and with sufficient power to maintain a constant supply of electricity at this kind of potential. Leakage immediately begins, and the charge fizzes off from the wires with a sound which is sometimes audible, and with a glow which is visible in the dark. Anyone walking about below the wires can sometimes feel the effect on the hair of the head, as of a cobweb on the face. They are then feeling the stimulating action of the electrification.

The electrification is maintained for some hours each day, but is shut off at night: it is probably only necessary to supply it during the early morning hours in summer time, and in spring time or in cold cloudy weather for the whole day, or during the time of the

* Appended to the article sent us by Sir Oliver Lodge were some interesting notes and details supplied to Sir Oliver by Mr. Newman and Mr. Bomford, who have carried out the experiments with the assistance of Mr. Lionel Lodge. To facilitate reading and subsequent reference, and to avoid repetitions, we have recast the article to some extent, by bringing these additional notes into the body of the article.—ED. *E. E.*

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plant's greatest activity. But at what stages of the growth of a plant the stimulus is most effective has still to be made out. However, in the case of wheat, both the ear and the straw is valuable, and the electrification is accordingly applied for a time each day during the whole period of growth until stooling begins.

The power required to generate the electricity is very small, for although the potential is high the

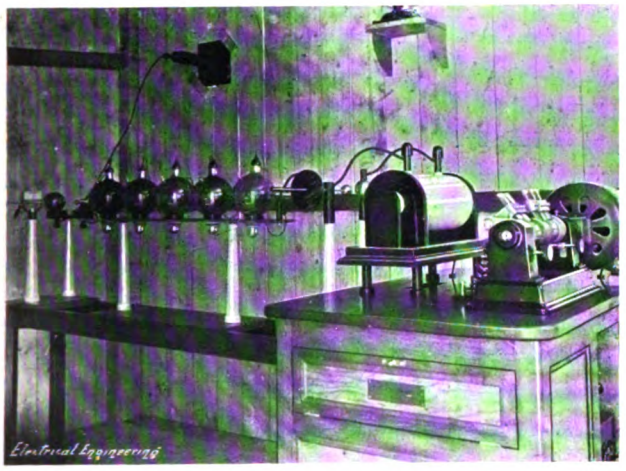

FIG. 1.—INSIDE THE TRANSFORMER SHED, SHOWING SIR OLIVER LODGE'S INDUCTIVE BREAK, SPECIAL COIL AND HIGH TENSION VALVES; FOR SUPPLYING CONTINUOUS CURRENT AT 100,000 VOLTS.

quantity is insignificant, and the energy is accordingly comparatively trivial. It is known that even when natural atmospheric electricity has accumulated intensely, and has become a thunderstorm, the quantity even then is quite small, though the potential is so enormous that the flashes are of astonishing violence and power while they last. The electricity can be generated in more than one way. It can be generated by the revolving glass plates of a static influence machine, usually known in this country as a Wimshurst machine; or it can be generated by transforming the current from a dynamo up to high tension, and rectifying to one direction. The first is in many respects the simplest, and was used in the early and small-scale experiments, but it can hardly be regarded as an engineering method adapted to continuous or rough use. The latter is the one which was adopted for the present trials.

The power is generated by a two-horse oil engine driving a small direct-current dynamo (3 amperes at 220 volts) in an outhouse of the farm. Thence the current is taken by ordinary overhead wires to a suitable weather-tight hut in the field, which contains a large induction coil and the rectifying apparatus. The only moving part here is the make and break contact in the primary circuit, and if the original dynamo had been an alternator, even this might be dispensed with. The high tension current from the secondary coil is rectified by means of vacuum valves in accordance with a patented device of my own, and then the negative pole is connected direct to earth, and the positive electricity is led by a specially insulated conductor out of the shed to the nearest post of the overhead insulated wires, which are thereby maintained at continuous high-positive potential.

In 1906, owing to the late delivery of some of the apparatus, the work had to be carried on with a somewhat improvised generating station at the commencement on March 16th; by the end of May, however, the installation was completed, and worked fairly continuously during the rest of the season, the current being supplied intermittently until July 10th, by which date the wheat had been in ear about a fortnight. From March 16th to July 10th, 1906, inclusive, the plant ran 621¾ hours on 90 days, and the average pressure corresponded to a ¾ in spark. In 1907, the plant was run 115 days, from March 28th to July 27th, 1,014 hours, and the average pressure corresponded to a ½ in. spark.

EXPERIMENTS IN 1906.

The acreage under treatment was spread over two different fields. One was a wheat field 18½ acres in extent. Eleven acres of this were under treatment, 2½ acres sown with Canadian wheat and 9 acres with English wheat. As a "control plot," seven acres of the field were sown with the same wheat, Canadian 5½ acres and English 1½ acres. The Canadian wheat was "Red Fife," and the English "White Queen." In the second field, 6½ acres of barley was under treatment, and a half-acre lot was planted with potatoes, mangolds, &c.

The results on the barley field, including the small plot, had to be neglected owing to the great local variations produced by the very irregular manuring the field had previously undergone; the wheat field, however, as far as one could judge, had been very uniformly treated previously.

In the wheat, difference was noticeable at an early stage, the young blades on the electrified part being, in the opinion of many observers, of a darker green. The crop was judged as considerably heavier by several practical observers, and the straw was, on an average, from 4 in. to 8 in. higher. Both experimental and control plots came into ear at about the same time, but the Canadian wheat under treatment was ready

CONTROL. ELECTRIFIED.

FIG. 2.—COMPARISON OF ELECTRIFIED WHEAT WITH WHEAT GROWN IN THE CONTROL FIELD UNDER THE SAME CONDITIONS; AN AVERAGE PLANT BEING TAKEN IN EACH CASE. NOTE THE BROADER LEAVES AND GREATER NUMBER OF SHOOTS OF THE ELECTRIFIED WHEAT.

for cutting some three or four days before the control area.

The crops were gathered separately from the electrified and unelectrified plots, and the resultant yields were as under:—

Bushels of Wheat per Acre.

(Estimated corresponding increase in straw not measured.)

	Electrified.	Non-electrified.	Increase.
Canadian (Red Fife) ...	35½	25½	39 per cent.
English (White Queen)...	40	31	29 ,,

Moreover, the electrified wheat sold at prices some 7½ per cent. higher, several millers in baking tests finding that it produced a better baking flour. No

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theoretical conclusions can be drawn from this fact, owing to the uncertainty existing as to what factors determine the strength of wheat, but it is interesting to note that greater strength is usually accompanied by increase in percentage of total nitrogen. [Later researches indicate that it is a function of the sugar present.]

Mr. J. Kirkland, of the National School of Bakery, Borough Polytechnic, found the evidence from baking tests supported by the average of dry glutens from all his tests thus:—

In the electrified	11·15 per cent.
In the unelectrified	10·35 ,,

The somewhat poor yield of wheat obtained from the unelectrified portion of the field is probably explained by a deficiency in lime, which has now been rectified. Further, the wheat was spring sown, and Red Fife, under this condition, does not usually yield good crops. The experiments are being repeated upon wheat during the present season, and strawberries are also under treatment once more.

EXPERIMENTS IN 1907.

In 1907, wheat was grown again in the 1906 wheat field. Current was cut off from most of the barley field, which was down to clover and rye grass. $8\frac{1}{4}$ acres in an adjoining field were planted with strawberries (Stirling Castle) in March, approximately $2\frac{3}{4}$ acres having a wire network erected over them. Mangolds were planted between the strawberry rows.

The wheat field was during the early spring given a dressing of lime, 10 cwt. to acre, 4 cwt. to acre bone meal drilled in, the unelectrified part given $1\frac{1}{2}$ cwt. sulphate of ammonia, and the electrified part $\frac{3}{4}$ cwt. Barley had been grown on the strawberry field in 1906, and this was given 10 tons to acre of farmyard manure, which was ploughed in.

Result of Wheat Crops, 1907.

(*Variety, Red Fife, Spring Sown.*)

$7\frac{1}{2}$ acres un-electrified gave 239 bus, 38 lbs. Head Wheat, 15 bus., 1 lb Tail.
11 ,, electrified ,, 455 bus., 50 lbs. ,, ,, 17 bus., 27 lbs. ,,

Or, summarising as before:—

Bushels per Acre (Head Wheat).

Electrified.	Un-electrified.	Increase.
41·4	32	29 per cent.

Electrified wheat brighter and a better sample. Increase due to better stooling and also better filling out of ears.

Strawberries.—This being the first year, the crop was necessarily very small, and was picked chiefly to see if any increase had been obtained. The result showed a 35 per cent. increase. Earlier ripening was also observed.

Mangolds.—It was found impossible to weigh either the whole or a part of this crop. Estimated increase (from number of cartloads removed), 25 per cent. Analysis showed an increase in the sugar where electrified, but the results varied considerably.

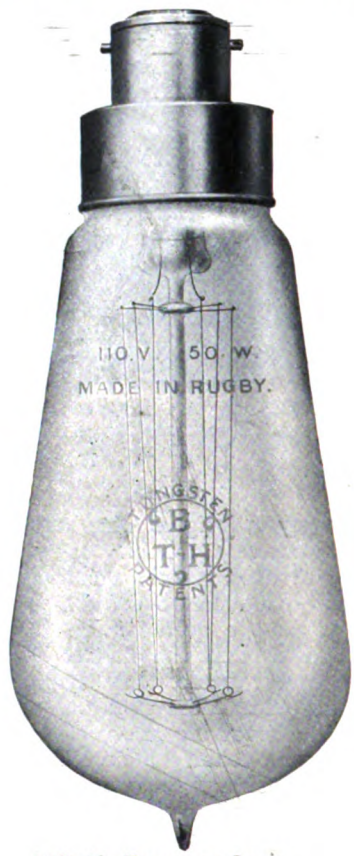
Raspberries.—Small plots of raspberry canes showed a marked improvement in growth. (A curious point about the raspberries was that the foliage and fruit on the old canes showed no difference, but that the new growth, particularly after the old wood was cut back, showed an enormous difference in favour of the electrified. Manurial treatment exactly similar.

Tomatoes.—Small plots of tomatoes also showed large increase in the crop.

Details of some earlier experiments made by Mr. Newman, and also a review of the history of the subject, were given in a Paper read by Mr. J. H. Priestley, B.Sc., before the Bristol Naturalists' Society (*Proceedings* of the Society, Fourth Series, Vol. I., Part III., 1907; or ELECTRICAL ENGINEERING, Vol. III., p. 477).

THE B.T.-H. TUNGSTEN LAMP

WE referred briefly in our description of the collective exhibit of the electric supply companies of London at the Franco-British Exhibition to the metal filament lamp which the British Thomson-Houston Co. are putting on the market. We are now able to give an illustration of one of these lamps. These lamps are the outcome of experiments which have been in progress for a considerable time, and, like the B.T.-H. Edison lamps, are made entirely at Rugby. In view of the patent complications which only too often impede the progress of new industries, it is interesting to note that the company definitely undertakes to defend all claims or actions for infringement of British patents in respect of the sale of tungsten lamps of its manufacture. The lamp illustrated is of the 110-volt 50-watt size, which has a bulb $6\frac{1}{4}$ in. long by $2\frac{3}{8}$ in. diameter, gives approximately 40 British candle-power. We are not able to give very full particulars as to the nature of the filament beyond stating that it is composed of pure tungsten, and can be used with equally satisfactory results on continuous or alternating current circuits working a temperature corresponding to an efficiency of 1·25 watts per British candle-power. In addition to the standard 100-125-volt 40-c.p. lamp, smaller lamps are made for 25 and 50 volts. The bulbs of these are $4\frac{1}{2}$ in. long and similar to ordinary carbon lamps, for which they may be substituted without alteration of shades or fittings. The 25-volt lamp is made in two sizes, $12\frac{1}{2}$ and 20 watts (approximately 10 and 16 candles); the 50-volt lamp is made in one size only, 20 watts (approximately 16 c.p.).



B.T.-H. TUNGSTEN LAMP.

Care is taken in marking those suitable for running in series with a distinguishing number. A special form of holophane shade is supplied, which gives an excellent distribution of light with these lamps. This can be supplied either clear or sand-blasted, but the best lighting effect can be obtained by using a clear holophane shade with a lamp having the tip end frosted. The sand-blasted shade, however, gives a very soft, bright effect with a clear lamp, and eliminates all the glare incident to the clear type. Where lamps hang in the direct line of vision the sand-blasted shade is desirable, but as this type somewhat modifies the candle-power distribution, it is recommended that the clear type be used whenever the lamps are out of the direct line of vision. The dimensions are $4\frac{3}{4}$ in. deep, $6\frac{3}{4}$ in. wide, and the shade is attached by a gallery fitting the ordinary shade ring.

The Telephone and Consumption.—Those who have been interested in the recent endeavour to create a feeling of alarm with regard to the danger of infection from telephone mouthpieces should read a logical and well-written review of the subject in the *Times* of last Saturday, evidently from the pen of a medical man who is in a position to speak with authority. The article concludes:—"To keep a telephone clean must, from æsthetic as well as sanitary reasons, be regarded as desirable, but to be scared by the discovery of a few hungry tubercle bacilli is neither logical nor justified."

Robertson Lamp Works Sports.—On Saturday last the Robertson Social and Athletic Club held their second annual sports at Mill Hill Park, Ealing. A very full programme, including running races, "lamp" races, cycle races, and tugs-of-war, was provided, and in the evening a concert by the Robertson Choral Section was followed by a dance. The Enfield Town Band played selections during the afternoon and in the evening for dancing. A "relay" running race for the Wilson Challenge Cup, competed for by Robertson's and the G.E.C., London, was won by the latter team. The prizes were presented by Mrs. C. Wilson. The Hon. Secretary, Mr. G. H. Freeman, is to be congratulated on the success of the afternoon.

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CONTROLLERS FOR LARGE MOTORS

THE increasing application of large motors to industrial purposes has rendered it necessary for designers to carefully consider the construction of suitable controllers. Owing to the difficulties experienced in the construction of satisfactory metallic controllers, there has been some tendency to adopt controllers of the liquid type for motors of 100 h.p. and upwards. The liquid type of controller has the advantage of being cheaper to construct than the metallic type; on the other hand, it is quite unsuitable for installing in many situations, and has disadvantages owing to the insulation difficulties and the use of liquids which are more or less evaporated and steamed according to the working conditions, with the consequent introduction of moisture in the atmosphere, which in many cases is not permissible. The usual standard method of building metallic controllers has been to employ a series of fingers, which, under spring pressure, make contact on a series of segments on the controller barrel. This type of construction has been generally satisfactory for dealing with small motors and with continuous current, which permits of the use of blow-out magnets; destructive arcing has been successfully dealt with. The great disadvantage, however, of this type of construction is the very small break obtainable, and with controllers for two- and three-phase motors the tendency has been to immerse the controller in oil in order to damp the arc, and it is now generally admitted that oil-immersed controllers are most suitable for alternating current motors, and they have therefore been standardised by most makers.

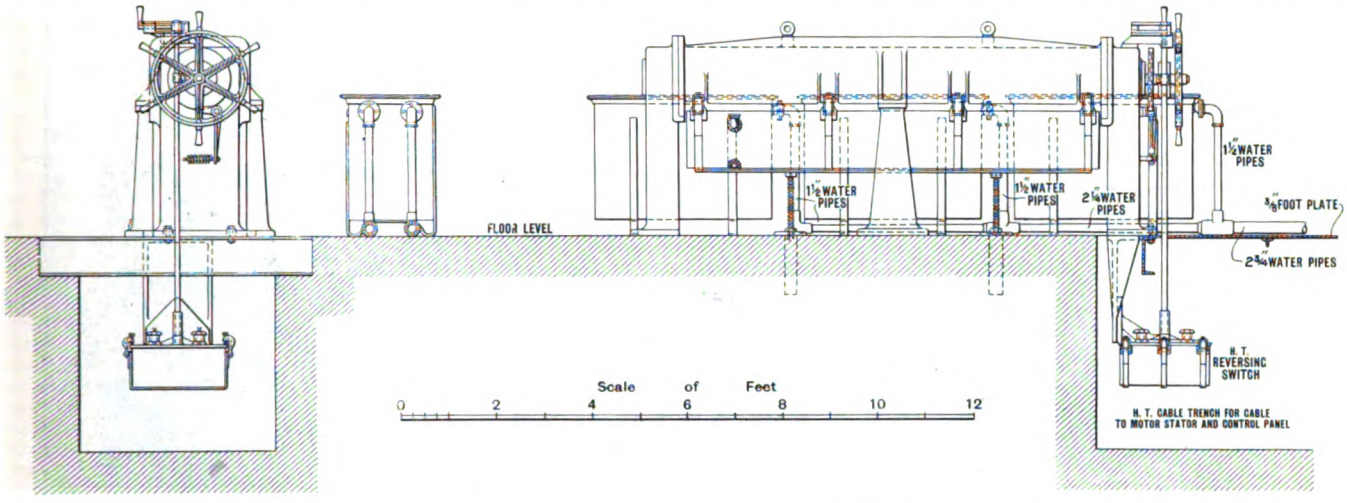

FIG. 1.—GENERAL ARRANGEMENT OF 400 H.P. 2,750-VOLT 3-PHASE OIL-IMMERSED CONTROLLER, WITH RESISTANCES AND SEPARATE REVERSING SWITCH.

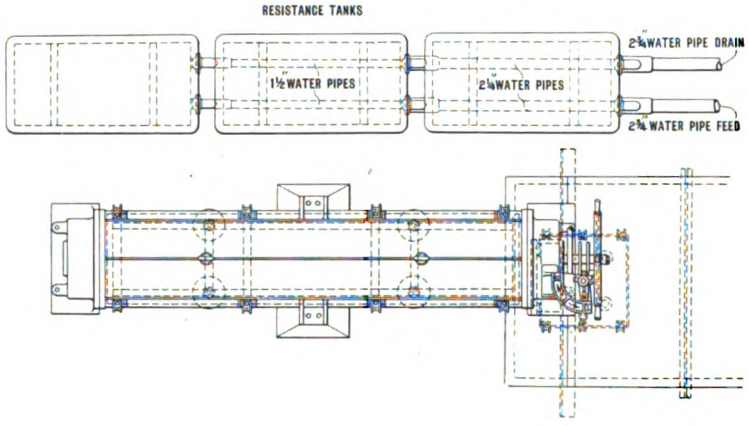

FIG. 2.—REVERSING SWITCH.

Serious difficulties, however, have been encountered with large controllers in oil built on the finger and drum principle owing to the difficulty of dealing with large currents with this type of contact, and also where many contacts are necessary the very small breaks obtainable. The supervision and maintenance costs owing to pitting and destructive arcing have therefore been considerable.

In order to overcome these difficulties, a new line of controllers have been designed to meet heavy conditions of service. A large example of the new pattern controller is illustrated in Figs. 1 and 3. This is for use with a 400 h.p. 2,750-volt three-phase reversible haulage motor, and it is arranged to provide 50 per cent. continuous speed regulation if required, and also provision is made for running dead slow for winding in the haulage rope.

The reversing is arranged for in the usual way by crossing two of the stator phases by means of a high-tension change-over switch, shown in Fig. 2, placed below in the cable trenches and operated by a lever near the controller hand-wheel. With this arrangement all the high-tension gear is situated away from the operator. The reversing switch is interlocked with the controller hand-wheel, and can only be operated when the hand-wheel is in the off position. The controller is arranged to cut resistance in or out of the rotor circuit, and is provided with 16 steps per phase, the rotor being wound for 520 volts. Each step of the controller consists of a quick make and break knife switch, giving 4½ in. break, and each switch is individually operated by

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its own cam fixed on the main spindle, the whole series of switches being oil-immersed. The controller is constructed on the loose-handle principle, and the speed of the break is independent of the operator, and therefore the controller cannot be held in an arcing position. The usual brake-drum is provided to define the various steps. With this type of apparatus the makers claim that the upkeep and maintenance is reduced to a minimum, and they have therefore adopted the same principle of construction for controllers of all sizes and types.

cooling pipes through which water is pumped being used to cool the oil. This arrangement keeps the space occupied by the resistances to a minimum, and provides a flexible arrangement, as more or less water may be used to cool the oil according to the working conditions of the load from time to time, and the heat generated is conveyed out of the haulage room. It is usually possible to obtain an ample supply of water in most mines from the existing pumps.

The resistances are built up on the unit principle, thus no

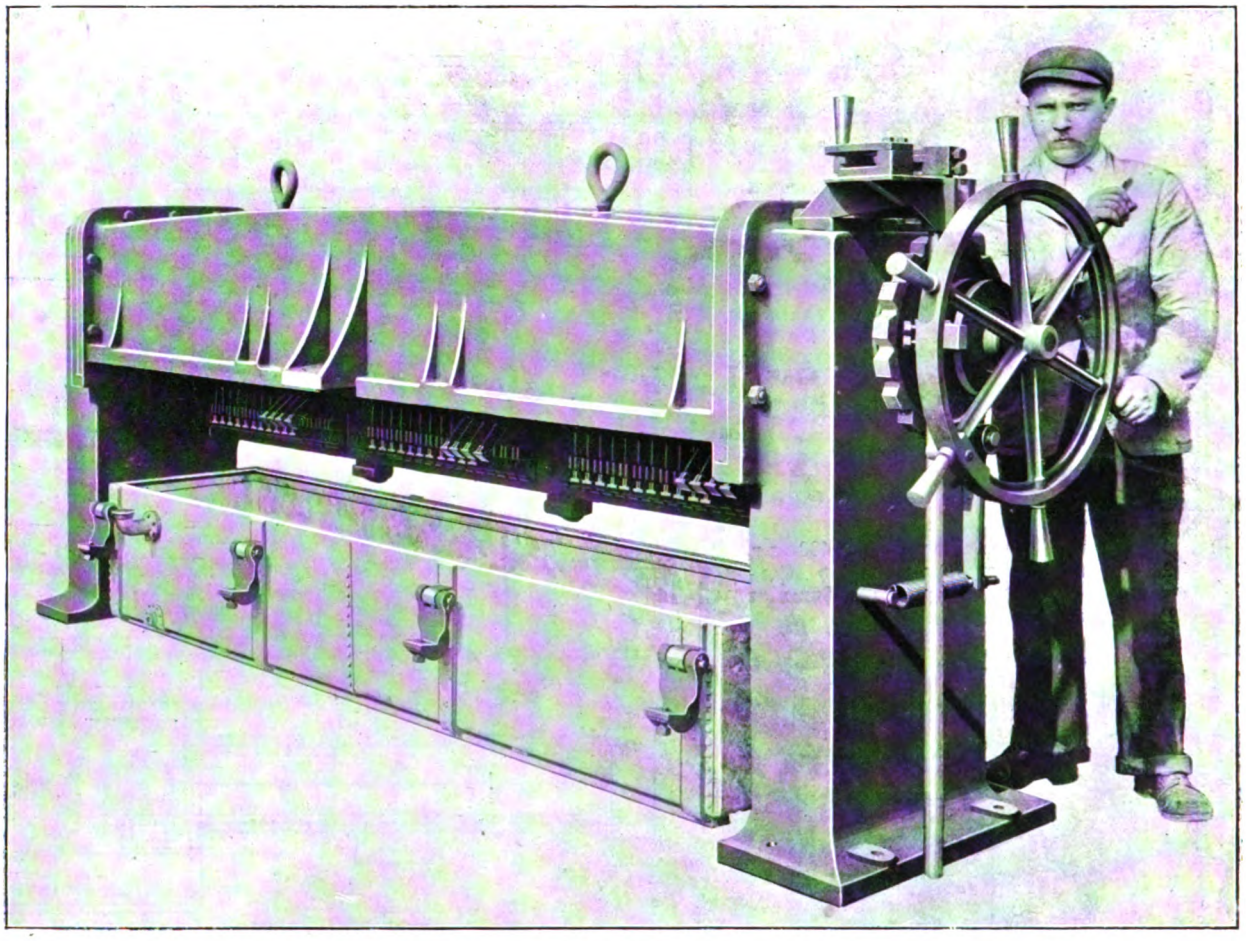

FIG. 3.—CONTROLLER FOR 400 H.P. 2,750-VOLT THREE-PHASE REVERSIBLE HAULAGE MOTOR.

The question of resistances for use with these large controllers has also received very careful attention. Where considerable energy has to be dissipated in resistances in confined spaces, such as haulage rooms, the questions of providing space and keeping the temperature of the room normal have to be considered. In order to deal with these problems and to produce resistances particularly suitable for colliery work, the resistances have been placed in enclosed tanks filled with oil, a system of copper cables whatever are used other than the cables from the controller to the terminals shown on top of the resistance frame.

These patent controllers have been put on the market by Messrs. Engineering Instruments, Ltd., and are made in two patterns. For alternating- and continuous-current motors they are made in a vertical type, with self-contained resistances, and in the horizontal pattern oil-immersed for alternating-current motors only.

Visit of Electrical Engineers to Germany.—Last October we had the pleasure of taking part in a tour organised by Mr. Leonard Andrews and his colleagues of the Key Engineering Co. to the Continent, the main object of which was to afford an opportunity to English engineers of inspecting examples of large gas engines and electrical installations, and a full account of the trip appeared in ELECTRICAL ENGINEERING, Vol. II., page 599. The success of this trip has led to the organisation of a further tour of a similar nature for the benefit of those who were unable to accompany the party last year. The itinerary has been somewhat modified, but some of the same installations are included. The party left London on Monday, travelling *viâ* Calais to Brussels, and on Tuesday took train from Brussels to Metz, whence they were conveyed on motor-cars to the German Government mines at Heinitz, where a large installation of gas engines running on coke oven gas was inspected. The journey was then continued by motor-car to Saarbrucken. Yesterday morning, after visiting the works at Saarbrucken of Messrs. Ehrhardt & Sehmer, the manufacturers of most of the engines inspected, the party again drove over to Metz and crossed the frontier to Homecourt, where there is a fine installation of gas engines at the French Government's rolling mills. To-day is devoted to a trip down the Rhine in a private launch from Bingerbruck to Coblence, and to-night will be spent at Dusseldorf. To-morrow's programme includes a visit to Messrs. Thyssen's work at Muelheim in the morning and the large gas-engine installation at the Bruckhausen Iron and Steel Works in the afternoon. The return to London is to be made on Saturday. The party includes the following gentlemen:—Mr. H. Talbot (City Electrical Engineer, Nottingham), Alderman Sir John Turney (Chairman of the Electricity Committee, Nottingham), Mr. Councillor Clarke (Nottingham), Mr. W. W. Lackie (City Electrical Engineer, Glasgow), Mr. J. Dalrymple (Manager, Glasgow Tramways), Mr. J. Ferguson (Engineer, Glasgow Tramways), Mr. R. H. Chattock (City Electrical Engineer, Birmingham), Mr. Councillor Ellaway and Mr. Councillor Freeman (Birmingham), Mr. S. J. Watson (Borough Electrical Engineer, Bury), Mr. A. C. Cramb (Borough Electrical Engineer, Croydon), Mr. Percy Allen (Runcorn), Mr. Lymn (Power Gas Corporation, London), Mr. Crampton, Mr. H. B. Mathews, Mr. E. W. Cowan (Messrs. Cowans, Ltd.), and Mr. R. B. Slacke & Mr. Leonard Andrews, of the Key Engineering Co.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published July 9th, 1908

A full list of these was published in our last issue. The following are abstracts of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

8,445, **Electric Induction Furnace.** GRÖNDAL KJELLIN CO. AND J. HÄRDÉN. This invention relates to induction furnaces consisting of an annular fusion chamber surrounding an iron core, the primary winding being wound on the iron core, and the material in the fusing chamber serving as the secondary winding. The lining of these fusion chambers needs to be frequently repaired, and, to avoid the delay due to the slow hardening of a new lining, the present invention provides means whereby a damaged lining, which is formed in a metallic casing, can be quickly removed and a new one substituted in a very short time. An illustration of this type of furnace was given on page 18 of ELECTRICAL ENGINEERING for July 2nd, 1908. Two claims, three figures

8,947, **Manufacture of Metal Filaments.** ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT. Thin filaments are made from finely powdered tungsten or molybdenum, or from oxides of these metals, with the addition of a binding material. To free the filaments from the carbon contained in the binding material, they are moderately heated in a limited quantity of air. Afterwards they are heated to a temperature higher than 1,500° C. in a reducing, carbon-free gas, for instance hydrogen, in order to reduce the oxides and sinter the filaments together. If this is done in an electric vacuum furnace, the latter must be lined with thorium or magnesium oxide to prevent fusion of the filaments to the sides of the furnace. Three claims.

21,584, **Three-wire Generator.** J. BURKE. A direct-current generator for supplying a three-wire distribution system. One or more auxiliary windings are wound in the same slots as the main armature winding, but with half the number of turns. If one auxiliary winding is used, one end is connected to a point on the main winding, and the other end to a slip-ring on which bears a brush in connection with the neutral conductor of the three-wire system. If more than one auxiliary winding is used, they are connected together at the slip-ring, the other ends being connected to equidistant points on the armature winding. The neutral conductor is thus maintained at a pressure half-way between the two outer conductors, as an E.M.F. is generated in each auxiliary winding, which, if added to the instantaneous value of the potential of the point of the winding to which it is connected, gives a constant potential at the slip-ring. The auxiliary windings also afford a path for the out of balance current. Where the system is much out of balance, better results are obtained with more than one auxiliary winding. The auxiliary winding must be so distributed that its parts are subjected to magnetic variations similar to those to which the main winding is subjected. Five claims, eleven figures.

22,302, **Method of Neutralising Induction.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). To protect telegraph or telephone conductors which run adjacent to rails used as return conductor on alternating-current railways from induction, a neutralising conductor connected in shunt to the rails is placed near the conductor to be protected. This will neutralise the electromagnetic induction, and, since the rails are earthed, will also partly neutralise the electrostatic induction. Resistances may be required in the shunt circuit to reduce the current to the proper amount. For the same purpose a transformer may be used, the primary winding being in series with the rails and the secondary with the neutralising conductors. Four claims, four figures.

1908 Patents

1,159, **Voltage Regulator.** W. H. THOMPSON. A synchronous machine and a series commutator machine are connected in parallel with the mains, and the shafts are connected by a differential gear mechanism. The synchronous motor will rotate at a constant speed irrespective of pressure variations, but the speed of the series motor will vary with the mains pressure. The rotation of the annulus of the differential gear, when the speeds are not equal, is caused, by a suitable mechanism, to vary the number of turns in the primary of a transformer, to the secondary of which the load is connected. The synchronous motor can be excited with direct current supplied from its own armature if this is supplied with a commutator. One claim, two figures.

6,409, **Suspension of Metal Filaments.** C. PAULI. It has been proposed to keep metal filaments in tension, and at the same time allow contraction, by inserting a spring in a glass tube between the yokes or carriers of the filaments. It has been found that the tensile strength of the filaments is so low when incandescent, that the spring is strong enough to break the filaments. According to this invention, the expansion of the spring is limited by suitable means. One claim, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Summaries of the more important of these patents will appear in our next issue.

1907 Patents

6,528, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Motor control systems.
9,009, RITCHIE. Telautographs.
11,926, BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitäts Ges.*). Controllers for cranes and lifts.
14,183, ENDERLEIN, LANDWEHR, & SCHULZ. Electrical signalling system for railways.
14,259, BLUNDELL. Ignition devices.
14,262, BROWN. Electric telegraph apparatus.
14,263, STONEHAM. Thermally-actuated contact makers.
15,058, KING. Separating iron from flour and grain.
15,079, ADLARD. Electrical heating apparatus.
15,100, STRAY. Electric primary clocks.
15,555, PECK. Equalising-devices for alternating current circuits.
15,966, VANDERVELL. Electric lamps for motor cars.
16,911, ELECTRIC IGNITION CO. & HALL. Electric ignition apparatus.
16,912, ELECTRIC IGNITION CO. & HALL. Magneto-electric ignition apparatus.
16,959, LAKE (*Brown Automatic Indicator Co.*). Reply or tell-tale telegraph.
17,457, HICKLEY. Electrolytic current rectifiers.
18,112, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Vapour condensers.
18,790, LAIRD. Electric time switches.
18,881, BRITISH THOMSON-HOUSTON CO. & DAWSON. Dynamo-electric machines.
21,255, COLLER. Electrical fuses or cut-outs.
21,403, DE CASTILHO. Electric and percussion primers.
21,551, COOPER. Control systems for electrically propelled vehicles.
22,123, TURNER. Brakes for tramcars.
22,648, SCHAFFLER *recte* GLOSSL, & WEISS. Apparatus for electrically firing mines.
23,708, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Control of alternating current motors.
24,299, TIMAR & VON DRECER. High-tension electric lamp.
24,363, PRINCE (*Dr. Paul Meyer Akt.-Ges.*). Switching devices for advertising purposes.
26,810, RUTHERBURG. Concentration of tungsten ores.
27,750, ROSING. Electrical transmission of optical images.
27,790, HELBIG. Electrical process for oxidising nitrogen.

1908 Patents

1,131, CAMPBELL & WILLIAMS. Magnetic stands for tools.
1,532, SIEMENS & HALSKE AKT.-GES. Electric signalling.
1,547, LANGE. Radio-telegraphy.
3,986, ALLGEMEINE ELECTRICITÄTS-GES. Electrically-driven rolling mills.
4,602, WEHRSEN. Discs for influence machines.
4,757, GRAHAM. Electric bells.
6,587, EGNER & HOLMSTROM. Microphones.
7,374, WOLHAUPTER. Insulated railway rail joints.
8,300, CREED & COULSON. Telegraphy.
10,394, SIEMENS BROS. & CO. & FERREIRA. Mechanism for electrically-operating railway signals.

Complete Specifications open to Public Inspection before Acceptance.

1908 Patents

9,449, F. KRUPP AKT.-GES. GERMANIAWERFT. Electrically operated heating devices.
13,101, WILLIAMS. Party-line telephone selectors.
13,133, DEGOUMOIS. Brakes for electric cars.
13,184, ZANDER. Electric melting furnaces and pots.

Expiring Patent

The following patent expires during the current week after a life of fourteen years :—

14,001 of 1894. **Single Line Railway Control.** E. TYER. Apparatus for electrically controlling the issue of a staff or similar pass at stations on a single-line railway by electrically locking or opening a box containing the staff at a distant station.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1906	1907	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	7%	10½—11	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅞—10⅜	
Do. 6% Cum. Second Pref.	10	6	6%	10⅜—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	100—103 xd	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	5½%	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co., Ltd.	5	10	10%	7—8	
Do. 7% Cum. Pref.	5	7	7%	6¾—7¾	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross. W. E. & City E. S. Co.	5	5	5%	3¾—4¼	
Do. 4½% Cum. Pref.	5	4½	2¼%	4—4⅛	−⅛
Do. 4% Deb. Red	Stock	4	4%	94—97	−1
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3¾—4¼ xd	
Chelsea Electric Supply Co., Ltd.	5	4¼	4¼%	3—3⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125 xd	
Do. 4½ 2nd Deb. Red	Stock	4½	4½%	100—103 xd	
Cty of Durham E. P. Dis. Co.	5	4	2%	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ltd.	10	5	5%	7⅜—8½	
Do. 6% Cum. Pref.	10	6	6%	10⅜—10⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108 xd	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	98—101	
Edmunson's Electricity Corp., Ltd.	5	4	1/6*	½—⅝	
Do. 6% Cum. Pref.	5	3½	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	63—73	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	+1
Hove Electric Lighting Co., Ltd.	5	9	8½%	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	10%	8—9	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	4	2½%	¾—1⅜	
Do. 6% Pref.	5	6	6%	4½—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	8	6¼%	4⅝—5⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅝—4¾ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109 xd	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89 xd	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	94—97 xd	
Newcastle & Dist. E. L. Co., £9 paid	10	5	4%	7¾ 8¼	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97 xd	
Newcastle-upon-Tyne Elec. Supply.	5	8	8%	5½—6	
Do. £2 Pm.	5	8	8%	5½—6	
Do. 5% Pref. (fully paid)	5	5	5%	5¼—5½	
Do. 10/- Pm.	5	5	5%	5¼—5½	
Notting Hill Elec. Ltg. Co., Ltd.	10	7½	7%	12—13 xd	
Oxford Electric Co., Ltd.	5	7	7%	5¾—6⅜	
Do. 4% Deb. Red	Stock	4	4%	95—99	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	7⅜—8¼	+¼
Do. 7% Non-Cum. Pref.	5	7	7%	6¼—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	83—88 xd	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	nil	—	¼—¾	
Do. 4% Deb. Red	Stock	4	4%	70—74	
South London Elec. Sup. Corp. Ltd.	5	3	4%	2⅜—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	1/-	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7%	1—1¼	−¼
Do. 4½% 1st Deb. Red	Stock	4½	4½%	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5%	1—2	
Do. 5% Cum. Pref.	5	5	5%	1⅞—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	87—90	
Westminster Elec. Sup. Corp., Ltd.	5	12	10%	7⅜—8¾	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5⅛ xd	+⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	90—92	
Central London	Stock	4	3%	72—75	−3
Do. 4% Preferred	Stock	4	4%	88—90	−2
Do. Deferred	Stock	4	2%	54—57	−1
Do. 4% Debentures	Stock	4	4%	103—105	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	80—83 xd	
City and South London Cons.	Stock	2⅜	4¼%	37—39	−1
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	5%	113—116	
Do. 5% Perp. Pref. 1896	Stock	5	5%	112—115	
Do. 5% Perp. Pref. 1901	Stock	5	5%	110—113	
Great Northern & City Pref. "A"	10	4	11s.d.	¾—1¼	
Gt. Northern, Piccadilly & Brompton	10	4	4%	6½—7	+½
Do. 4% Perp. Deb.	Stock	4	4%	89—92 xd	+2
Mersey Cons.	Stock	nil	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	nil	—	3—6	
Metropolitan Cons.	Stock	1	1½%	38½—39½	
Do. 3½% Preference	Stock	3½	3½%	86—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	nil	—	12—13	
Do. 6% Perp. Deb.	Stock	6	6%	115—120 xd	−2
Do. 4% Deb.	Stock	4	4%	71—76 xd	
Do. Perp. Extension Pref. (5%)	Stock	nil	—	21—26	−2
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3	3½%	44—48	
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	5%	40—44	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104 xd	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	5	1/-*	¼—½	
Do. 5% Cum. Pref.	1	5	5%	⅝—⅞ xd	
Do. 4½% Deb. Red.	Stock	4½	4½%	8—89	−1
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91 94 xd	
British Electric Traction Co., Ltd.	10	—	—	1⅜—1⅝	
Do. 6% Cum. Pref.	10	6	6%*	4½—4⅝ xd	
Do. 5% Perp. Deb.	Stock	5	5%	95—98	+1
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1906	1907	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%	%		
Dublin United Trams Co.	10	6	6%*	12½—13½	
Do. 6% Pref.	10	6	6%	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	93—96	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	1½	—	¾—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61 xd	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93 xd	+2
London Street Tramways Co.	4	4/9	4/6	⅛—⅞	
London United Trs., Ld., Cm. Pf.	10	5	5%	7—8 xd	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	79—84 xd	
Metropolitan Elec. Trams, Ltd., Def.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96 xd	
National Elec. Construction Co. Ltd.	1	10	2/-	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	nil	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	1/-*	¾—⅞	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92 xd	
Potteries Electric Traction Co. Ltd.	1	4	4%	¼—½	
Do. 5% Cum. Pref.	1	5	5%	½—¾	
Do. 4½% Deb. Red	Stock	4½	4½%*	93—96	
Provincial Tramways Co. Ltd.	10	3¾	4%	4⅝—5½ xd	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼ xd	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	—	6%	¾—1	
Do. 4% Deb. Red.	Stock	—	4%	75—79 xd	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	75—80 xd	
Yorkshire (West Riding) Elec. Trams	5	nil	—	⅞—1⅜	
Do. 6% Cum. Pref.	5	nil	—	3⅛—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—86 xd	+1
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3⅝	15/-*	58—61	
Do. 6% Pref. Ord.	Stock	6	30/-*	102—103	−¾
Do. Def. Ord.	Stock	1¾	1¾	15½—16½	+½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	83—86 xd	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3¼	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103 xd	
Direct United States Cable Co. Ltd.	20	4¼	4/-*	13¾—14	−¼
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	98—100 xd	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	100—102	−1
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	7/6	12⅞—13½	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100½—102½	
Eastern Telegraph Co.	Stock	5¾	7%	133—136	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	101—103	+½
G. N. Tel. Co. (Copenhagen)	10	20	20%	27—29 xd	
Indo-European Telegraph Co. Ltd.	25	13	65/-	55—58	+1
Marconi Wireless Telegraph Co. Ltd.	1	nil	—	⅜—⅞	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	+½
Do. Deferred	Stock	5½	6%	115½—117½	+2
Do. 6% Cum. 1st Pref.	10	6	6%	10½—12½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—12½	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅝	
Do. 3½% Deb. Red	Stock	3½	3½%	98—100 xd	
Do. 4% Deb. Red.	Stock	4	4%	100—102½ xd	
Western Telegraph Co., Ltd.	10	7	7%	13½—14 xd	+⅛
Do. 4% Deb.	Stock	4	4%	99½—101½ xd	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	nil	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	6%	2⅛—2⅜	
Babcock & Wilcox, Ord.	1	20	1/7½*	3⅛—4⅛	
Do. 6% Pref.	1	6	7½%	1⅞—1⅞	
British Insulated & Helsby Cables, Ltd.	5	10	10% & bonus	6—6½	
Do. 6% Cum. Pref.	5	6	6%	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	100—103 xd	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	—	4½%	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	nil	—	⅛—⅛	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48 xd	
Brush Electrical Engineering Co.	2	nil	—	0—½	
Do. 6% Pref.	2	nil	—	⅛—⅛	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	53—58 xd	
Callender's Cable and Const. Co., Ld.	5	15	15/-	9¼—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5½ xd	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—107 xd	
Consolidated Electrical Co., Ltd.	1	3	3½%	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅝—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	90—93 xd	−2
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜	
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	
Edison & Swan United "A." £3 paid	5	4½	2/6	½—¾	
Do. do. (fully paid)	5	4½	4/2	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	76—79 xd	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	½—½	
Do. 7% Cum. Pref.	2	7	—	1½—1¾	
Do. 4% 1st Mort. Deb.	Stock	4	4%	62—65	−1
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7½—8 xd	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	87—90	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	15%	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—107	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	15	17½%	31—33	
Do. 4% Deb. Bds. Red	100	4	4%	100—102 xd	
Willans & Robinson, Ord. Shres	1	nil	5%	¾—1¼	
Do. 6% Cum. Pref.	5	nil	6%	3½—3¾	
Do. 1st Mtg. Deb. 4% Red.	100	4%	4%	72—76	

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LOCAL NOTES

AUSTRALIA: *Brunswick and Coburg.*—Proposals have been made for installing an electric light and power plant in these districts. According to the *Australian Mining Standard*, the suggestion of the company from which the scheme emanates is that a power house shall be erected at Brunswick, and that a tram service shall be inaugurated between the two places. A 25 years' lease is required.

BELFAST: *Tramway Employees' Grievances.*—The district secretary of the Tramcar Cleaners' Union in Belfast has complained to the Corporation with regard to the treatment of the men for having taken part in meetings calling attention to the conditions under which they are working. The men have passed a resolution leaving the matter in the hands of the union officials, and, in the event of a climax being reached, it is stated that assistance will be rendered by the Belfast Trades Council and other labour organisations in the country.

BOURNEMOUTH: *Tramway Accounts.*—The Borough Electrical Engineer's report to the Tramways Committee for the year ended March 31st shows that 1,908,938 units were generated, an increase of 31,135 units over the previous year; 1,654,026 units were used for traction, 138,444 for street lighting, 43,919 for car-shed lighting, 30,763 for car-shed power, 39,777 for generating station lighting, and 12,009 for generating station power. The total working expenses, including interest and sinking fund, amounted to 1·262d. per unit, or 2·75d. per car mile, and the money value was £12,939. The expenses are slightly higher than last year, owing to the increased cost of coal. The Electrical Engineer recommends the installation of further generating plant and condensing plant. The Traffic Manager, in his report, stated that the system now covers 21·718 miles of route, comprising 29·44 of track, of which the Corporation owns 17·08 miles in Bournemouth, 5·26 miles in Christchurch, and are lessees of 7·10 miles in Poole. The traffic receipts amounted to £85,745, an increase of £2,404, whilst motor-omnibus receipts decreased by £44 to £278. The total receipts amounted to £86,225, an increase of £2,044 over the previous year. The number of passengers carried was 13,924,418, an increase of 498,229, whilst the car miles only showed an increase of 1,845, the total being 1,760,239. The working expenses amounted to £52,753, a decrease of £485, notwithstanding extra expense incurred by reason of the Workmen's Compensation Act. Including the expenditure upon the motor omnibuses, this figure was increased to £53,163, which is about £2,000 below the estimates for the year. The total tramway expenses were 7·19d. per car mile, a reduction of 0·07 per car mile over the figure for the previous year, whilst the working expenses, exclusive of electric power, amounted to 5·26d. per car mile against 5·28d. The cost of power was reduced from 1·98d. per car mile to 1·93d. There was a gross balance of £33,062, which is £2,479 in excess of the previous year's gross balance. The ratio of working expenses to receipts has been reduced from 63·66 to 61·66.

BRENTFORD: *Condition of Tramway Track.*—A letter from the Board of Trade was read at the last meeting of the Council, stating, with reference to complaints as to the condition of the tramway track, that Col. Yorke would be sent to inspect the line. It was arranged that the Chairman and other members of the Council, and the Surveyor, should meet Col. Yorke when the visit took place.

BRIGHTON: *Electricity Accounts.*—At the last meeting of the Corporation, the accounts of the electricity department, which were abstracted in our issue for June 25th, were passed.

BROMLEY: *Electricity Staff Outing.*—The annual outing of employees of the Bromley Electric Light & Power Co. took place last week at Margate.

BURNLEY: *New Plant.*—In connection with the putting down of a 750-kilowatt generator, a deputation is to visit Durham to inspect a direct-current turbo-generator. The Electricity Committee is in doubt whether to instal a turbine or reciprocating engine.

CARDIFF: *Tramway Administration.*—A discussion took place by the Electrical and Tramways Committee on Thursday with reference to the 10 per cent. which is charged to the tramway account upon all work in connection with tramway track allocated to the Public Works Committee. This amount has hitherto been regarded as a contribution towards the establishment expenses of the Public Works Committee, and the Finance and Public Works Committees have each been asked to appoint five members to discuss the matter with the Tramways Committee. Last year the amount paid by the Tramways Committee to the Public Works Committee under this head amounted to £700, and it is stated that in the current year it will be about £1,400.

CHATHAM: *Runaway Tramcar.*—As a car belonging to the Chatham & District Light Railways Co. was descending a sharp hill in Middle Street, Old Brompton, on Thursday, the brakes refused to act, and the car gradually increased its speed until at the bottom of the hill it left the rails and dashed into the wall surrounding the Chatham Dockyard. There were only three passengers on the car, but there were no serious injuries.

COATBRIDGE: *Electricity in Mining.*—A few years ago, owing to the lessees of the Summerlee Colliery being unable to come to terms with the owners, this property was compelled to be shut down. The Summerlee Iron Co., however, has now negotiated a long lease of the collieries, and they have been re-opened. The new arrangement for the working of the pit includes electrically-driven tipplers, screeners, washers, and centrifugal pumps. The only use which will be made of steam in connection with the pit will be for the winding engines.

COVENTRY: *Electricity Accounts.*—The accounts for the electricity undertaking for the past year show a profit, after meeting capital charges, of £5,647, against £5,114 for the previous twelve months. The number of consumers has increased from 951 to 1,020, and the connections from 140,177 to 171,133 8-c.p. lamps equivalent. The number of units sold has increased from 3,950,785 to 4,822,114, and the revenue from £27,145 to £31,852. Working expenses have increased from £11,028 to £15,388, this being largely attributable to the increased price of coal. The capital expenditure during the year amounted to £38,947, bringing the total to date of £218,907.

CRETE: ***Telephones.*—A British Consular report states that in January last the Crete Government called for tenders for the establishment of a telephone system in the island. The only tender received, however, was from a Cretan firm, but it could not be considered as it was unaccompanied with the necesary financial guarantee.

DARTFORD: *Electric Supply by Power Company.*—The Rural District Council has received notice from the South Metropolitan Electric Light and Power Co., Ltd., of their intended application to the Board of Trade for a Provisional Order authorising the supply of electricity in the Council's district.

DOVER: *Admiralty Supply.*—The Admiralty Electrical Engineer has notified the Corporation that it will probably be necessary to modify the clause of the contract with regard to electric supply relating to the maximum demand, in order that this may be increased to 500 kw. for power and 150 kw. for lighting. The Electrical Engineer, reporting upon this, states that the larger supply will necessitate an expenditure of £1,100. The matter is still under consideration, and further report will be presented.

DUNDEE: *Trolley Omnibuses.*—The proposal to adopt trolley omnibuses for the outskirts of Dundee has been further discussed by the Tramways Committee in conjunction with other members of the Town Council. Mr. Peter Fisher, the Tramways Manager, has planned a car suitable for local requirements, which will accommodate 24 passengers, and cost from £600 to £700 each, three such cars being contemplated. It has been unanimously agreed by the Tramways Committee to adopt the system, and details are to be placed before the Board of Trade for their sanction.

EALING: *Electricity Supply by Private Owner.*—At the meeting of the Town Council on Thursday, the Town Clerk reported the result of the proceedings against the Ealing Hippodrome for having supplied Messrs. Lipton's, Ltd., with electricity. In view of future action the matter was discussed in private. At the police court hearing at Brentford it was stated that an arrangement was entered into by the Town Council with Mr. Walter Gibbons for the supply of current to the Hippodrome on special terms. There was a restaurant attached to the Hippodrome, leased by Messrs. Lipton, and, Mr. Gibbons supplied them with current, the effect being to put the Council in the position of supplying electricity in bulk, which it had no power to do. For the defence it was urged that the agreement entered into with the Town Council by Mr. Gibbons covered the whole of the buildings at the Hippodrome. Mr. Gibbons, giving evidence, said when he first took over the Hippodrome he approached the Council with a request to be supplied at cheaper rates. He was refused, and thereupon obtained expensive machinery to generate his own current. Before it was installed the Council came to him with an offer to supply at a lower rate, and he got rid of the machinery at a loss of £250. The Bench held that a technical offence had been committed, but decided to dismiss the information under the powers of Section 1 of the Probation of Offenders Act, 1907, on payment by the defendants of two guineas costs.

EDINBURGH: *Electric Lighting Tariff.*—The Electricity Committee recommend that consumers using electricity during restricted hours should be allowed a reduction of $\frac{1}{8}$d. per unit, and that consumers who use their motors for three or four hours per day throughout the year should also be granted a similar reduction. It is further recommended that the price to lighting consumers for the current year shall be reduced by $\frac{1}{8}$d.

Non-statutory Power Supply.—At a Convention of royal burghs in Edinburgh on Friday, Bailie Murray reported that he had brought the question of the supply of electric power by non-statutory companies in Scotland before the Annual Convention of the Incorporated Municipal Electrical Association, and it had been left to the Council to deal with the matter. It was decided to appoint the Town Clerks of Partick and Dundee to represent the Convention at any meetings or representations to Parliament, and a circular is to be sent to all burghs owning electrical undertakings drawing their attention to

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the matter, and asking them to support the attitude of the Convention.

EPSOM: *Position of Electricity Undertaking.*—The Lighting Committee have held a special meeting to consider the financial position of the electricity undertaking. The accountant submitted an approximate statement as at September 30th next, showing an estimated excess of liabilities over assets of over £400. The Committee asked that the Council should transfer £475 from the district fund to the electric lighting account forthwith, this sum to be subject to adjustment at the close of the Council's financial year. After long discussion at the last meeting of the Council a motion for the adoption of the recommendation for the supply of £475 from the district fund was withdrawn, the recommendation not being adopted.

ERITH: *Tramway Intercommunication.*—Negotiations are still proceeding between the Urban District Council and the Bexley District Council with a view to effecting tramway intercommunication. The Bexley Council offered to lease to the Erith Council, on certain terms, the Bexley tramway from a point in Market Place, Bexley Heath, to Northumberland Heath. The Erith Council, not being prepared to accept this offer, have submitted alternative terms to the Bexley authority. At the last meeting of the Erith Council it was reported that the Highways Committee of the London County Council in connection with the suggested junction between the L.C.C. tramways at Abbey Wood and the District Council's trams, and the through running of the latter to Beresford Square, Woolwich, state that they were not at present prepared to make any arrangement. They suggested that the deputation should further interview them in three months' time, and that in the meantime the tramway officers of the respective Councils should keep in touch.

EXETER: *Officials' Salaries.*—At the last meeting of the Corporation an endeavour was made to have a recent recommendation of the Electric Lighting Committee, to increase the salaries of certain employees at the eletric lighting works, rescinded. The Chairman of the Electric Lighting Committee, however, defended the recommendation, and argued that, having good men, it was best to retain their services. The motion that the recommendation should be rescinded was lost by a large majority.

FARNHAM: *Overhead Wires.*—The Council is still discussing the question of consenting to the erection of overhead wires by the Farnham Electric Lighting Co. The Council are insisting upon a plan showing where it is proposed to erect poles, but the company state that until they have canvassed the district, and know where their consumers will be, they will be unable to prepare this.

FELTHAM: *Electrically-Driven Sewage Pumps.*—At the last meeting of the Urban District Council the Drainage Committee submitted a scheme for drainage by electric pumps, gravitating systems being unsuited to the level nature of the locality. The Committee recommended that Mr. Midgley Taylor, of Caxton House, Westminster, be employed to advise as to the best scheme for sewage disposal, including, if practicable, arrangements for street lighting by electricity. Notice has been received from the United Electric Supply Co. of their intention to apply for a Provisional Order to supply current in the Feltham and surrounding districts.

GLASGOW: *Tramways Accounts.*—At the last meeting of the Corporation the tramways accounts, which we abstracted in our issue for June 25th, were discussed. Mr. J. Macfarlane, Convener of the Tramways Committee, moved the adoption of the report, and gave a general *resumé* of the position of the undertaking. After a long discussion it was agreed to take back the report for further consideration as to how the Common Good item of the surplus should be disposed of.

HAMPTON WICK: *Electric Lighting.*—The Council has received notification from the United Electric Light & Traction Co. of their intention to apply for a Provisional Order to supply electricity within the Council's area. The Council has resolved to dissent formally.

HEYWOOD: *Joint Tramway Working.*—The Bury and Rochdale Corporations have hitherto worked the tramway system in Heywood as a joint concern, upon agreed terms. The Heywood Council is now pressing for a revision of these. A conference of representatives of the three authorities has been held, and there is every prospect of an agreement being come to.

HULL: *Electricity Accounts.*—The annual report and balance-sheet of the electric supply undertaking was presented to the Council last week. After charging all expenditure, and allowing £1,500 for switchboard renewals, the gross profit for the year amounted to £2,083 more than that of the previous year, notwithstanding that reductions in price took effect for the full year as against a half-year only for the corresponding period ended March, 1907. The gross revenue increased from £45,433 to £49,555, and, although the price of coal had been approximately 40 per cent. higher than during the previous year, the expenditure had risen but very slightly. In fact, the coal cost had dropped from 0·41d. to 0·39d. per unit. The sum of £1,069 has been added to the reserve fund.

ITALY: *Genoa Tramways.*—The following are the statistics of the electric tramways in Genoa and district for 1907:—Total length of lines, 89 miles; length of lines worked (131·355 kilomts), 82 miles. The car stock consists of motors, 230; trailers, 144; funicular, 4; omnibuses, 33; making a total of 411 vehicles. The distance run last year was 7,139,739 car miles, and the number of passengers carried was 52,027,355. The receipts amounted to £283,672, and the expenditure to £184,609, leaving a gross balance of £99,063.

Genoa-Busalla Electric Railway.—On October 10th, 1907, was announced the formation of a private company to construct an electric railway from Genoa to Busalla *via* San Pantaleo, Torazza, Busaletta, Crocetta d'Orero and Casella. The works for applying electric traction to this line are in course of construction by the Italian Westinghouse Co., and the central power station is being erected at the Chiappella Quarry, at the west end of the port of Genoa.

Savona: Electric Traction.—The State railway authorities have decided to convert to electric traction the branch railway line Savona-S. Giuaeppe. This conversion is rendered necessary by the mountainous state of this line. There is a probability of a company being formed with the object of constructing and running an electric tramway line from Savona to Vado.

KINGS LYNN: *Electricity Accounts.*—The accounts of the Electricity Department for the past year show a profit of £563, after providing £3,213 for interest and sinking fund.

LAUNCESTON (TASMANIA): *Proposed Tramways.*—A proposal is being made to form a local company for the construction of tramways in this town.

LLANDUDNO: *Generating Station Smoke Nuisance.*—At the Llandudno Petty Sessions last week, the District Council was summoned for creating a nuisance by allowing black smoke to be discharged from the chimney at the generating station. For the defence it was pointed out that the Council had done all they reasonably could to prevent a nuisance. Some months ago £300 were spent in fitting mechanical stokers to two boilers, and to a certain extent this had prevented the emission of black smoke. It was now proposed to fix similar apparatus to two more boilers. The Bench, however, made an order for the abatement of the nuisance.

LONDON: *London County Council Tramway Guide.*—The guide to the tramway system of the Council, which is now in preparation, will consist of (1) an alphabetical list of places of interest in London, together with, in the case of those which are accessible by tramway, an indication of the route by which they may be reached, and (2) a list of the various tramway routes, with route diagrams and particulars of the car service, &c. A number of photographs and other illustrations will also be included in the guide, which will be of octavo size and sold at 1d. per copy.

North London Tramways.—The electric tramcar service between Finsbury Park and Moorgate Street was inaugurated last week.

Lambeth: Tramway Speeds.—In reply to a communication from the Council that the speed of the electric trams in South Lambeth Road and Stockwell Road should not exceed 12 miles an hour, the Board of Trade have written that they see no reason to vary the maximum speed of 16 miles an hour, as there are no sharp curves or steep gradients on the route.

Kennington Tramway Brotherhood.—An appeal is made for contributions to make good the deficit of £350 upon the hall for meetings of the St. Mark's Tramway Brotherhood, which was opened at Kennington Oval this year. The hall has been designed mainly for use of men employed on the tramways. The membership of the brotherhood, the principles of which are the avoidance of betting, gambling, intemperance, &c., is now about 2,000.

Shoreditch: London Electric Power Bills.—A conference was held in the Town Hall last week of representatives of Borough Councils owning electricity undertakings. The object of the gathering was to consider the London and District Electric Supply Bill, and the London Electric Supply Bill, as amended in the House of Lords, and the decision of the Conference was that both Bills should be opposed by petition.

Streatham: Tramways.—A local landowner has made an offer to the London County Council to contribute £1,000 towards the cost of laying a tramway from the High Road, Streatham terminus, to the county boundary in Mitcham Lane.

LOUGHBOROUGH: *New Telephone Exchange.*—The National Telephone Co. has opened a new telephone exchange at Lutterworth.

LUTON: *Tramway Results.*—At a recent meeting of the Corporation, it was stated that the tramways, which were recently opened, and are being worked by Messrs. J. G. White & Co., under a lease from the Corporation, had been a great success up to the present.

MANCHESTER: *Damages against Corporation.*—The Corporation were sued at the Manchester Assizes on Monday by a Mrs. Ellisson for damages for the death of her husband. Mr. Ellisson, it appears, carried on business as pawnbroker and jeweller in Ducie Street, and it was claimed that his death was directly attributable to the after-effects of inhaling, in his bedroom, fumes arising from the fusing of an electric cable belonging to the Corporation. On the suggestion of Mr. Justice Bucknill, before whom the action was heard, the parties arrived at a settlement, the Corporation agreeing to pay £125 damages, and costs.

NEWCASTLE: *Tramway Receipts.*—During the week of the Royal Agricultural Show at Newcastle, the number of passengers carried upon the tramway system was 1,151,685, an increase of

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314.899 over the corresponding week of last year, and the receipts amounted to £5,232, an increase of £1,423 over the corresponding week of last year. The average receipt per car mile for the week went up to 14·24, against 10·85 last year.

NOTTINGHAM: *Tramway Accounts.*—The annual report of the Tramway Manager states that the total income for the past year amounted to £153,745, and the expenditure, including sinking fund, interest, &c., amounted to £131,586. Of the balance, £17,000 have been contributed to the rates, the last instalment of £900 written off the cost of motor omnibuses, and the remaining £4,457 has been carried to reserve fund, which now amounts to £59,812. The number of passengers carried, viz., 34,411,860, showed an increase of 3,193,169 over the previous year, and the car miles run, viz., 3,299,283, show an increase of 567,631 over the previous twelve months. The average fare paid per passenger amounted to 1·05d., compared with 1·06d. for the previous year. The receipts per car mile dropped from 12·30d. to 11·18d., owing, to some extent, to the unsatisfactory results upon two new routes, including one to Trentbridge. The receipts upon these particular routes were 1·90d. per car mile less than the amount required to meet the charges for interest and sinking fund.

OLDHAM: *Electricity Accounts.*—At the last meeting of the Corporation, Alderman Bolton, in moving the adoption of the electricity accounts, said he had much pleasure in being able to say that there was a profit of £1,723, in spite of the fact that they had had to pay 1s. 4½d. per ton more for coal, which amounted to £1,230 during the year. They had also had to pay out of revenue £504 on account of boilers, and £511 on accounts of the water purifiers. With regard to next year, it was estimated that boiler repairs would entail a further expenditure of £800, that the water purifiers would involve a payment of a further £500, and that the assessment would be increased by £116. He also drew attention to the fact that the profit had been placed to reserve, and mentioned that at one time the undertaking had had a reserve of £10,000. Owing to the Local Government Board inspector, however, refusing to pass certain accounts out of revenue, this reserve fund had now dwindled down to nothing, and he hoped the Council would not ask the electricity Committee to pay a penny in relief of rates until they had a reserve of £50,000.

PENARTH: *Proposed Tramway Scheme.*—The District Council having communicated with the Local Government Board as to the legality of taking a poll in reference to the proposed tramways to Cardiff, has been referred to the district auditor.

RICHMOND: *Tramways.*—Sir Clifton Robinson has informed the Town Council that unless consent is given to the adoption of the overhead trolley system the Bill authorising the tramways in Kew Road and over Kew Bridge will be dropped. He intimated that in the light of recent experience the surface-contact system of traction was not one that the directors, on the ground of public safety alone, would be prepared to instal along so important a route.

SHEFFIELD: *Electric Lighting.*—At the last meeting of the Corporation Councillor Bennett, in an explanatory speech with reference to the accounts of the electric lighting undertaking, which we gave in our last issue, stated that the people who thought the undertaking should be making larger profits and contributing large sums to the relief of rates, did not realise the difficult competition which it had to face. In his opinion the progress of the undertaking had been satisfactory. The output had increased by more than 1,500,000 during the 12 months just ended, and in 10 years it had increased from under one million to over 8,500,000 units. Similarly, the revenue had increased by £9,067 during the year, and during the past 10 years it had increased by over 400 per cent. Further, the undertaking had paid to sinking fund in nine years £109,490, and in interest £189,997, or an average of £33,274 per annum. The profit for the current year would have been £7,280 instead of £4,796, but for the increased cost of coal. Councillor Bennett also drew attention to the works costs, namely, 0·57d. per unit sold, and pointed out that in his special report Sir Alexander Kennedy regarded an average cost of less than 0·6d. per unit sold as a very good one under all the circumstances. For the first time in the history of the undertaking the amount of energy sold for power purposes now exceeded that sold for lighting.

Tramway Employees' Appeal.—At the last meeting of the Corporation, it was decided to allow tramway employees to appeal to the committee in serious cases involving dismissal.

SOUTH SHIELDS: *Electricity Accounts.*—The accounts of the electricity undertaking for the year ending March 31st, 1908, show a revenue of £25,608, which is an increase of £2,907 over the previous year, whilst the expenditure amounted to £13,538, an increase of £4,140. The gross profit of £12,070, however, is a decrease of £1,232 compared with the previous year, and after meeting interest and sinking fund charges there is a net profit of £1,358, which the Electricity Committee recommend should be placed to reserve.

SUNDERLAND: *Electricity Accounts.*—The annual report of Mr. A. S. Blackman, the Corporation Electrical Engineer, shows that during the year ended March 31st the number of units generated was 10,933,825, or 1,625,482 over the figure for last year, whilst the number of units sold was 8,644,523, an excess of 1,067,000 over the number sold during the previous year. Power users have consumed 4,344,854 units, or 794,180 over last year. The number of consumers, as distinct from power users, now amounts to 1,224, an increase of 54 during the year, and the number of units sold for lighting purposes was 1,401,501, an increase of 142,450. The horse-power of motors installed is now 694,504, an increase of 91,509. The consumption for tramway purposes amounted to 1,834,026 units, an increase of 7,919. The capital expenditure during the year amounted to £57,467, bringing the total upon the undertaking to £403,295. This new capital expenditure had had the object of reducing the expenditure per kilowatt installed from £51 to £42 9s. The total costs, excluding capital charges, were 1·614d. per unit, a reduction of 0·052d. over the previous year. The total expenditure amounted to £35,224 and the revenue to £58,202. Capital charges, however, amounted to £24,886, thus leaving a debit balance of £1,908. In his report Mr. Blackman recommends the re-designing of the plant in order to make it up-to-date by the provision of new motor-driven pumps. The approximate cost of this he puts at £1,200, and considers it would be amply repaid in its effect upon the running costs. At last week's meeting of the Corporation some severe criticisms were made upon the results for the year, but it was decided to postpone serious discussion until the next meeting, when the chairman of the Electricity Committee, Mr. Alderman Bruce, will be present.

Telephone Tariff.—A number of telephone users in Sunderland, who are also land owners, have expressed their intention of not giving the company facilities for erecting poles upon their property except at greatly increased rents until the terms of the agreement now put before the telephone subscribers are modified.

SWANSEA: *Electricity Accounts.*—The net profit upon the electric lighting undertaking for the year ended March 31st amounts to £1,231, against £741 for the previous year. The gross profit was £10,246, from which interest and sinking fund, proportion of expenses on debenture bonds, and allowance of £64 due to defective meters, bad debts, &c., absorbed £8,950.

WADEBRIDGE: *Electric Lighting.*—A scheme of electric lighting has been placed before the Council by a syndicate, under which it is proposed to supply electricity by means of overhead wires fixed on poles about 30 ft. high. A representative of the syndicate attended the last meeting of the Council and explained the scheme, and it was agreed to sanction an application by the syndicate for a Provisional Order on the understanding that the work would be completed within twelve months, and that the Council should be entitled to purchase at the end of 15 years, or any other period which might be stipulated in the agreement.

WALSALL: *Tramway Supply.*—The Electricity Committee has provisionally approved an agreement for supplying the South Staffordshire Tramways (Lessee) Co., Ltd., with the current required for working the tramway lines leased to them, the price, subject to revision every three years, being 1½d. per unit, less 10 per cent. discount. The company is to take a minimum of 60,000 units per annum for the remainder of the term during which the lines are leased to them, viz., up to December 31st, 1921. The Local Authority is to bear the cost (estimated at £800) of laying the necessary cables.

WALTON-ON-NAZE: *Electricity Supply.*—Mr. H. R. Spence, of the Coast Development Co., which owns the pier at Walton, has notified the Council of his intention to apply to the Board of Trade for a Provisional Electric Lighting Order for the district.

WEYMOUTH: *Electricity Accounts.*—The third annual report of the Electricity Committee for the year ended March 31st shows that of the capital of £52,165 sanctioned, there has been expended £46,608. The number of consumers was 321, an increase of 59, whilst the total number of connection was equivalent to 23,893, 33 watt lamps, being an increase of 3,658 during the year. 176,644 units were sold for private lighting, 27,243 for power purposes, and 149,528 for public lighting, making a total of 353,415, an increase of 49,471. The gross receipts amounted to £5,672 and the gross expenditure to £2,727. Capital charges, &c., amounted to £3,043, leaving a deficiency on the year's working of £98, against £895 for the previous year.

WORCESTER: *Electric Signs on Lamp Posts.*—The Electricity Committee recommend that the street arc-lamp posts should be let for supporting electric light signs on such terms as the committee might approve. A number of members objected to the disfigurement of the district by such advertisements, and at the last meeting of the Corporation an amendment was carried authorising the committee to bring up a report showing what advertisements it was proposed to allow and the prices to be charged.

Electricity Accounts.—The Council has approved of the electricity accounts which we abstracted in our last issue.

WORKSOP: *Meter Rents.*—The Worksop Traders' Association has been informed by the Urban District Council that they cannot see their way to make any reduction at present in the charges for meter rents. At a meeting last week dissatisfaction was expressed with this decision, and the secretary was instructed to again write to the Council with regard to the matter.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA (SYDNEY).—Specifications are in preparation for a new storage battery at the municipal electricity works. The estimated cost is put at £22,500, exclusive of buildings.

According to the *Australian Mining Standard*, pending the introduction of a complete scheme to finance expenditure upon new telegraph and telephone work in the Commonwealth, it will be necessary to provide for the immediate appropriation of a sum of £32,345 for special work required during the year 1908–9.

BO'NESS.—The National Electric Construction Co. have reported to the Council with regard to extensions in the electricity works. They state that since the completion of the works the two original generators of 100 kw. capacity each have been heavily taxed, the peak load at times reaching 190 kw. In order to cope with present demands, it is proposed to instal a 300-kw. generating set, including a surface condenser and motor-driven air and circulating pumps; a new feeder panel and generator panel will be added to the switchboard, and a new feeder cable will be run to Kinneil and Grangepans. The estimated cost of extension is £6,000, and the Council has agreed to the scheme.

ECCLES.—A Local Government Board inquiry has been held into the application of the Corporation for sanction to borrow £16,270 for the extension of the electricity plant and mains.

FAREHAM.—A Local Government Board inquiry is to be held shortly in connection with the application of the Council for sanction to borrow £10,000 for electric lighting purposes.

FARNWORTH.—A Local Government Board inquiry was held last week into an application for sanction to borrow £7,000 for electric lighting. It was stated that the Council proposed to take a bulk supply from the Lancashire Power Co., with whom they have made very favourable terms upon an agreement to take 400,000 units per annum. Mr. R. B. Leach, the Electrical Engineer, explained to the inspector that the present works had never been designed for a motor load, and that the growth of such a load necessitated the expenditure proposed. Under the agreement with the Power Co. they would take energy at 10,000 volts three-phase and convert it themselves. The details of the expenditure proposed are as follows :—New engine house, stores, &c., £1,281; transforming plant, £2,500; switchboards, £450; extensions to battery, £300; new services, £700; contingencies, £100; floating expenditure, £383; whilst £1,284 have been spent in advance.

HEYWOOD.—A Local Government Board inquiry is to be held here into the Corporation's application for sanction to borrow £16,000 for extensions, &c., at the electricity supply works.

HORNSEY.—The Borough Council has authorised the extension of cable in Southwood Lawn Road at a cost of £43.

IPSWICH.—Tenders are invited for twelve months' supply of (1) rubber insulated wires for insulation work; (2) paper insulated lead-covered cables for laying underground; (3) bare copper trolley wire and bare copper strands. Particulars from the Chief Engineer and Manager, fee £1 1s. for each specification, and tenders by July 22nd.

KRUGERSDORP.—The Council will shortly be requiring additional electrical machinery.

NATAL.—The Natal Government is expected to be in the market for electrical plant during the next few months.

SPAIN.—The *Gaceta de Madrid* of June 28th states that tenders are invited for the supply to the Department of Posts and Telegraphs of 8,000 metres of aerial and subterranean telephone cable. Tenders will be opened 30 days from the above. Tenders must be accompanied by a deposit equal to 5 per cent. of the total value of the tender. Local representation is understood to be necessary. Copy of the form of tender, and the general and special conditions under which the contract will be granted, may be seen by British makers on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

Miscellaneous

LONDON: *London County Council.*—An expenditure not exceeding £400 is recommended by the Highways Committee for temporary turn-outs during the reconstruction of the tramways in Caledonian Road and Seven Sisters Road.

MANCHESTER.—Tenders are invited for the supply of special permanent-way track-work. Particulars from the General Manager (fee £2 2s., returnable) and tenders to the Chairman of the Tramways Committee, 55 Piccadilly, Manchester, by July 28th.

PORTSMOUTH.—The Tramways Committee invite tenders for six or twelve months' supply of best smokeless Welsh steam coal from August 13th, 1908. Particulars from the Engineer, Fratton Grove, and tenders to the Town Clerk by July 20th.

RAINHILL.—The Committee of Rainhill County Asylum invite tenders for an electrically-driven plunger pump. Particulars from the Clerk and tenders by July 23rd.

SIERRA LEONE.—Tenders are invited by the Municipal Corporation of Freetown for the lighting by electricity of the municipal buildings and streets by arc and incandescent lamps. Tenderers to quote price per 1,000 units. The exclusive right to supply electricity for private lighting for a period of at least 30 years will be granted to the successful tenderer. The right to instal electric tramways may also be acquired. Tenders to Town Clerk, Freetown, not later than August 22nd, 1908. The Corporation do not bind themselves to accept the lowest tender. The notice may be seen at the office of Messrs. Wilkinson & Broadbent, 4 Queen Street Place, E.C.

SUNDERLAND.—A main is to be extended to the Hendon Branch Library at a cost of £150.

Wiring

LONDON.

E.—The Trafalgar Square school is to be altered and reconstructed at a cost of £507. Architect, T. J. Bailey, L.C.C., Spring Gardens, S.W.

E.C.—Alterations and additions to the theatre at the Guildhall School of Music by the City Corporation

S.E.—The Vauxhall (L.C.C.) fire station is to be enlarged. Architect, W. E. Riley, L.C.C., Spring Gardens, S.W.

A factory is to be erected at Norwood for the trustees of the Stockwell Orphanage. Mr. R. Milnes, Stockwell Orphanage, Clapham Road, S.W.

W.C.—Premises in Holborn are to be adapted for trade classes, for L.C.C. (£5,460.) Architect, T. J. Bailey, L.C.C., Spring Gardens, S.W.

PROVINCES.

ALDERLEY EDGE.—Extensions to the David Lewis Colony (£4,500). Architect, Mr. George H. Willoughby, 3 York Street, Manchester.

BANGOR (CARNARVON).—Extensive additions to the Carnarvonshire and Anglesey Training College (£26,000). Architect, Mr. Hare, c/o Committee of Bangor Normal College.

BIRKENHEAD.—Council school at Hemingford. Estimated cost, £18,000. R. T. Jones, Secretary to Education Authority.

BLACKBURN.—The Blackburn District Co-operative Society are building a central boot and shoe establishment in Northgate.

BOURNEMOUTH.—Proposed municipal buildings at an estimated cost of £16,000.

BRENTFORD.—Additions to isolation hospital. Surveyor, J. W. Croxford, Clifden House, Boston Road, Brentford.

CARDIFF.—The County Council of Glamorgan has decided to erect a County Hall and offices.

The Wholesale Co-operative Society has acquired the old Cardiff Town Hall for conversion to a depôt.

CAMBRIDGE.—Extensions to the Baptist Church at Histon. Architects, George Baines & Son, 5 Clement's Inn, W.C.

CHELMSFORD.—New County Council education offices in Duke Street.

DARTFORD.—Council school at Crayford, Northend. Architect, C. E. Lancaster Parkinson, 44 Bedford Row, W.C.

Extensions to Bow Arrow Hospital by Rural District Council.

DURHAM.—New Council schools. A. J. Dawson, Clerk to Education Committee, Shire Hall, Durham.

DEVONPORT.—A County Council school at Camel's Head, providing 1,000 places. W. H. Crang, Secretary to Education Authority, Devonport.

ECCLES.—The Education Committee invite tenders for electric wiring at the new Clarendon Road Council school. Specifications, &c., from Mr. H. Lord, architect, 42 Deansgate, Manchester, and tenders by July 25th.

EVESHAM.—New public elementary school at Swan Lane. Plans by Worcester County Architect, Worcester.

FLINTSHIRE.—County Council school at Ewloe Green; estimated cost, £2,100. Director to Education Authority, Mr. J. Bevan Evans, M.A., Mold.

GLAMORGAN.—A County Council school at Llest. Dr. J. James, M.A., Director to Local Education Authority, Cardiff.

GOLDERS GREEN.—Church to seat 300. Messrs. F. W. Brodie and Arthur Waugh, of Golders Green, joint secretaries.

GOSPORT.—New school in Grove Road; estimated cost of £7,474. Architect, E. J. Trench, Upper King Street, Norwich.

GRAVESEND.—A Council school; estimated cost, £8,800. C. E. Hatten, Secretary to Local Education Authority, Gravesend.

HERTS.—County Council school at Cheshunt; estimated cost, £4,540. Director to Local Education Authority, A. R. S. Hallidie, Hertford.

HESWALL.—A new school for the Liverpool Juvenile Reformatory. Architect, H. Langton Beckwith, 3 Cook Street, Liverpool.

HULL.—New Wesleyan Church at Marfleet; estimated cost, £2,000.

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ILFORD.—The Education Committee invite tenders for electric wiring and fittings for about 200 16-c.p. lamps at the Uphall School. Tenders to the Secretary by July 20th.

ILFRACOMBE.—Council elementary school. Builder, R. Pickett, Fore Street, Ilfracombe.

ILKLEY.—New Wesleyan Methodist Church at Ben Rhydding; estimated cost, £2,800.

KINGSTON-ON-THAMES.—Adaptation of "The Grove," Penrhyn Road, Kingston, for Education Committee's office accommodation; estimated cost, £400. Ramsay Nares, Secretary to Surrey Education Committee, Kingston.

LEEDS.—New Catholic College; estimated cost, £10,000. Architect, Mr. Benedict Williamson, c/o Rev. J. Kerr, S.J.

LEYTON.—New houses; estimated cost, £2,000. Builders, Messrs. Rowley Bros., of Tottenham. Architect, Herbert Riches, 3 Crooked Lane, King William Street, E.C.

LINCOLN.—Extensions to the City Diseases Hospital (£850). City Surveyor, Mr. R. A. MacBrair. Builder, Joseph M. Harrison, Melville Street, Lincoln.

MANCHESTER EXHIBITION.—The management of the Manchester Electrical Exhibition are open to receive tenders for wiring the buildings, but tenders will only be considered from contractors who are exhibitors. Particulars from the offices, 2 Queen Anne's Gate, Westminster.

MUSWELL HILL.—Blocks of residential flats. Architects, Messrs. Coleman & Holmes, Archway Road, Highgate.

NEWTON HEATH (LANCS).—Wesleyan Sunday School. Architects, Smith & Matley, 14 Ridgefield, Manchester. Builders, Young, Tinker & Young, Monsall Street, Queen's Road, Manchester.

NORTHWICH.—Free library (£4,500), and secondary school (£14,000). Sir John Brunner, M.P., donor.

NOTTINGHAM.—Alterations and additions to the School of Arts (£10,000). Particulars, Town Clerk.

OXFORD.—Reconstruction of Cattle Market (£5,000). Surveyor (Corporation), W. H. Castle.

RADCLIFF.—Municipal buildings (£13,500). Samuel Mills, Clerk to Urban District Council.

RAMSGATE.—New School (£13,000). E. B. Sharpley, secretary to Education Authority, Ramsgate.

RICHMOND.—Additions to the Town Hall. Alterations at Richmond Theatre. Architect, Mr. B. Crewe, 75 Shaftesbury Avenue, W.C.

ROCHDALE.—New schools, Church Army headquarters, and social club. Architects, Sykes & Evans, 7 Chapel Walks, Manchester.

SOUTHGATE (MIDDLESEX).—Additions to Colney Hatch Asylum (£450). Architect, W. E. Riley, L.C.C., Spring Gardens, S.W.

SWANSEA.—Forty-four working class dwellings. Borough Surveyor, Geo. Bell.

WAKEFIELD.—Wesleyan Sunday school and church (£2,200). Architects, Messrs. Garside & Pennington, Pontefract, Yorks.

WALTHAM ABBEY.—Messrs. F. Joyce & Co., Ltd., are to erect a factory at Waltham Abbey at a cost of £14,318. Builders, W. Lawrence & Son, Waltham Cross.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The following were the tenders received for the new submarine cable connecting Tasmania with the main land. As we have already announced, the tender of Messrs. Siemens Bros. & Co., at £47,955, was accepted. The India Rubber, Gutta Percha & Telegraph Works Co., Ltd., £61,000; Norddeutsche Seekabelwerke, A. G., £58,000; the Société Industrial des Telephones, £87,200; the Telegraph Construction & Maintenance Co., Ltd., £56,000; W. T. Henleys Telegraph Works Co., Ltd., £97,000; and Siemens Bros. & Co., Ltd., £47,955.

BURNLEY.—The tender for alterations and additions to the offices at the electricity works has been placed with Mr. C. Brierley, of Fishpool.

CRAWLEY.—An order has been placed with the D.B. Battery Co. for a battery.

DERBY.—The tender of Messrs. E. Morley & Sons, at £43 15s., for fixing a weighbridge at the electric power station, has been accepted.

DUNDEE.—The tender of Messrs. Lowden Bros., for the electric wiring of the new Peters' Electrical Engineering Laboratory at the Dundee University College has been accepted at £49.

EDMONTON.—The Board of Guardians at the last meeting decided, on a report by Messrs. May & Hawes, of Westminster, to enter into a five years' agreement with the North Metropolitan Company for the supply of current for power and lighting to the new infirmary at 2½d. per unit.

EPSOM.—The Council has accepted the tender of Messrs. Dorset, at £17 18s. 9d., for placing telephone instruments at new pumping and fire stations at the waterworks.

FELIXSTOWE.—The D.P. Battery Co. has received an order for a battery of 110 cells of the L.S. 17 type, 224,000 watt hours, together with a Lancashire Dynamo Co.'s booster and accessories. The battery is under maintenance option.

HORNSEY.—The Borough Council has accepted the tender of Herbert Clarke, Ltd., for the supply of wharf slack for the electricity department; that of Charrington, Sells, Dale & Co., for hard steam coal (Ibstock); and the tender of Rickett, Smith & Co. for anthracite peas (Aberpergwym).

JOHANNESBURG.—An order for 200 street lamps, brackets, and fittings have been placed with the A.E.G. Electrical Co. of South Africa by the Johannesburg municipality. The tender of the Universal Electrical Manufacturing Co. has been accepted by the Corporation for the supply of 1,200 pairs of S.P. cut-outs, 1,200 sealing chambers, and 600 connectors. Five hundred Osram lamps are also being supplied by the General Electric Co.

KING'S LYNN.—The tender of Messrs. William Cory & Sons for 1,500 to 2,000 tons of Bestwood nut slack for the generating station at 9s. per ton has been accepted.

LONDON: *London County Council.*—With reference to the G.B. Surface Contact tramways, which are now in use between Aldgate and Bow, the Highways Committee report that in connection with the supply and fixing of magnet skate equipments upon these cars, it has been found that a single equipment, owing to large size of the Council's cars and other circumstances, do not give satisfactory results, and they recommend that these cars shall be fitted with a double equipment. The G.B. Surface Contact Co. offer to supply the equipment for 12 cars at £137 a car, and for the remainder of the 48 cars at £125 per car, and it is recommended that this offer shall be accepted.

The following tenders have been received for the manufacture, supply, and delivery of high and low tension switchgear for the second portion of the Greenwich generating station :—

Spagnoletti, Ltd. (recommended)	£2,212 0
Whipp & Bourne	2,349 11
Johnson & Phillips, Ltd.	2,403 2
The Electric Construction Co., Ltd. ...	2,646 6
British Westinghouse Electric & Manufacturing Co., Ltd.	2,864 0
A. Reyrolle & Co., Ltd.	3,700 0

The following tenders have been received for the supply of about 100,000 tons of coal required at the Greenwich generating station for the 12 months ending July 31st, 1909 :—

		s.	d.
Wm. Cory and Son, Ltd. (recommended)	100,000 tons	11	0
G. Owen and Co., Ltd.	100,000 ,,	11	1½
J. and M. Gunn and Co.	40,000 to 50,000	11	6
John Hudson and Co. (London), Ltd.	100,000 tons	11	8
Myers, Rose and Co., Ltd.	50,000 ,,	11	7
	20,000 ,,	12	3
Dinham, Fawcus and Co., Ltd.	10,000 ,,	11	9
Alfred Blackmore and Co.	10,000 ,,	11	9
	25,000 ,,	12	3
Harris, Harkman and Co., Ltd.	50,000 ,,	11	6
	50,000 ,,	12	10
Rickett, Cockerell and Co., Ltd.	30,000 ,,	12	10
Cleeves and Co.	30,000 ,,	12	11
S. Einstein and Co	100,000 ,,	13	6
Lindsay, Blee and Co., Ltd.	1,000 to 1,500 per month.	13	6
Charrington, Sells, Dale and Co.	12,000 tons	13	4
	12,000 ,,	14	2
*Joseph Fenwick, Newcastle-on-Tyne	—	14	3

* Not in acordance with specification.

The Highways Committee recommend that the wiring and fitting for the electric lighting and power of the second portion of the Greenwich generating station should be carried out by the Tramways Department. It is recommended, however, that the wiring and fitting of the central car repair depôt should be done under contract.

The following tenders have been received for the heating and ventilating of the central car repair depôt :—

	£	s.	d.	£	s.	d.
Davidson and Co., Victoria Street, S.W.	1,447	10	0	1,520	0	0
The Standard Engineering Company, Queen Victoria Street, E.C. (recommended)	—			1,477	0	0
Musgrave and Co., Victoria Street, S.W.	2,158	13	1	—		
Jas. Keith and Blackman Company, Farringdon Avenue, E.C.	2,524	3	0	—		

The first set of figures represent the specified requirements, and the second set represent alternative schemes.

Poplar.—The following tenders have been received for an additional water-tube boiler at the electricity works :—

Stirling Boiler Co., Ltd. (*accepted*)	£2,225
Clarke, Chapman & Co., Ltd.	£2,573
Turner Bros.	£2,605
Babcock & Wilcox, Ltd.	£2,750
Davis & Co	£2,100

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The tender of Messrs. Nicholls & Reynolds, at £737, has also been accepted for a new sub-station at Millwall. The structure will consist of a steel frame with hollow concrete block walls.

Stepney.—The Electricity Supply Committee has provisionally accepted the tender of the Reason Manufacturing Co., Ltd., at £175 for meters up to a capacity of 10 amperes. For meters above a capacity of 10 amperes, the tender of Messrs. Ferranti, Ltd., has been provisionally accepted at £328 10s. The following tender has been provisionally accepted for demand indicators, Reason Manufacturing Co., Ltd., £359 11s. For the annual supply of carbons the tender of the Sloan Electrical Co. has been provisionally accepted at £766 17s. 2d. For time switches the tender of Messrs. Venner & Co. has been provisionally accepted at £303 6s. 9d. In connection with the extension, now in progress, of street lighting by flame arc lamps, the Electricity Supply Committee has decided that 73 "Gilbert" magazine flame arc lamps be purchased from the Gilbert Arc Lamp Co., Ltd., at a cost not exceeding £8 10s. each, subject to the company making one or two slight modifications in the lamps as required by the Borough Electrical Engineer. For the supply of 70 switches and cut-outs, the tender of the Universal Electric Manufacturing Co. has been provisionally accepted at £1 3s. 3d. each.

MALTON (YORKS).—The Northern Counties Electricity Supply Co., at the request of the Council, has submitted a tender for street lighting. This tender, which is recommended for acceptance, contained a provision that on the nights of full moon, and two nights before and after, the street lamps shall not be lit. When the matter came before the Council it was unanimously decided to strike out this clause.

NEWCASTLE.—Messrs. R. McAlpine & Sons, of Glasgow, have been awarded the contract for the buildings in connection with the new power station of the Newcastle Electric Supply Co. The contract, which amounts to £60,000, involves the laying of a raft of concrete 5 ft. thick, upon piles, to form the foundation. The same firm have also in hand the formation of tunnels under the rivers Tyne and Weir, which are to be used for carrying cables.

RAWTENSTALL.—Messrs. Underwood Bros., of Dukinfield, have secured the contract for track work for reconstructing the tramways from steam to electric traction.

STOWMARKET.—The D.P. Battery Co. is supplying to the Suffolk Electricity Co. a battery of 130 cells of the company's L. 15 type, 1,800 watt hours, with a Lancashire Dynamo Co.'s booster and accessories. The battery is under maintenance option.

WEST AUSTRALIA: *Cottesloe.*—The D.P. Battery Co., Ltd., have received an order for the renewal of the Central Station Battery of 120 cells of their W.L. 9 type.

WALSALL.—The Electricity Committee have provisionally accepted the tender of T. Boston & Son, Ltd., Birmingham, for the supply of coal to the electricity department for one year; the Chloride Electric Storage Co., Ltd., for cleaning out the Hospital Street battery; Messrs. Jones & Horsfield, at £40, for covering new steam pipes at the generating station; and of Callender's Cable & Construction Co., Ltd., for laying a new feeder cable along Wednesbury Road Messrs. Baker & Co., of Rotherham, are to supply 60 car-wheel tyres at £16 2s. 6d. per ton, and the tender of Worthington & Co., at £22 17s., for the supply of line material, including mechanical ears, large and medium Brooklyn strains, and lignum vitæ strips has been accepted.

WILLESDEN.—The following tenders have been received for converting plant:—

Name.		
Crompton and Co., Ltd.	Motor generator	£713
Schorch	,, ,,	726 10s.
British Thomson Houston Co., Ltd.	,, ,,	735
Electric Construction Co., Ltd.	,, ,,	750
British Westinghouse Co., Ltd. (accepted)	Rotary converter	786
General Electric Co., Ltd	,, ,,	873
Siemens Bros. Dynamo Works, Ltd.	Motor generator	874
British Electric Plant Co., Ltd.	,, ,,	955
Bruce Peebles and Co., Ltd.	,, converter	1045
Mavor and Coulson, Ltd.	,, generator	1070
Johnson and Phillips, Ltd.	,, ,,	1104

The specification was for a 300 kw. set for converting alternating current at 3,000 volts to direct current at 480 volts. The tender accepted, as will be seen, was not the lowest, but the Council decided that it was the most economical having regard to the efficiency guarantee. The full-load efficiency in the case of the accepted tender was 94 per cent.

Rent of Cable.—In the Appeal Court last week the National Telephone Co. appealed against the decision of Mr. Justice Warrington that they are not entitled to lay a cable upon the bridge at Tonbridge Station except upon the payment of an annual rental of £30 and with the consent of the plaintiffs. We reported the action before Mr. Justice Warrington in our issue for April 16th, 1908, and the appeal against this decision was dismissed, with costs.

COMPANIES' MEETINGS AND REPORTS

CONSOLIDATED ELECTRICAL CO.—At the ordinary general meeting on Monday, Mr. H. Allen, Chairman, presiding, it was stated that the income for the past year amounted to £6,941 against £7,532 in the previous year, but this loss is more than accounted for by the fact that in the previous year the cash profit of over £1,200 was made by underwriting. The company has investments in the Private Wire & Telephone Installation Co. and the Anglo Portuguese Telephone Co., the latter of which has proved a remunerative investment. With regard to the former, however, it was pointed out that remunerative orders are becoming more and more difficult owing to the impossibility of small concerns competing successfully with powerful undertakings like the General Post Office and the National Telephone Co., and so their investments in this company, the Chairman remarked, must be regarded as a loss. The report and accounts were adopted.

DUBLIN UNITED TRAMWAYS CO.—Subject to final audit, the directors recommend the payment of dividends for the June half-year at the rate of 6 per cent. per annum on the preference shares and 6 per cent. per annum free of income tax on the ordinary shares, carrying forward £6,494, in addition to £7,494 unexpended of the sum provided last year for reconstruction and maintenance.

ELECTRIC CONSTRUCTION CO.—The report for the year ended May 31st, 1908, states that there has been a satisfactory increase in the volume of the company's business during that period. The amount of work in progress is considerably greater than at this time last year, including large power installations for India and the Midlands, in addition to machines of all sizes for home and abroad. The industry, however, is still suffering severely from over-production, and a small margin of profit only is obtainable. The net profit for the year, after payment of £10,250 for debenture interest, and crediting £5,000 as formely to depreciation account, is £5,932 6s. 9d. The sum brought forward from last year is £208 16s. 4d., and the amount available for distribution is therefore £6,141. The directors recommend that this profit be appropriated in payment of the dividend on the preference shares for the year ended May 31st, 1907, viz., £4,395, leaving a balance to be carried forward of £1,746. In view of the volume and character of the work in progress, the directors hope to declare about the end of December a dividend on the preference shares for the year ended May 31st last. In accordance with the arrangements described by the Chairman at the last annual general meeting, the directors have subscribed for £5,000 4½ per cent. preferred ordinary shares of the Madras Electric Tramways (1904), Ltd. A portion of the company's holding in the tramways has now been disposed of, and a depreciation of £2,000 on the realisation has been debited to general reserve fund. Your directors are pleased to report a marked improvement in the traffic receipts from the tramways during the past few months. The meeting will be held on Monday.

ELECTRICAL POWER STORAGE CO.—The directors' report and accounts to May 31st, 1908, show that the profit for the year, including the balance of £786 brought forward, is £4,860, out of which the directors recommend the payment of a dividend of 5 per cent. on the paid-up ordinary share capital, which will absorb £4,491, and leave £359 to be carried forward. The buildings, plant, tools, &c., have been maintained in thorough repair and condition at a cost of £3,046, which sum has been provided out of revenue. The debentures, amounting to £28,400, which appeared in the last balance sheet, have been redeemed. These have been replaced to the extent of £10,000 (part of an authorised issue of £30,000), thus reducing the debentures outstanding by £18,400. Owing to the fluctuations in the price of lead and other raw materials, together with the general depression in trade, the volume of business has somewhat decreased as compared with the previous year. The meeting is to-day.

HENDON ELECTRICITY SUPPLY CO.—At the first annual meeting of this company, Mr. C. F. Tufnell, who presided, referred to the good progress that had been made in the laying of mains and erection of sub-stations for the distribution of the bulk supply from the North Metropolitan Electric Power Supply Co. Pending the completion of these arrangements a temporary generating station was being worked. This supply was, however, not being carried on under statutory authority, but the permanent supply was to be given under the terms of the Hendon Electric Light Orders of 1889 and 1903. These Orders were originally in the name of Messrs. Crompton & Co., but an unopposed Bill was now before Parliament for their transference to the company.

LANCASHIRE POWER CONSTRUCTION CO.—The report for the past year states that the total liabilities amount to £53,765, and that a committee of shareholders has recommended the creation of £300,000 5 per cent. debenture stock, of which £150,000 will be offered to the shareholders at par, with a bonus of 50 per cent. in 4 per cent. income bonds. The stock will be secured by a specific first mortgage on all the debenture stock and shares of the Lancashire Power Co., and by a floating charge on the other assets and undertaking. There will also be created £100,000 non-cumulative 4 per cent. income bonds, ranking in priority to the present A and B shares. At the

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meeting on Tuesday the report and accounts were adopted, and Mr. H. F. Parshall was appointed chairman of the company.

NATIONAL TELEPHONE CO.—The directors' report for the half-year ending June 30th, 1908, states that the income amounted to £1,452,826, as compared with £1,315,038 for the corresponding period of 1907, being an increase of £137,787. The working expenses amounted to £832,638, as compared with £749,760 for the corresponding period of 1907, being an increase of £82,878. The net result for the half-year (after deducting the Post Office royalties amounting to £139,546) is a profit balance of £480,641, as compared with £439,979 for the corresponding period of 1907, being an increase of £40,661. The rentals carried forward for unexpired terms of running contracts amount to £1,314,591, as compared with £1,210,117 at the corresponding period of 1907, being an increase of £104,474. Out of the available balance of £369,427, the Board recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 6 per cent. per annum on the deferred stock, less income tax in all cases. It is also proposed to transfer £140,000 to the reserve fund account, which now stands at £2,804,961, and to carry forward the balance of £10,677. The sume of £496,584 has been expended on capital account during the half-year in the erection of 16,761 additional exchange and private stations, and in the construction of underground works. The following three directors retire, and, being eligible, offer themselves for re-election viz., Mr. Charles Swain Agnew, the Right Hon. Lord Harris, and Sir Albert Kaye Rollit. The meeting will be held at Telephone House, Victoria Embankment, on Wednesday, July 23rd.

NORTH MELBOURNE ELECTRIC TRAMWAY & LIGHTING CO.—The accounts from October 11th, 1906, to September 30th, 1907, after providing for debenture interest, show a deficit of £8,897.

SIEMENS BROTHERS & CO.—The report for 1907 recommends a dividend of 4s. per share for the year, carrying forward £1,116. The sum of £3,500 has been written off the value of shares held.

YORKSHIRE ELECTRIC POWER CO.—An extraordinary general meeting was held at Leeds on Thursday, when the following resolution was passed:—"That the resolution passed at the extraordinary general meeting of shareholders of the company, held on the 26th day of September, 1905, authorising the borrowing of sums not exceeding £80,000 upon the terms therein mentioned, be rescinded so far as it authorises the borrowing of any further sums in excess of the sum of £40,000 already borrowed. And, further, that under the powers of and in exercise of the provisions contained in the Yorkshire Electric Power Act, 1901, and the Acts incorporated therewith, this special meeting orders that the directors be and they are hereby authorised to borrow a further sum or sums not exceeding in the whole £45,000, on mortgage of the company's undertaking, ranking after the £40,000 already advanced by Messrs. Barclay & Company, Limited, bearing interest at the rate of 6 per cent. per annum, and repayable with a bonus or premium at the rate of £5 per cent. after five years on six months' notice being given by the lender, or after two years on six months' notice being given by the company." Mr. A. G. Lupton, who was in the chair, stated that the new capital was required in connection with the supply at Brighouse and other places, and for the general development of the company. The directors had been giving very careful attention to the best way of raising the money, and had hoped to be able to issue debentures for the full amount authorised by their Act and so pay off the £40,000 which had been borrowed from the bank. On the advice of their brokers, however, they had come to the conclusion that the best plan was to obtain money by a second mortgage on the company and to ask the shareholders to find this capital, which would rank directly after the money owing to the bank. The money would be repayable in five years, if desired by the lenders, or at the option of the company any time after two years, repayment being made at the rate of £105 for every £100 invested, the rate of interest being 6 per cent. per annum paid half-yearly. With regard to the future prospects of the company, the chairman mentioned that, in addition to the Brighouse Corporation, which was arranging to close down its generating station and take the whole supply from the company, negotiations were also being carried on with the West Yorkshire Tramways Company for the supply to the tramways which it was supposed to run in Brighouse. Agreements had also been made to supply electrical energy at Hipperholme and to the Distributing Company which would supply the tramways at Ossett. Arrangements were also being made to construct an overhead main to supply in the Barnsley district. When all these were connected, a revenue of £18,000 per annum was anticipated, which would leave a considerable balance for dividend after meeting working expenses and interest.

Telegraph Traffic.—The Indo-European Co.'s lines between Tauris and Teheran were interrupted for one day only on the 6th inst. There is also one interruption to cable communication to report, viz., between Kwandang and Menada, both these places being in the Island of Celebes. But the island can, of course, still be reached by telegraph.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars net c.i.f. port of arrival quoted on Tuesday night was £59 to £59 10s. per ton. (Last week same price.)

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the creditors of the Kevan Electric Co. will be held on July 28th, at 35 Carey Street, Lincoln's Inn Fields, London, at 11.30 a.m.

The first meeting of creditors of T. A. Evans, trading as T. Evans & Co., electrical and mechanical engineers, Swansea, was held at the offices of the Swansea Official Receiver, on Thursday. Liabilities were put at £2,699, and assets at £68. The failure is attributed to speculation in a colliery undertaking. No creditors attended, and the official receiver remains trustee.

BERGMANN - ELEKTRIZITATS - WERKE AKT. - GES., BERLIN.—This company has for some time past been making experiments in connection with electric traction for main line railways; and, in order to be able to take advantage of the experience gained in this direction, has acquired the Westinghouse Company's patents in Germany.

CHANGE OF ADDRESS.—The Ebonestos Manufacturing Company inform us that owing to the largely increased demand for their moulded ebonestos insulators they have moved their works and offices to 127 Pomeroy Street, Old Kent Road, London, S.E. Telephone No., Deptford 887.

MESSRS. COWANS, LTD.—We are informed that Messrs. Cowans, Ltd., have now completed the reconstruction of their Salford works, which were destroyed by fire on January 21st last, and are now in a position to accept business for prompt delivery.

OUTING.—Some 200 employees of Simplex Conduits, Ltd., together with various managers of departments and branches, took part in a most successful outing to Matlock, Bath, on Saturday, July 4th. During the sports a challenge cup, presented by Mr. L. M. Waterhouse, was competed for.

PORTABLE VOLTMETERS.—Messrs. Elliott Bros. ask us to announce that they are in a position to supply portable indicating and recording voltmeters for direct-current and alternating-current circuits that comply with the requirements of the Board of Trade and local authorities for measuring the supply voltage on consumers' premises. These instruments have been approved for this purpose.

COMPANY MORTGAGES, &c.

COATBRIDGE & AIRDRIE ELECTRIC SUPPLY CO.—Particulars have been filed of a charge of £7,235, dated June 29th, secured upon the undertaking and all property of the company present and future, including benefits of certain agreements. The holders are the County of London Electric Supply Co., Ltd.

RHONDDA TRAMWAYS & ELECTRIC SUPPLY CO.—Particulars have been filed of £44,000 debentures created August 7th and secured by a trust deed dated August 8th, 1907. The property charged is the benefit of a trust deed, the benefit of an assignment of leasehold redemption policies dated March 16th, 1908, and the company's undertaking and property present and future, including uncalled capital. The trustees are Mr. C. A. Scott-Murray, director of the Sun Life Assurance Co., 63 Threadneedle Street, London, and Mr. L. B. Schlesinger, 21 Cornhill, London, E.C.

NEWCASTLE ELECTRIC SUPPLY CO.—A memorandum of satisfaction in full of mortgage debenture dated January 2nd, 1908, securing £300,000, has been filed at Somerset House.

STOTHERT & PITT.—Particulars have been filed of £50,000 second debentures created by a resolution on June 17th, 1908, the property charged is the company's undertaking and property present and future, including uncalled capital, subject to £250,000 prior debentures. There are no trustees. An issue of £30,000 debentures, part of the above series, has been registered.

SWITCHGEAR CO.—Particulars have been filed of mortgage and modifying deed, dated June 5th, 1908, of an issue of £3,000 debentures registered on August 24th, charged on £3,000 second debentures issued by Cowans, Ltd. The holders are Mr. E. A. M. Bindloss, 253 Monument Road, Birmingham, and Mrs. E. Clarke, Kanawha, Newton Abbot.

COWANS.—A memorandum of satisfaction to the extent of £2,000 of debenture stock, dated February 26th, 1908, securing £5,000, has been filed.

Municipal Tramways Association.—A meeting of the Lancashire and Cheshire Managers' Section of the Municipal Tramways Association was held at Bury last Friday. The meeting was held in the Council Chamber, where the visitors were welcomed by the Mayor (Alderman Collinge), who is also chairman of the local Tramways Committee. After the meeting, at which various topics relating to the management and working of tramways were discussed, the delegates visited the Bury car depot, and the works of Messrs. Mountain & Gibson, of Elton Fold.

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PARLIAMENTARY INTELLIGENCE

HIGHGATE HILL TRAMWAYS.—The Bill promoted by the Highgate Hill Tramways Co. for the conversion of the line to electric traction and running powers over certain portions of the London County Council tramways, has now been formally withdrawn in consequence of the agreement to sell the undertaking to the London County Council.

TELEGRAPH CONSTRUCTION BILL.—Standing Committee C of the House of Commons had this Bill under consideration on Thursday. The Bill relates to the construction and maintenance of telegraph lines, and gives the Postmaster-General additional powers in the case of owners or occupiers refusing consent to the erection of telegraph and telephone lines upon their land; it also deals with flying wires over adjoining land roads, and the lopping of trees ostructing the telegraph lines. The Bill, with some amendments, was passed.

The Bill was read a third time in the House of Commons on Tuesday.

PATENTS AND DESIGNS BILL.—This Bill was considered in Committee of the House of Commons last week, was reported to the House without amendment, and was subsequently read a third time. The Bill only consists of one clause, and, as pointed out by the Attorney General, makes good a drafting mistake in the Patent Act of last year, the effect of which was to deprive litigants the right of appeal in cases where the patentee was alleged not to be the first inventor, where the invention was alleged not to be new, where there was alleged to be no subject matter for a patent, and in a whole group of similar important cases in connection with which the Government never intended to restrict the right of appeal.

PROGRESS OF ELECTRICAL BILLS.—The Lords' amendments to the Electric Lighting Provisional Order Confirmation Bills Nos. 1 and 2 were agreed to in the House of Commons on Wednesday last week. The Doncaster Corporation Bill and the Leeds Corporation Bill were read a third time in the House of Lords on Wednesday last week.

Electric Lighting Provisional Order Confirmation Bill 3, and Tramways Provisional Order Confirmation Bill No. 2, were read a second time in the House of Commons on Monday. The Wolverhampton Corporation Bill was read a third time in the House of Lords on Monday.

LONDON ELECTRIC POWER BILLS.—The London and District Electricity Supply Bill was read a third time in the House of Lords on Monday.

APPOINTMENTS AND PERSONAL NOTES

The Poplar Borough Council has increased the salary of Mr. J. H. Bowden, Borough Electrical Engineer, from £500 to £600 per annum as from July 1st, 1908.

Herr Robert Dahlander, Chief Engineer in the Electric Traction Department of the Swedish State Railways, has resigned in order to take over the management of the State Electricity Supply Works in Stockholm.

Mr. E. White, Superintendent of the Hilton Road generating station, has resigned.

Mr. J. Hebb, who was recently appointed canvassing engineer to the Derby electricity undertaking at 25s. with commission, will in future be paid £2 10s. per week inclusive.

The Journal.—The July number of the *Journal* of the Institution of Electrical Engineers (No. 190, Vol. xli.) contains the following Papers and reports of the discussions thereon :—"Electrical Power in Railway Goods Warehouses," by H. Henderson; "Electrical Power in Docks," by C. E. Taylor; "Fuse Phenomena," by Prof. Schwartz and W. H. M. James; "Artificial Load for Testing Electrical Generators," by R. K. Morcom and D. K. Morris; and "Rules of the Society of German Electrical Engineers," by W. P. Steinthal. Sir William Preece's lecture on "America Re-visited" is also included, and an original communication, entitled "The Potential of Partially-Insulated Systems in Relation to the Potential of Earth," by M. B. Field.

Electric Lifts with Push-button Control.—The electric lift at the new offices for the National Pension Fund for Nurses, at Buckingham Street, opened by the King and Queen recently, was installed by Archibald Smith & Stevens. It is fitted with push-button control, and requires no attendant. On each floor served is an ordinary button push, pressure of which will call the lift if it is not already in use. If the door is not locked after entering the cage the control circuit is interrupted and the cage cannot be moved. In the cage are placed a number of button pushes corresponding to the number of floors served, and pressure of any one button will send the cage to the corresponding floor. A stop-button is also provided to stop the cage if a wrong button has been pressed. When the lift is in use all the controlling buttons are dead, so interference with the passenger using the lift is impossible. No door can be unlocked or opened when the cage is not standing opposite that particular door. We understand Messrs. Archibald Smith & Stevens have also erected eight lifts worked on this principle at the new offices of the *Morning Post* newspaper, Strand.

MISCELLANEOUS CITY NOTES

BRITISH INSULATED & HELSBY CABLES.—The transfer books will be closed from July 18 to 25 inclusive, for the preparation of warrants for dividends on the preference shares. The warrants will be posted on July 30th.

COMPANIES STRUCK OFF REGISTER.—Among the companies which have been struck off the register under date July 10th is the New Electric Light Syndicate, Ltd., which was registered on December 12th, 1895.

The following companies will be struck off the register at the end of three months from July 10th, unless cause is shown to the contrary :—Cox Thermo-Electric Co., Ltd.; Simplex Electric Tramway Conduit Syndicate, Ltd.; Standard Dynamo & Motor Manufacturers Co., Ltd.; United Electric Wire & Telegraph Works, Ltd.

CITY & SOUTH LONDON RAILWAY CO.—The directors recommend a dividend at the rate of 1½ per cent. per annum on the ordinary shares for the June half-year. The dividend for the corresponding period of 1907 was 2½ per cent. £1.500 are carried to renewals fund, and £1,800 carried forward.

HESWALL DISTRICT POWER CO.—This company has just issued a prospectus inviting subscriptions to £30.000 £1 shares. Messrs. T. L. Miller, Wilson & Pegg are consulting engineers to the company, which has entered into an agreement with the Parish Council and the Wirral District Council, who are the ruling authorities, under which an application will be made to the Board of Trade for a Provisional Order. The District Council has the option of purchasing at the end of 21, 28, or 35 years.

MEXICAN TRAMWAYS CO.—A dividend of 4 per cent. per annum for the three months to June 30th has been declared.

NEWCASTLE-ON-TYNE ELECTRIC SUPPLY CO.—An interim dividend of 2½ per cent., less tax, has been declared on the ordinary shares for the June half-year.

TELEGRAPH CONSTRUCTION CO.—An interim dividend of 12s. per share is recommended.

THOMAS PARKER.—Owing to the increasing demand for Rees Roturbo pumping and other machinery, for which Thomas Parker, Ltd., holds the sole manufacturing right for Great Britain and Ireland, the present working capital of the company has been found to be inadequate for the increased business. Consequently a new company is being formed, entitled the Rees Roturbo Manufacturing Co., Ltd., which will take over the whole of the assets and liabilities of Thomas Parker, Ltd., and carry on the business as a going concern. The directors of Thomas Parker, Ltd., intended originally to transfer the business under the powers given them in the Memorandum and Articles of Association of the company, and at a meeting of shareholders in April this scheme was passed unanimously. Owing, however, to a judgment given in the High Court immediately after this meeting, the directors were advised that it would be necessary to proceed by a voluntary liquidation and a transfer by the liquidator under the 161st section of the Companies' Acts of 1862. The necessary meetings of shareholders have now been held, and the scheme has been passed, and the company is now in voluntary liquidation for the purpose of carrying out the scheme, in full accordance with the advice of counsel. In the meantime, the business will go on as usual.

UNITED RIVER PLATE TELEPHONE CO.—A final dividend of 5 per cent. on the ordinary shares, making 8 per cent. for the year, free of tax, is recommended. The amount carried forward is £4.904.

NEW PUBLICATIONS

"Journal" of the Institution of Electrical Engineers. July, No. 190, Vol. 41. (London : E. & F. N. Spon.) Price 5s.

"Handbook of Farm Buildings, Ponds, &c., and their Appurtenances." By Thomas Winder. With a chapter on the "Application of Electricity to Farming and Agriculture," by J. W. Beauchamp, Deputy Manager of the Sheffield Corporation Electric Supply Department. (Sheffield : Pawson and Brailsford.) Price 6s. 6d.

Arrangements for the Week.—The Institute of Marine Engineers is holding a meeting in the Congress Hall, at the Franco-British Exhibition on Saturday next, July 18th, at 7 p.m., when Mr. W. P. Durtnall will read a Paper on "The Generation and Electrical Transmission of Power for Main Propulsion and Speed Regulation."

Obituary.—We regret to have to announce the death, on Wednesday last week, of Lord Blythswood, at his residence, Blythswood House, Renfrewshire. Apart from his work in the social and political life of West Scotland, Lord Blythswood was one of the comparatively few members of the House of Lords greatly interested in science, and carried out a considerable amount of research work in connection with Röntgen rays, as well as experimenting in connection with physics, having a private laboratory of his own at Blythswood House. Glasgow University conferred an honorary degree upon him in recognition of his scientific work. His Lordship was born on February 22nd, 1857. The funeral took place on Saturday at Inchinnan Churchyard, near Glasgow.

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ELECTRICAL ENGINEERING

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SUMMARY

A fire occurred upon the City & South London Railway near Moorgate Street station on Thursday. An official inquiry was opened by the Board of Trade on Monday, at which Mr. P. V. McMahon, Electrical Engineer to the Company, expressed the opinion that the fire was not an electrical one. The inquiry was adjourned *sine die*. (Page 130.)

The following books are reviewed in this issue:—"Industrial Electrical Measuring Instruments," by K. Edgcumbe; "Modern Electrical Theory," by N. R. Campbell; and "Wireless Telephony," by E. Ruhmer (translation). (Page 131.)

An article on "Rail Corrugation" summarises a recent essay by the Belgian engineer, M. Lassalle, in which he suggests a connection between the characteristics of the series motor, which will set up a condition of alternate slip and roll, and this form of rail wear. As contributing to the effect, he shows that the normal load impressed by car-wheels upon the rail-heads approaches the elastic limit of the steel. (Page 132.)

The annual report and accounts of the Manchester Corporation Electricity Department records a considerable increase in the load and a reduction in the total expenses per unit sold as compared with last year, notwithstanding the increase in the price of coal. The figure now stands at 1·379d. per unit, with the inclusion of all capital charges. A surplus of £17,545 has been obtained on the year's working. (Page 133.)

In view of the opening of the section of the Midland Railway equipped on the single-phase system, a good deal of interest has been directed to the progress of the work on the London, Brighton and South Coast Railway, which was the first to decide upon this system. We are able to give a few notes on the form which the equipment will take. Considerable difficulties have had to be overcome owing to wide variations in the height of the overhead conductor enforced by local conditions, and the most elaborate precautions are being taken to minimise interference with neighbouring telegraph and telephone lines. (Page 134.)

In his annual statement in the House of Commons on Friday, the Postmaster-General said that the Government was determined that the telephone system should be placed upon a paying basis. With regard to complaints as to overcharging on the measured rate system, experience, he said, had shown this to be impossible. On the question of wireless telegraphy Mr. Buxton said he was glad that the relations between the Post Office and the Marconi Co. had entirely changed, and were now of a most friendly character. (Page 134.)

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A STATEMENT sent by Mr. MILES WALKER, at the request of the Sub-committee on Symbols of the British Electrotechnical Commission, relates to the creation of a number of new symbols to represent physical quantities. It is proposed that the use of initial letters, such as "R" for resistance, "C" for current, &c., should be avoided, as such letters are not international. The substitution of entirely new signs is put forward as a way out of the difficulty, and some examples are given. It is further suggested that the name of the symbol should be the name of the unit represented. (Page 135.)

THE replies of Mr. C. M. SHAW to the discussion on his Paper on "The Reconstruction of an Electric Lighting Scheme," and of Mr. H. A. RATCLIFF to the discussion on his Paper on "The Standardising and Testing Department," both read at the Nottingham Convention of the Incorporated Municipal Electrical Association, are given in full. (Page 136.)

THE annual report of Mr. G. SCOTT RAM, his Majesty's Electrical Inspector of Factories and Workshops, reports that the increase in accidents due to electric causes reported under the Factories Acts is smaller than might be expected from the growth of the applications of electrical power in factories. A number of the accidents mentioned are due to easily preventable causes, of a nature that has been frequently commented upon in previous reports, and many are due to pure carelessness. In view of several fatal accidents that have occurred through faulty electric handlamps, Mr. Ram goes into the design of these in some detail, giving illustrations of lamps in which exposed metal work is liable to become "live" through accidental contact with conductors, and some better forms in which this risk is practically eliminated. Several fatal accidents with voltages in the neighbourhood of 250 are recorded, but it is noticeable that all these are on alternating-current circuits. Some interesting statistical tables are included. (Page 137.)

A SHORT note calls attention to rather an amusing aspect of the telephone difficulties in Paris. (Page 139.)

A VERY simple electrolytic prepayment meter has just been put on the market. The insertion of a coin lowers an electrode into a caustic soda solution. Current can then be drawn from the supply until the level of the liquid falls, on account of the electrolytic action, below that of the electrode, when a resistance is inserted in series with the consumers' lamps. The electrode can be immersed again by the insertion of another coin. The chief features of the meter are simplicity and low cost. (Page 140.)

A DESIGN for an arc-lamp standard for the streets in the City has been submitted to the Electrical Engineer to the City of London by a firm of iron-founders. The design includes no means for lowering the lamp, so that the use of a tower for cleaning and adjustment would be necessary. (Page 140.)

THE electrical equipment of the Stanningley Ironworks, near Leeds, includes the electrical driving of a great variety of machinery for general engineering work. The supply is taken from the mains of the Yorkshire Electric Power Co., and transformed down on the premises from 10,000 volts to 400 volts. There are over fifty motors, aggregating nearly 1,000 h.p., and vary in size from 2 to 140 h.p. each. (Page 141.)

OUR fourth illustrated article on matters of electrical interest at the Franco-British Exhibition, contains some further particulars of the electrical engineering exhibits, including some additions to the collective exhibit of the electric supply companies of London which have been made since our last description. An account is also given of the method of control employed for the electrical driving of the large newspaper press in the *Daily Mail* Pavilion. Some further notes of the power plant in the Exhibition will appear in our next issue. (Page 143.)

IN a Paper read before the Institute of Marine Engineers on Saturday by Mr. W. P. DURTNALL, the application of the "Hart-Durtnall" electrical power transmission system to main marine propulsion was dealt with. The author estimated the possible saving in necessary boiler capacity and coal consumption to be gained by utilising electrical transmission with polyphase induction motors, and described how different economical speeds could be obtained by variations in the number of effective poles of the motors. (Page 147.)

A LETTER from Mr. A. M. TAYLOR refutes some of the criticisms made on his Paper discussed at the Nottingham Convention of the Incorporated Municipal Electrical Association, and one from Mr. A. BENNIS relates to the relative advantages of certain types of automatic stokers referred to in the discussion on another Paper read at the Convention. (Page 148.)

NOTES are given under "Electrochemistry and Electrometallurgy" of an electrical method of maturing wines and spirits, and on experiments which are being conducted at Marseilles on the electrical stimulation of vegetable growth by current-carrying conductors buried in the ground. A new primary cell in which aluminium and magnesium electrodes are employed, and which, on addition of hydrogen peroxide will give an E.M.F. up to 1·7 to 2·1 volts is described. Other subjects dealt with are the electrolytic oxidation of copper and the electrolysis of pure hydrochloric acid. (Page 149.)

UNDER "Electrical Science," in the British and American section, is a note on the results of some investigations into the magnetic properties of the iron alloys known as "stalloy" and "lohys" iron. In the Continental section a method of obtaining a high-potential direct pulsating current from an induction coil with a Wehnelt interrupter is described. A Paper by C. TISSOT, referring to the composition of thermo-electric detectors for electromagnetic waves, is abstracted, and particulars of an automatic repeating ballistic galvanometer constructed by GUILLET are also given. (Page 149.)

SOME novelties in the way of telephone apparatus and branch switches are illustrated and described. (Page 150.)

A PATENT specification by the BRITISH THOMSON-HOUSTON CO., referring to a simple system of multiple-unit control, was published on Thursday last. The system consists in operating motor-controllers on the separate cars of a train by relays and an independent control circuit. An arrangement for equalising the load on alternating-current systems is described in a specification by J. S. PECK, and the BRITISH THOMSON-HOUSTON CO. have a second specification relating to the control of compensated series commutator motors. A specification by the ALLGEMEINE ELEKTRICITÄTS GES. describes a method of control for three-phase rolling-mill motors to enable the control to be effective at speeds considerably below the normal synchronous speed. The improvement of microphones by the substitution of hydrogen for air in the granule chamber is the object of a patent by C. E. EGNÉR and J. G. HOLMSTRÖM. Application for the amendment of a specification relating to induction furnaces has been received from the GRÖNDAL KJELLIN CO. Two patents of electrical interest expire during the current week; one of these is that for the well-known method of transformation from two- to three-phase devised by C. F. SCOTT, and the other relates to controllers for electric lifts and winches. (Page 151.)

BEFORE the Unopposed Committee of the House of Commons last week a long discussion took place in connection with a report by the Home Office and the Commissioner of Police upon the Metropolitan Electric Tramways Bill. The Bill proposes the construction of

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a short extension of tramway in the Harrow Road, and the Commissioner of Police asked that temporary tramways should be on a level with the surface of the roadway; that the company should not be allowed to carry parcels; that the Commissioner should be authorised to call the attention of the Board of Trade to cases where the track is in a bad state of repair; and that he should have the use of the tramway standards for fixing directions for traffic, &c. The Committee were against the Commissioner on the first two points, but conceded the others. (Page 153.)

IN the House of Lords on Tuesday, the London United Tramways Bill, which provides for the construction of tramways over the new King Edward VII. bridge at Kew, was passed with a provision that the County Councils of Middlesex and Surrey shall have the right to decide whether the overhead or any other system of traction shall be adopted. (Page 153.)

THERE is a debit balance of £1,000 on the working of the Ayr electricity undertaking for the past year.—The annual report upon the Croydon Corporation Tramways for the year ended March 31st, 1908, shows a balance of £2,829 after providing for interest and sinking fund. The number of passengers carried was 16,277,318, an increase of 83,416 over the previous year. Complaint is made in the report of the high price charged by the Electricity Committee for the energy.—The Dundee Tramways Committee has decided to be its own insurers against third-party risks, and £1,000 per annum is to be set aside for this purpose.—The Hastings Corporation has agreed to Sunday trams on condition that the Sunday profits shall not be taken into consideration in fixing the price should the Corporation acquire the company's undertaking.—Alderman SMITH, the deputy chairman of the Liverpool Tramways Committee, brought a libel action this week against some other members of the City Council, but on Monday the jury decided that he had failed to prove malice.—There is a net profit of £888 upon the Bermondsey electricity undertaking for the past year after meeting interest and sinking fund.—The accounts of the Wolverhampton electricity undertaking show a net profit of £3,325 for the year ended March 31st, 1908.—The Yarmouth electricity accounts for the past year show a small deficit of £14. (Pages 155 to 157.)

THE Highways Committee of the London County Council recommend that tenders be invited for lighting Westminster Bridge by electricity.—Extensions to the public arc lighting in Swindon are contemplated at a cost of £1,180.—The York Electricity Committee invite tenders for electrical accessories.—A 900 kw. direct-current generator with Belliss engine is required by the Hull Corporation.—The Dewsbury Corporation requires a storage battery, reversible booster, switchgear, &c.—The Local Government Board has sanctioned a loan of £27,000 for extensions to the Ilford electricity undertaking.—For the information of wiring contractors we give particulars of a large number of buildings about to be erected in London and the provinces. (Pages 157 to 159.)

THE report of the City & South London Railway Company for the June half-year shows a gross profit of £47,536, and after making provision for debenture stock, interest, &c., there is a net balance of £32,999. A dividend of 1½ per cent. is recommended upon the ordinary stock.—The net profit for the year to March 31st of Messrs. Crompton & Co. amounts to £31,220. A five per cent. dividend is recommended.—The report of the Bombay Electric Supply & Tramways Company shows a balance available for distribution of £30,701.—The report of the East London Railway Co. states that a report has been prepared dealing with the question of converting the line to electric traction.—There is a net trading profit of £59,753 shown by the accounts of the General Electric Company for the past year. A dividend of 5 per cent. upon the ordinary shares is recommended.—Subscriptions have been invited for £100,000 five per cent. prior lien debenture stock of Edmundson's Electricity Corporation; for £125,000 ordinary £1 shares by the Malta Tramways Company; and for £500,000 4½ per cent. redeemable debenture stock by the Toronto Power Company.—Dividends are announced by the Bournemouth & Poole Electricity Supply Company, the St. James & Pall Mall Electric Light Company, and the County of London Electric Light Company. (Pages 159 to 161.)

THE Central Ireland Electric Power Bill was passed by the House of Commons Committee last week. The only opposition was by the Dublin and Alliance Gas Co., who opposed on the question of unfair competition, and called Mr. STEPHEN SELLON, who expressed the opinion that the scheme could not be financially sound. (Page 161.)

THE cars upon the G.B. Surface Contact system, which has been in experimental use in the Mile End Road, have been temporarily withdrawn, and a full report on the matter is to be placed before the next meeting of the London County Council. (Page 161.)

THE annual report of Mr. G. SCOTT RAM on the accidents due to electrical causes which he comes across in the course of his work as His Majesty's Electrical Inspector of Factories always contains matters of interest, and is valuable as making public results of experience with electrical apparatus of every shade of good and bad design, and revealing possible causes of easily preventible danger which might pass unsuspected. Last year the subject of badly constructed motor-starting gear was given particular attention, and in the latest report, published at some length in this issue, Mr. RAM deals more especially with faulty hand-lamps, and shows, by citing actual examples, how often there is a lack of proper precautions to prevent liability of exposed metal parts becoming live. The layman on reading the report will perhaps be a little apt to infer that anyone taking hold of one of such lamps will immediately drop down dead, and may clamour that electric hand-lamps *per se* are dangerous; but it must be realised that the purport of Mr. RAM'S report is to emphasise dangers which exist, although remote, and not to call attention to the obvious fact that for every hand-lamp which causes even a harmless shock, many millions have not only stood the rough use to which they are inevitably subjected, but prevented risks of even more serious kind by obviating the use of naked lights. The question may perhaps be asked whether it is really the right course to depend absolutely upon the excellence of construction of the lamp to prevent the possibility of the user being subjected to the voltage of the circuit, and this brings up again the vexed question of what is the lowest "dangerous" voltage. It may certainly be argued that a voltage, the use of which is perfectly justifiable for fixed installation work, may not be suitable for use with a lamp which is grasped in a man's hand. One possible way of avoiding such risk as exists on alternating circuits, and it is on alternating circuits that most of the "moderate voltage" accidents occur, is to take advantage of the economies of the low-voltage metal filament lamp, and instal transformers either for the whole group of lamps or at the plug from which the hand-lamp is supplied in order to step down the voltage to a value which is harmless, however great the leakage, and which enables high-efficiency lamps to be used with filaments thick and robust enough to stand hard usage.

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Two decisions affecting tramways in the metropolitan area have been given by Parliamentary Committees this week which deserve attention. It is the practice of the Board of Trade and the Home Office to make individual reports upon all Bills which come before Parliament should the circumstances warrant it, and such reports have to be complied with unless very good reason is shown to the contrary. It is, of course, open to the promoters to oppose such reports, and thus it happened that a report by the Home Office, instigated by the Commissioner of Police, upon the Metropolitan Electric Tramways Bill was objected to before the Unopposed Committee of the House of Commons on Thursday, and, on the whole, there was good reason for this opposition. It appears that the Commissioner of Police has been asked to suggest further precautions in the interests of the general street traffic within the area of his jurisdiction, and he asked, among other things, that all temporary tramway rails should be laid level with the surface of the roadway, that the carrying of parcels should be prohibited, and that the Commissioner should have the right to call the attention of the Board of Trade to the condition of the tramway track. The fact that accidents occurred from the use of temporary raised rails during the reconstruction of the South London tramways is not sufficient reason for imposing upon tramway authorities the additional expense of laying what is in effect permanent track for purely temporary purposes, for, as several members of the Committee pointed out, it is the duty of other traffic using the road under these conditions to use proper care. Similarly the Committee, after having heard what is being done in other towns with regard to carrying parcels on tramways, refused to accede to the Commissioner's request. There can be no objection to the Commissioner having the power to call the attention of the Board of Trade to the condition of tramway track, for although this can already be done by the road authority or twenty ratepayers, neither party appears to take the matter very seriously. The other decision referred to was upon the London United Tramways Bill, in which a House of Lords Committee gave the Surrey and Middlesex County Councils the absolute right to determine whether an underground or overhead system of traction shall be used upon the new King Edward VII. bridge at Kew. This decision upholds the principle of local authorities' veto in connection with tramway matters which has been declaimed against on so many occasions, and had the company's suggestion of leaving the matter to the decision of the Board of Trade been accepted by the Committee a greater measure of fairness would have been given.

A GOOD deal has been made in those sections of the Press which imagine that their readers care more for sensationalism than dispassionate accuracy, of the fire which occurred last week on the City and South London Railway under circumstances reported in another column. The matter has been the subject of a Board of Trade inquiry by Col. YORKE and Mr. A. P. TROTTER, and we must withhold our opinion as to the actual cause of the fire until these gentlemen issue their report. From the evidence which has been heard there would seem to be room for doubt as to whether the cause of the fire was electrical or not, and further investigation appears to be required. The occurrence was nothing like so serious as has been made out, although the work of the Fire Brigade was, as is bound to be the case in a tunnel fire, attended with great difficulty. No one was hurt, and the statements as to panic among the passengers in the daily papers, as well as of the damage done, are gross exaggerations. The comments of the *Globe* on the inquiry are amusing. The railway is referred to as "a new method of travel," whereas it was opened in 1890, and all the witnesses at the inquiry had been for eighteen years in the employ of the company.

FIRE ON THE CITY AND SOUTH LONDON RAILWAY

ON Thursday evening, at about six o'clock, a fire occurred in the tunnel of the City and South London Railway, close to Moorgate Street Station, on the Bank Station side. It appears that as the driver of a Euston to Clapham Common train was approaching Moorgate Street from the northern side, he noticed a glow in the tunnel on the other side of the station, and by the time he had drawn up at the platform, he realised that some mishap had occurred. The attention of the stationmaster being drawn to the matter, instructions were at once given for the passengers to leave the train, and fortunately they all reached the surface without any danger or panic. By this time volumes of smoke had penetrated from the tunnel into the station, and the Fire Brigade was sent for. Considerable difficulty was experienced by the firemen in getting to the spot where the fire had occurred, owing to the smoke, and after endeavouring to deal with it from Moorgate Street Station end, an effort had to be made from the Bank Station, from which the firemen dragged the hose along the tunnel. It was not until eleven o'clock on Thursday night that the outbreak was finally overcome, when it was ascertained that a number of Jarrah wood sleepers and a disused signal box had been burned, but that no real serious injury had occurred to the permanent way; in fact, trains were again running on Friday.

An official inquiry was held by the Board of Trade on Monday, at the offices of the City and South London Railway Co., Moorgate Street, the presiding official being Lieut.-Col. Yorke, who was accompanied by Mr. A. P. Trotter, Electrical Adviser to the Board of Trade. Among those present were the General Manager of the Company, Mr. T. C. Jenkin, the Electrical Engineer to the Company, Mr. P. V. McMahon, and the Electrical Engineer of the City of London Corporation, Mr. A. A. Voysey. Evidence was first called from the officials at the Moorgate Street Station. The lift machinery attendant at Moorgate Street said that when he first noticed the fire, he fetched some sand and threw it on to two sleepers, the underside of which was on fire. This had little effect, however, and he informed the stationmaster what was going on. The stationmaster stated that when he arrived at the spot and threw sand upon the sleepers, the main cable became ignited. The current was then switched off. In answer to Mr. Trotter, the stationmaster protested against some statements of the daily papers as to the manner in which the passengers left the station. As a matter of fact, there was not the slightest sign of alarm amongst any of the passengers. The driver of the train coming from the north stated that he sometimes saw evidence of little fires on the line, but reported them to the stationmaster at the next station. Mr. P. V. McMahon, the Electrical Engineer to the Company, said that from the evidence, he was quite convinced that the fire was not of electrical origin. He did not think that the cables were the cause of the fire. With regard to the previous witness's evidence as to seeing little fires on the line, he said that sometimes light occurred at the base of an insulator near the sleeper, but this was soon remedied when the accumulation of carbon was brushed away. In the case of all recent repairs, wood sleepers have been replaced by slate slabs. There was no truth in the statements which had been made in the daily papers that the track for over one hundred yards leading into Moorgate Street Station had been destroyed. Mr. A. P. Trotter here remarked that when he visited the tunnel after the fire, he only found four sleepers badly charred. Mr. McMahon said that so far as the permanent way was concerned, they could have resumed running the trains half an hour after the outbreak was extinguished. The smoke and smell were no doubt largely due to the coating of the cables, and he agreed that it was important that the cable covering should be of non-inflammable material. He had formed a theory that possibly the fire had been caused by a spark from a shoe of one of the locomotives. Lieut.-Col. Yorke on this point raised the question as to why, if this was the cause, the sand did not put the fire out.

No further evidence was called, and the inquiry was adjourned *sine die*.

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REVIEWS OF BOOKS

Industrial Electrical Measuring Instruments. By Kenelm Edgcumbe. 227 pp. 5½ in. by 8½ in. 126 illustrations. (London: Archibald Constable & Co.) 8s.

MR. EDGCUMBE has produced a very satisfactory book, which he is more or less right in claiming to be the first on the subject published in English. He writes of the various instruments as a maker speaking to users. The latter are assumed to be men in actual work, who need not be told a lot of preliminary theory and history, but are accustomed to use instruments every day. Such men, however, will always allow that a maker must be able to tell them a good deal about those that they use already and a good deal more about those of which they have not had practical experience. The why and wherefore is given to a reasonable extent in plain words; in alternating current instruments even, mathematics are cut down to a minimum, and the few vector diagrams are so simply put that, instead of irritating, they will rather serve to reconcile to their use those who are not accustomed to them, a consummation devoutly to be wished. There are forty pages of preliminary and general matter. The remarks on accuracy are good reading for any instrument user, and the table of the accuracy which may be expected from various types of instrument is a conservative one, as it should be. Constructional details such as springs, pivots, shunts, winding, and damping, are well and shortly dealt with. The various types of instruments, ammeters, volt-meters, watt-meters, ohm-meters, galvanometers, and dynamometers, are described and discussed. It would have been easy to have filled up the book with illustrations of these, from various manufacturers' catalogues, and to have made a far more pretentious volume, without in any way increasing its value. Mr. Edgcumbe has, however, adopted the much wiser course of giving no illustrations of the outside of any instrument; he has confined himself to diagrams of the various types which will apply to all makes alike, and has dealt solely with the principles common to all when dealing with a type made by more than one manufacturer. At the same time the reasons for sundry little details and precautions are given which, while well-known to makers, are liable to be overlooked by users when buying instruments. Several little points in their use are also mentioned, which it is convenient to have all in one book instead of scattered in various papers.

Pyrometers are barely within the scope of the book, and the cymometer is distinctly outside it. The oscillograph—well, one thinks of it as a laboratory instrument, and yet it is quite rightly included, as it is to a great extent, and should be still more, an industrial one.

Mr. Edgcumbe has been very successful in sinking, though in no way concealing, the fact that he is himself a manufacturer, and although he naturally mentions some of his own special ones with the rest, his book distinctly deals with instruments, and not with particular makes of them.

Modern Electrical Theory. By Norman R. Campbell. 332 pages, 5¼ in. by 8½ in.; 32 illustrations. Cambridge Physical Series. (Cambridge: The University Press.) Price 7s. 6d. net

THE rapid accumulation of experimental facts and of speculations in the domain of electricity and optics during the past ten years have made it exceedingly difficult for anyone but the professional expert to obtain anything like a comprehensive view of modern electrical theory. The books that have been published hitherto, at least in this country, are either of a more or less popular nature, or deal only with special branches, such as conduction through gases or radio-activity.

Mr. Campbell's work is, we believe, the first serious attempt "to expound the subject in its logical order, to analyse the arguments by which the various phenomena are correlated, to draw special attention to the assumptions that are made, and to show which of these assumptions are fundamental in the modern theory of electricity and which may be expected to be abandoned in this further progress of investigation." To accomplish this within the space of about three hundred pages, considering the wide range of phenomena to which the electron theory has been applied, was no light task; great condensation was necessary, and has been attained chiefly by omitting detailed descriptions of experiments and lengthy mathematical investigations. These details, however, can easily be filled in by the reader, as references are given at the end of each chapter to all the most important special treatises and original papers. The conception of Faraday tubes, developed with such success by J. J. Thomson, is utilised throughout, and is briefly explained in the first chapter. In the second chapter the ordinary electromagnetic theory is explained. It was the complete failure of this theory to explain certain optical phenomena, *e.g.*, magnetic rotation, which led H. A. Lorentz, thirty years ago, to the conception of electrons.

Succeeding chapters deal with the modern electron theory, and discuss the phenomena of magnetism, thermal and electrical conductivity, conduction through gases, radioactivity, and the constitution of the atom. The last chapter is devoted to the laws of electromagnetism, and contains an exceedingly good *résumé* of our knowledge of the optics of moving systems.

It is a book that should be read by all students of physical science; those who desire merely a good general knowledge of recent developments in electricity will find that it contains all that is essential; while those who wish to specialise will find it an excellent introduction and guide.

Wireless Telephony. By Ernst Ruhmer; translated by J. E. Murray, D.Sc. 224 pp. 8¾ ins. by 6 ins. 145 illustrations. (London: Crosby, Lockwood & Sons.) 10s. 6d. net.

RUHMER'S "Drahtlose Telephonie," which was published in Leipzig about a year ago, has as its chief characteristic the fact that it is the only volume extant devoted entirely to the art of telephony without intercommunicating wires. When it appeared in its original tongue, the book was a small one; but this English edition is, strange to say, a comparatively bulky volume. The contrast is due not so much to an appendix, or to publishers' advertisements, as to the employment of very thick glazed paper, and to prodigal indulgence in large diagrams. For instance, whole pages are, on occasion, given up to absurdly simple line drawings, and other pages are occupied by pictures of buildings or barges—beautiful when regarded as samples of half-tone blocks—with a relatively infinitesimal piece of wireless telephone apparatus in the field of view. This sumptuousness has caused the book to appear at what may be considered as rather a high price for the amount of information conveyed.

The first part of the work is rather more than a third of the whole, and is devoted to what is called photo-telephony, that is, telephony by means of beams of light. As is well-known, photo-telephony is based on the fact that the electrical resistance of selenium varies with the intensity of the light falling upon it. Bell and Tainter are notable names in the inception of photo-telephony, but Ruhmer himself, the present author, has in recent years improved the sensitive apparatus, has brought into use the speaking arc, and has thus extended the range of light-telephony to as far as 2 or 3 miles. All this is set forth in detail, and is of considerable scientific interest, though of but small technical import.

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The next part of the work deals with wireless telephony of the purely electrical variety. First is described the "induction telephony," such as was carried out by Preece and Gavey between long parallel horizontal wire circuits closed through the earth. Then comes a description of spark telephony. Here are set out some of the various methods that have been proposed for producing streams of sparks of rapidity great enough to transmit sound waves by their variations of intensity. Some good oscillograph diagrams are given, but the general descriptions are very sketchy. About 50 pages are devoted to arc methods of wireless telephony; and the summary, here given by the author, of the work that has been done by various experimenters is a very just one, but not a very instructive one. The author makes an attempt to discriminate between the true singing arc (called by him the *pure* Duddell phenomenon) and the interrupted or screeching arc (the *impure* Duddell phenomenon). In the former, the current through the arc is practically sinusoidal, and, at its lowest value barely reaches zero value; in the latter the arc current is zero for an appreciable fraction of every period, and is thus, in the author's opinion, really of the character of a spark discharge in which a series of damped wave trains follow one another with great rapidity, but in which the sparking rate is in no way directly related to the frequency of the oscillations produced at each spark. The reader will find, we fear, that the author's explanations of these very complex phenomena, are often lacking in clearness; intelligibility is too often sacrificed to brevity. Nevertheless, the book is interesting and topical.

RAIL CORRUGATION

A RECENT number of the *Bulletin* of the "Association des Ingenieurs Electriciens sortis de l'Institut Electrotechnique Montefiore" (Liége), contains a study by M. Lassalle of rail corrugation which puts into a definite form certain theories of the causes of rail corrugation, and endeavours, by a quantitative analysis of the conditions, to show that the suggested causes are competent to produce the observed effect. One feature which distinguishes M. Lassalle's work from that of many theorisers on the subject is that it offers an explanation of the prevalence of corrugation on electric tramways as compared with their comparative rarity on railways and tramways worked in other ways.

Considering a stationary car of 10 tons weight carried by four wheels of 75 cm. diameter on rails weighing 43 kgs. per metre, and having a table 4 cms. wide, the author shows that the maximum compressive stress on the rail-head is 26 kgs./mm.^{2}, and as the elastic limit in compression of rail steel is from 30 to 35 kgs./mm.^{2}, it is reasonable to suppose that a running car will frequently stress the rail heads beyond the elastic limit, and produce permanent deformation, especially if the pressures between rail and wheel change suddenly producing shocks or incipient blows, or if abrasion occurs. How shocks and abrasion competent to produce deformation of an undulating character, or corrugations, may arise, the author seeks to show by an argument which is outlined below. Consider a car in motion upon a straight level track, provided with a series motor driving each axle, and let all the conditions be symmetrical, loads equally distributed, wheel diameters equal, motors exactly similar, ideal conditions, in short. Let the car be running at a uniform speed, then the motor or driving couple and the resistance couple are in equilibrium on each axle, this couple corresponding to a point on the torque speed characteristic of the motor for the controller notch in use, *i.e.*, for the voltage supply and the amount of resistance in the motor circuit. Now if the controller is moved to the next higher speed notch the motors will accelerate and reach a higher steady speed corresponding to a point on another torque speed curve, and assuming proper adjustment of the rheostat, the change will be smooth. But if the controller is moved over, say, three notches without pausing to let the motors attain their steady speed for each step, the motor couple will rise suddenly, and may produce wheel slipping when the resistance couple will fall sharply by the difference between the coefficient of adhesion and the coefficient of sliding friction, and the velocity of the revolving masses will increase, whilst the motor couple diminishes until it becomes less than the resistance couple due to the sliding friction. As soon as this occurs slipping ceases and adhesion recommences, whilst the motor current and couple again increase sharply, and slipping may be repeated. There may be several alternations of slipping and adhesion due to too great a movement of the controller before a new condition of equilibrium is reached, and the periods of these alternations will be very short. Whilst slipping the wheels abrade and wear the rails. The number of alternations, and therefore of successive abrasions, will depend upon the value of the coefficients of adhesion and of sliding friction, the forms of the motor characteristics and the amount of controller movement. The change from adhesion to slip and *vice versâ* will be sudden.

If corrugation may be produced in this way under the ideally symmetrical conditions postulated, it is evident that irregularities in the track, in the distribution of weight upon the car wheels, and other of the conditions may conduce to it. M. Lassalle proceeds to consider the case of curves where it is evident that alternate skid or slip and roll must occur, and also the effect of braking where excessive brake block pressure may produce intermittent skidding.

That corrugation is produced by such alternations of slip and roll or skid and roll has been suggested by several engineers during the discussion, which has been in progress for several years, and various causes of such alternations have been suggested. M. Lassalle, we believe, is the first to point out the possible connection between the characteristics of the series motor, coupled with the other conditions, and this troublesome form of rail wear, and thereby he may have found the answer to the rather puzzling question why corrugation is so distinctively (though not exclusively) a disease of electric traction. The suggestion is worth following up, and should not be difficult of experimental proof.

It is worthy of note that Professor Carus-Wilson, in the Paper read before the Tramway and Light Railways Association Congress on July 10th, asserts that corrugation is caused by alternate skid and roll, which he attributes to a particular combination of circumstances connected with wheel and rail wear. (It should be explained that "skid" means the condition that the wheel is revolving at a slower rate than that due to the velocity of the car, and "slip" means the condition that the wheel is revolving at a quicker rate than that due to the velocity of the car.)

Professor Silvanus Thompson said at the British Association meeting last year, in reference to corrugation, that "a periodic effect pointed to a periodic cause." The alternations suggested are necessarily periodic. But it is evident that the skid and roll or slip and roll may be set up by various means, and it is a merit of M. Lassalle's work that he discusses several in a quantitative manner which is worth study. Professor Carus-Wilson has hit upon one which does not seem to have occurred to M. Lassalle, but he will probably readily admit the possibility of others.

The question of hardness of rail is slightly touched on in the paper, to show that the normal loads, approximate to the compressive elastic limit of rail steel, and evidently the harder the steel the more resistance it will offer to the corrugating tendency.

Waves leave ripples in the sand, but wear the granite smooth.

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MANCHESTER ELECTRICITY SUPPLY ACCOUNTS

THE following particulars of extensions and alterations to the plant of the Manchester Corporation are recorded in the annual report which accompanies the accounts for the year ended March 31st last.

Dickinson Street Generating Station.—Messrs. Bruce Peebles have satisfactorily completed their contract for the installation of three 1,500 kw. motor convertor units at the Dickinson Street sub-station. Negotiations between the department on the one hand and Messrs. Parsons and Messrs. Siemens on the other hand have been concluded, and arrangements made for satisfactorily carrying out the terms of the contract in regard to the two 750 kw. turbo-generators. A contract has been placed with Messrs. Richardson-Westgarth & Company for the installation of two Contraflo surface condensing plants in conjunction with the Musgrave engines, in place of the existing Körting condensers.

Bloom Street Generating Station.—The alterations to the flywheels on Nos. 1 and 2 Musgrave engines have been successfully completed. It is expected that similar operations on Nos. 3 and 4 engines will be carried through this summer. An agreement has been entered into with the Rochdale Canal Company in respect of the use of the canal water for condensing purposes, and the necessary works to carry this agreement into effect have been commenced.

Stuart Street Generating Station.—The contract for the installation of a 6,000 kw. Willans-Siemens three-phase turbo-alternator complete with Richardson-Westgarth condensing plant, which was entrusted to the first-named firm, has been carried to a successful conclusion. Considerable alterations and extensions to the high-tension switchgear have also been carried out by Messrs. Ferranti, Ltd., with good results. Further contracts are pending in respect of additional water-tube boiler, cooling towers, high-tension switchgear, pipework, and a second 6,000 kw. turbo-alternator.

A large number of sub-stations have been put down on consumers' premises, especially in the case of large manufacturing works, and nearly 20 miles of new mains have been laid during the year, bringing the total mileage of mains up to 338.

The total number of units generated and sold as compared with the previous year are given below.

	Year ended Mar. 31, 1907.	Year ended Mar. 31, 1908.
Units sold for private purposes ...	22,686,508	33,826,430
,, public lamps ...	91,938	98,818
,, traction	24,786,457	29,511,840
Total units sold	**47,564,903**	**63,437,088**
Units used on works	3,796,709	3,879,683
Units used in distribution or unaccounted for	11,695 302	15,436,218
Total units generated	63,056,914	82,752,989

No distinction is made between units sold for lighting or power as in previous reports, so that it is not possible to put into figures the relative increase of the two services.

The maximum supply demanded and corresponding load factors are given below.

	Max. demand.	Load factor.
Lighting and power ...	18,233 kw.	21·15 per cent.
Traction	10,288 ,,	32·8 ,,
Total	28,521 kw.	25·3 per cent.

The following table gives a summary of the average costs expressed in pence per unit sold, compared with the previous year:—

COST PER UNIT SOLD.

	Year ended Mar. 31, 1907.	Year ended Mar. 31, 1908.
Generating costs—		
Coal	0·213d.	0·247d.
Oil, waste, water and stores ...	0·028	0·029
Salaries and wages	0·081	0·064
Repairs and maintenance	0·076	0·066
Total generating costs	0·398	0·406
Distributing costs—		
Salaries and wages	0·066	0·065
Repairs, maintenance, &c.... ...	0·076	0·056
Total distribution costs ...	0·142	0·121
Total works costs	**0·540**	**0·527**
Management charges, &c.—		
Rent, rates, and taxes	0·137	0·109
Salaries and wages	0·035	0·030
Insurance, law, Parliamentary and special charges	0·006	0·006
Miscellaneous	0·013	0·007
	0·191	0·152
Total costs, excluding capital charges	**0·731d.**	**0·679d.**
Interest	0·333	0·260
Sinking fund and repayment of loans	0·351	0·282
Renewals suspense account	0·202	0·151
Applied in extension of works where borrowing powers are not granted (wages of permanent employees engaged on capital account)	0·012	0·007
Total costs, including capital charges	**1·629d.**	**1·379d.**

The total working expenses as analysed above amounted to £179,358, and the receipts from all sources were £385,024. Of the balance thus given, interest and sinking fund absorbed £68,855 and £77,268 respectively. £10,000 was carried to renewals expense account, and £1,998 was applied in extension of works where borrowing powers are not granted (wages of permanent employees employed on capital account), so that the final result was a surplus of £17,545, of which £10,000 was paid over in aid of rates, and the remainder carried to reserve. The costs of generation given above are, of course, averages for the three stations.

The following table shows the capital expenditure as at March 31st, 1908:—

Dickinson Street Generating Station—	
To land (including law charges incidental to acquisition)	£47,546
,, Buildings	51,755
,, Machinery and switchboards	172,315
Bloom Street Generating Station—	
To land (including law charges incidental to acquisition)	15,083
,, Buildings	57,878
,, Machinery and switchboards	127,330
Stuart Street Generating Station—	
To land (including law charges incidental to acquisition)	9,982
,, Buildings	210,832
,, Machinery and switchboards	327,610
To Stuart Street Railway	81,380
,, Distributing stations	326,906
,, Mains	889,468
,, Meters	57,306
,, Motors	26,371
,, Instruments	3,446
,, Cable stores and workshop, Polygon, Ardwick ...	30,532
,, Cottage property	3,993
,, Office furniture	2,288
,, Street lighting at Gorton	578
Total	£2,442,599

British Trade Correspondents in Canada.—The President of the Board of Trade has appointed Mr. R. Grigg, who recently completed a Commercial Mission in Canada and Newfoundland for the Advisory Committee to the Board of Trade on Commercial Intelligence, as H.M. Trade Commissioner in Canada. He has also appointed the following gentlemen as local trade correspondents in Canada:—Mr. W. J. Davidson, Vancouver; Mr. J. J. Shallcross, Victoria; Mr. J. Appleton, Winnipeg; Mr W. E. Anderson, St. John, New Brunswick; Mr. G. B. Ramsey, Quebec; Mr. A. T. Weldon, Halifax, Nova Scotia. It is possible that some further appointments of local correspondents may be made in Canada. The local Trade Correspondent in Newfoundland is Mr. H. W. le Messurier.

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ELECTRIC TRACTION ON THE BRIGHTON RAILWAY

THE following particulars of the electrical working which will shortly be inaugurated on the suburban lines of the London Brighton & South Coast Railway are taken from a souvenir what was issued in connection with the formal opening of the reconstructed Victoria Station. The station has been designed to separate the main line and suburban traffic as much as possible, and at the south end of the eastern side offices is the electric switch cabin, to be brought into use when electric trains are running. The section of the line at present being electrified extends from Victoria to London Bridge, a distance of nearly nine miles, equalling approximately 23 miles of single line. In Victoria Station five platform and two through lines, and in London Bridge Station six platform lines are being electrically equipped.

The improved service contemplated will require seven working trains and one spare one, each train comprising two third-class motor coaches with luggage and motorman's compartments, each equipped with four 125 h.p. motors. The motor coaches form the first and last coach of a standard three-coach train, the middle one being a first-class trailer coach. It is proposed to give a ten minutes' service throughout the day; the time occupied by a journey from Victoria to London Bridge or *vice versa* will be 25 minutes including stops, as compared with 36 minutes as at present required by the steam trains. The total seating capacity of each three-coach train is 188. Great care has been devoted to the comfort of passengers, and contrary to the American practice of adopting coaches of the tramcar type with end doors, which have been used on the underground railways and which have proved draughty and inconvenient, a modified form of side-entrance compartment coach has been designed, so that in the case of any one compartment being full, passengers can pass into the next without having to leave the carriage, this arrangement giving greater convenience to passengers and saving time at the stations. Ample rack accommodation is provided for small parcels and hand luggage, and particular attention has been devoted to simple, but effective, decoration, and efficient and abundant lighting. The coaches are painted in the new London Brighton & South Coast colour, the bodies being 60 ft. in length and 9 ft. in width, with lofty and well-ventilated compartments. The electrical equipment on the motor coaches is so arranged that passengers cannot under any circumstances have access to any high-tension apparatus, which, indeed, is only accessible to the railway staff when the energy is cut off and all high-tension connections connected to earth, and thus rendered absolutely safe.

As regards the electrical equipment of the line, the overhead conductor which conveys electrical energy to the motors consists of a heavy grooved solid wire, ½ in. in diameter, which is supported at every few feet by means of dropper wires suspended from stranded steel catenary cables, which are in turn suspended from massive porcelain insulators through a double insulation which has been tested to ten times the working pressure. The insulators are supported upon specially designed steel structures. Due to the constantly varying nature of the line on this section, a very great number of different types of support had to be designed, the strength of these having been calculated on a basis of a factor of safety of 10 to 1, which has in all cases been worked to in the overhead equipment. The overhead conductor is divided into sections at each station, specially constructed switchgear being provided in fireproof cabins for the control of the sections. By this means it is possible to isolate any section of the line in case of necessity, and in order to secure the safety of those whose duty it will be to make repairs or carry out inspection, a system of interlocking has been devised.

A complete system of telephone communication exists between all the switch cabins as well as the signal box adjoining to them, and by the use of simple electrical relays the signalman can, in case of emergency, cut off the energy from the overhead line on the sections which are controlled by him. The switchgear has been designed so as to be as simple as possible, and it is arranged that any stationmaster, signalman, or other authorised person can easily and safely operate the switches without danger of his coming into contact with any apparatus under high pressure.

In order to meet the conditions which have been imposed in the case of the South London line as regards voltage drop in the return circuit with a view to complying both with the provisional requirements of the Board of Trade, and the requirements of the Admiralty in respect to interference with apparatus at the Greenwich Observatory, a special system of cables was rendered necessary, and a duplicate feeding system has been provided throughout the line, everything having been so designed as to secure certainty and safety of operation. Up to the present time the cables have been laid between Battersea Park and Queen's Road Stations, and 11 of the 13 switch cabins have been erected. The switchgear in four cabins has also been completed, and the work of equipping the remainder is in active progress.

The supply of energy is to be obtained by the Brighton Company from the London Electric Supply Corporation, whose mains from their station at Deptford to the switch cabin at Queen's Road Station have already been laid and tested, and whose railway generating plant, consisting of four units of some 2,000 kw. each, has been installed and is in readiness at Deptford to supply the requisite power.

For the normal work of the line it is estimated that one of these units will supply sufficient energy, so that there is little fear of failure due to lack of generating power. In addition to the above precautions, in order to avoid all possible danger of interference with the many telephone and telegraph circuits which exist along the line, the overhead wires in the majority of cases have been removed and the circuits carried in lead-covered air-space cables, metallic returns being substituted for earth returns in all cases. Many serious difficulties have been encountered during the equipment of the line, since the section which is being dealt with includes two terminal stations, together with numerous low bridges. The tunnels at Denmark Hill have also added a difficulty owing to the nature of their construction, and to the curvature of the line in the tunnels. Practically all kinds of construction which go to form a railway are met with on this length, and, as a consequence, very many obstacles have had to be considered and overcome in designing a satisfactory equipment. The nature of the embankments has rendered special foundations necessary in many cases, and these have had to be piled to a great depth in order to ensure stability. Another difficulty in connection with the low bridges at Victoria Station which has been a serious obstacle is that the railway servants have to work upon the roofs of trains in the terminal stations, and consequently the overhead conductor had to be placed at a height of 21 ft., rendering it necessary to design a special form of current collector bow capable of working satisfactorily at high speeds through a range of between 21 ft. and 14 ft., giving a vertical movement of 7 ft., and this has been by no means an easy task. It has also been necessary in order to ensure the safety of passengers and railway servants under these low bridges to design and adopt special devices whereby it will be impossible for accidental contact to be made with the high-tension equipment.

POSTMASTER-GENERAL'S ANNUAL STATEMENT

THE House of Commons went into committee on Friday on the vote of £11,821,530 for salaries and expenses of the Post Office, including telegraphs and telephones.

The POSTMASTER-GENERAL said the total revenue last year was £22,500,000, and the expenditure £18,750,000, leaving a surplus of rather over £3,750,000. The estimates for the present year gave a surplus of about the same amount. Dealing with the telephone system, he said that the department was determined that this should be carried on upon a paying basis. On the question of charges, various proposals had been made for modifying the rates, but the matter was still under discussion. At the same time, he was very glad that the Post Office had got into more intimate touch with the Chambers of Commerce and others. Complaints had been made, he said, as to overcharging upon the measured rate system, but, as a matter of fact, this was impossible. Experience had shown that so far as the automatic check was concerned, the balance of incorrect calls was in favour of the customer. Complaints upon this point in the past had been due to the fact that people were not always aware how much their telephones were used. An amusing case occurred to him recently where a subscriber, who had made a violent expostulation, subsequently inquired into the matter and found that the housemaid had been using his telephone, without authority, to communicate with her young man.

The underground telegraph system was making steady progress, about £230,000 having been spent upon it this year. With regard to overhead telegraphs, the Telegraph Construction Bill now going through Parliament would assist him very materially in obtaining wayleaves from individuals, some of whom might be designated as blackmailers.

With regard to wireless telegraphy, the Convention of 1906 had now been ratified by Great Britain for all her Colonies, with the exception of Newfoundland and the Orange River Colony, and he thought it had also been ratified by all the Great Powers, with the exception of the United States, which was, however, in favour of the principle of the Convention, and would doubtless ratify it later on. He was pleased to say that the relations between the Post Office and the Marconi Co.,

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hitherto of a somewhat unfriendly character, had now been changed, and were of the most friendly kind. He was sure the company was wise in accepting the principle of intercommunication, and it was impossible for the Government, looking at the telegraph and telephone systems from past experience, to allow any monopoly with regard to wireless telegraphy. Two experimental stations had been started by the Post Office, and commercial stations were now being worked which could be used at any moment for postal purposes without having to buy up companies or monopolies.

SYMBOLS FOR PHYSICAL QUANTITIES

Suggestions of the British Electrotechnical Commission

AT the request of the Sub-committee on Symbols of the British Electrotechnical Commission, Mr. Miles Walker has sent us a long statement as to the possibility of creating a number of new symbols to represent physical quantities. The committee are very desirous of hearing the views of writers, readers, and printers of scientific literature as to the feasibility of the scheme, and any suggestions for improvement.

The desirability of a standardised notation for the representation of physical quantities in scientific books and periodicals, which shall be the same in all langages, has often been pointed out. The subject is under the consideration of the International Electrotechnical Commission with a view to international agreement, and committees in the different countries (in England under the Chairmanship of Lord Rayleigh, O.M.) are discussing this particular subject, and are dealing at present more especially with symbols for electrical and magnetic quantities. There are, however, continues Mr. Walker, two great difficulties which arise when we try to fix upon a standard notation. The first is the difficulty of persuading a number of writers and readers who have become accustomed to a certain symbol for a certain quantity to change it in favour of an equally large number of writers and readers who have become accustomed to another symbol. For instance, in France and Germany the letter "I" commonly represents the strength of an electric current, while in England and America "C" is more commonly used. In the second place, there are not enough letters in the two or three alphabets at our disposal to give a distinct symbol to each quantity, without resorting to the combination of more than one letter to form a single symbol. There is a great objection to this combination of letters, because the use of sub-script letters and numbers is required for distinguishing between particular quantities of the same general kind. If, for instance, C represents current, C_a might conveniently represent armature current, and C_1 the current in circuit No. 1. It would therefore not be good to take C_a to represent capacity, or any other quantity other than an electric current.

There is, moreover, an objection to using letters at all to represent quantities in a universal notation, because, unless initial letters are used, there is no connection in the mind between the letter and the quantity, and the symbol is difficult to remember. We cannot always use initials, because the initial letters differ in different languages. For instance, in England "R" commonly stands for resistance, while in Germany it is more convenient to use "W" for *widerstand*. Moreover, the same initial occurs for a great number of different quantities. For instance, "R" might stand for Resistance, Reluctance, Reactance, Radius, &c. One way of avoiding the above difficulties would be to create a number of new symbols which could be printed by means of type like ordinary letters, and which would represent each physical quantity in a distinctive manner. The question, however, arises as to whether a number of entirely new symbols would be acceptable to writers, readers, and printers alike, and the Sub-committee on Symbols appointed by the British section of the Commission has requested the writer to place his views publicly before the profession, with a view of obtaining suggestions and criticisms as to the feasibility of such a scheme from as wide a circle as possible.

In choosing a symbol, we would try to make a very simple picture of something that reminds us of the quantity in question. For instance, ⌇ might represent temperature. If we were told that this simple outline of a thermometer represents temperature, we would have no difficulty in remembering it. Similarly ⌇ might represent force, and the various "forces" might be derived from it; for instance, ϟ electromotive force (conventional representation of lightning), and Ω magneto-motive force.

It is not my purpose here to say what would actually be the best form of symbol for each quantity, but it is not a difficult matter to devise very simple characters which can be written quickly, easily, and with sufficient accuracy, and which can at the same time assist the memory to connect them with the quantity for which they stand. What would the printers say to the new type? The writer has taken up this matter with a very large publishing firm, and is assured by their chief expert that 200 or 300 new type would be a small matter to a modern printer, who is already accustomed to deal with many hundreds of different founts, each of which contains from 30 to 120 different symbols. He estimates that a printer in a large way of business has at his command as many as 60,000 distinct type, differing from each other either in letter, size, body, or face. The addition of 200 or 300 more would be a drop in the ocean. The size of the new type could be standardised for most purposes, and it would only be in some special case that another size would be called for. The setting-up of the formulæ with the standard size of type would be simpler than with the present system, in which sub-script letters are often unnecessarily introduced. One symbol under the present system sometimes consists of four or five letters.

If it be admitted that the introduction of new symbols is advisable, the question arises, what shall the new symbols represent exactly? Shall the sign ⌇ (temp.) represent temperature in any units, or shall it represent the number of degrees of tempeature, measured by some scale agreed upon, and embodied in the definition of the symbol. If the system of units employed be not prescribed, fewer symbols would be required, and the general writer who now says vaguely "Let T equal the temperature" would find the symbol sufficient for his purpose. But from the reader's point of view there is much to say in favour of a symbol which will embody in its definition a standard system of units. Any formula expressed in such symbols would be completely self-contained, and would be an exact statement of a physical fact. Until the units employed in any formula are known, the formula expresses only half its meaning. Perhaps some slight addition to the symbol, or even to the whole formula, might be used to indicate that the standard system of units is employed. Without that addition, the symbol would have a general meaning. For instance, ⌇ might equal temperature, while ⌇ might indicate the degrees centigrade above the absolute zero. The name of the type might be the name of the physical unit which it represents; for instance, for ϟ we might read "volts." If writers, printers, and readers, who have any definite views as to the best method of devising a system of symbols, would communicate with the technical press, they might assist in solving the many difficulties which arise in connection with this matter.

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THE RECONSTRUCTION OF A COMBINED STEAM AND WATER POWER SCHEME

WE have received a copy of Mr. C. M. Shaw's reply to the discussion on his Paper on "The Reconstruction of an Electric Lighting Scheme, with Observations on the Working of a Combined Steam and Water Power Plant," read before the Nottingham Convention of the Incorporated Municipal Electrical Association. The paper, in which Mr. Shaw described how the Worcester electrical undertaking had been reconstructed with a view to obtaining fuller benefit from the water power available, and the discussion, were reported at some length in our issue of July 9th.

In his reply Mr. Shaw expresses agreement with Mr. Hoadley in his remarks regarding the multiplicity of systems, plant, &c., in use at Worcester. The rearrangement of the works under these conditions proved to be a most interesting problem, which fortunately, for financial reasons, has very seldom to be solved. The old original high periodicity single-phase system had not been changed over to polyphase, though steps were being taken to provide for such a contingency if a power load arose outside the district now served by the D.C. system. Regarding the original design of the station only necessitating the running of steam plant, on one or two occasions when the water plant was useless through drought or flood, this had caused much discussion and interest in the past, and was still a point of contention to the general public, who looked upon water power from as optimistic a point of view as had been expressed in Nottingham.

The experience of Mr. Brydges at Eastbourne was by no means an isolated case. Wholesale scrapping of uneconomical out-of-date plant was often the best remedy, though severe, to bring about economies and turn a losing concern into a profitable one. Unfortunately many engineers are deterred from taking this course through local or other reasons.

The cost of maintaining two steam stations with out-of-date plant at one works was undoubtedly the main reason for the unsatisfactory state of affairs at Worcester, and the author agreed with Mr. Vignoles as to concentrating the whole of the steam plant at one station with large steam units. With the knowledge acquired at Worcester he was of the opinion that a subsidiary station of just sufficient dimensions to contain the water turbines would have been fully justified. The cost of production at the latter station was particularly low, and the output and load factor were sufficient to give a substantial return on the outlay that would have been necessary for such a station. With regard to the governing of turbines the load on this plant was particularly constant, owing to same being used either solely for lighting or a steady power load. At times, however, trouble is experienced when two motors of 60 h.p. belonging to the Waterworks Department fall off without notice; at such times the speeds of the turbines increase rapidly, so much so that the action of governors and gate-control gear is incapable of satisfactorily controlling the speed, hence hand control is the most satisfactory in this special instance.

THE TESTING AND STANDARDISING DEPARTMENT

MR. H. A. RATCLIFF has also sent us a copy of his reply to the discussion on his Paper on the above subject read at Nottingham. He writes:—I quite agree with Mr. Wilkinson when he refers to the lack of suitable testing apparatus, as I happen to know that in many stations it is a common practice to use an ammeter having a range, say, from 0–150 amperes, for the purpose of testing ampere hour meters on a load as low as 1 or 2 amperes. The co-operative scheme was not intended to apply to all the testing work of a generating station, but only such work as necessitated the use of special and costly apparatus, and which would be outside the limits of the £250, or perhaps even the £500 collection of apparatus advocated by Mr. Wilkinson. The repair and construction work, &c., has been criticised, but I may say that in Manchester we have saved many hundreds of pounds by the repair, conversion, or reconstruction of old and obsolete apparatus; and as regards the armature winding, we have nearly 1,200 motors belonging to the hiring department, and there are usually one or two armatures or other vital parts in for repairs; the result of undertaking this work ourselves has been to save a considerable amount of delay, and reduce the cost at least 50 per cent. Several speakers have referred to the Phase Shifter. One or two Continental firms make a small phase shifter at a large price. My experience with them, however, has not been very satisfactory, and I happen to know, in the case of one firm of manufacturers, that they prefer not to use it in their own test rooms. As far as I am aware, most of the English meter makers either use choking coils, &c., or else an alternator with special phase tappings. The apparatus described by Mr. Cridge is evidently an induction motor with an open-circuited rotor; the only objections to its use are the rather considerable magnetic leakage, and the necessity for distinct stator and rotor windings. The apparatus described in the Paper has only one winding, and, therefore, is more in the nature of an auto-transformer, with the additional advantage of also being a voltage regulator. Mr. Hornby's 25s. to 30s. phase shifter is a distinct novelty, as the Continental made articles usually cost as many pounds. As far as I am aware, there is no very reliable single-phase power factor meter on the market as, owing to the theory of their construction, they are all affected, more or less, by changes in frequency. In Manchester we use an idle current ammeter as an indication of whether the current is lagging or leading, and obtain the actual power factor from the ratio of watts to volt-amperes. Mr. Haydn Harrison raises several points with which I cannot quite agree, the first being the use of a portable photometer with a screen at 45° to the horizontal. The advantages of this I am unable to appreciate, except in so far as the fact that the errors introduced by the application of the cosine law are probably less than in the case of using a horizontal screen. The method advocated of using the Simmance-Abady Photometer is not, in my opinion, a legitimate one. The cosine law is preferably introduced into the calculations, and not into the construction of a photometer. When the screen or flicker disc bisects the angle between the light under test and the standard light, the cosine effect cancels out so far as the photometer is concerned. Mr. Harrison's experience with the "Harcourt" lamps appears to have been unfortunate. I have found that most consistent results may be obtained, provided that attention is paid to a few essential details; it is most important that the necessary correction for atmospheric conditions should be applied, as otherwise errors of the order of 5 per cent. are quite possible. The great advantages of the "Harcourt" lamps are that: it is a fairly concentrated source of light as compared with the long filament of a standard incandescent lamp, and it is a *mechanically reproducible standard*. The photometer referred to by Mr. Cridge is, I believe, made by Messrs. Simmance & Abady, and appears to be a modification of, or improvement on, the well-known "Ritchie" wedge; it is only suitable for lights of the same colour, and is not intended to supersede the flicker photometer. Mr. Burnett refers to the question of stop-watches. Watch errors are very slight if the right sort are used. Ordinary fly-back chronographs are of no use for meter testing. The best type of watches are those having a stopping and starting detent on the balance wheel, and a slow zero return motion. Watches constructed on this principle have no starting error, and the timing error is insignificant, as even such a large variation as five minutes a day would only be a matter of 0·35 per cent. Other matters referred to by Mr. Burnett are rather outside the scope of the Paper, as details of tests have not been included, but I agree with him that dial tests are very important, and in Manchester no meter is passed unless it has registered at least 10 units on the dials; usually about 20 to 30. Makers' constants are never taken as correct without checking, and in the case of complex and three-phase meters, &c., the actual constant is always calculated from the gearing. Incidentally, experience has shown that the makers' certificates referred to by Mr. Wilkinson have never yet been found to agree with the actual results of the tests on the meters. Twenty seconds is too short a time for a reliable revolution test, and at least 45 seconds should be taken as a minimum figure.

Territorial Army.—The following appointments have been announced in the *London Gazette*:—*Southern Wireless Telegraph Company, Royal Engineers:* Harry Bryant Matthews to be Captain. Dated April 1st, 1908 *Southern Cable Telegraph Company, Royal Engineers:* Robert Bucknall Bowker to be Lieutenant. Dated April 1st, 1908. *Southern Air Line Telegraph Company, Royal Engineers:* John William Danielsen to be Captain. Dated April 1st, 1908; Arthur James Dickinson to be Lieutenant. Dated April 1st, 1908. *Western Command Telegraph Companies, Royal Engineers (Army Troops):* Captain Roland Martin Macrory, Royal Engineers, from the Adjutancy of the 1st Lancashire Royal Engineers (Volunteers), to be Adjutant for the residue unexpired of his tenure. Dated April 1st, 1908.

The *Times* states that the allocation of London Territorial Engineer units includes London Wireless Telegraph, London Cable Telegraph, London Air Line Telegraph, and London Balloon Companies, R.E., all of which have been formed from the London Division of Electrical Engineers. The designation of the unit detailed for the "Defended Ports" is "London Division Electrical Engineers." (Temporarily retained.)

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REPORT OF THE ELECTRICAL INSPECTOR OF FACTORIES AND WORKSHOPS

THE annual report of Mr. G. Scott Ram, H.M. Electrical Inspector of Factories, contains the following table of accidents in electricity supply works reported during the year 1907 :—

Table I.

Accidents at Electrical Generating Stations and Sub-stations, 1907.

Description.	Electricity Supply Companies and Local Authorities.		Private Stations.	
	Non-fatal	Fatal.	Non-fatal.	Fatal.
Non-Electrical—				
At engines, pumps, and generators..	29	—	5	—
At boilers and steam plant	61	2	10	—
At coal handling plant	17	—	2	—
Falls	53	4	3	1
Struck by falling bodies	29	—	3	—
Miscellaneous	57	1	5	—
	246	7	28	1
Electrical—				
At switchboards, when engaged in ordinary routine work; mostly due to faulty design of apparatus..	10	—	1	—
Cleaning, repairing, &c., at "live" switchboards	13	1	3	—
Cleaning, repairing, or other handling of switchboards supposed to have been made "dead"—				
(*a*) Skilled persons	1	—	--	—
(*b*) Unskilled persons	—	—	—	—
Adjusting brushes	9	—	2	—
Miscellaneous	15	1*	2	1
	48	2	8	1

* Suicide.

The electrical accidents, although showing a slight increase, are again not many. Under the first heading, three were due to mistakes on the part of the switchman. One was due to the failure of a large oil-type fuse, whereby the oil was ignited and severely burnt the arms and face of the attendant.

Under the second heading, the fatal accident occurred in an extra-high pressure sub-station (11,000 volts) to a boy, who had been told to grease two switches which had been made "dead." Having done this work, it is supposed that he turned his attention to the next switch, which was "live," with the result that he was killed. This accident points to the danger of not screening off the live sections from the dead portion of a switchboard when work has to be done, and again draws attention to the undesirability of employing unskilled persons, particularly boys, in such places unless under the immediate and constant supervision of a competent person. Several others of these accidents occurred at high-pressure and extra high-pressure switchboards, and again emphasise the danger of switchboards not being arranged so that they can be made "dead" in sections when work upon them becomes necessary. In one case the chief engineer of the station had undertaken the work of overhauling a high-pressure switch himself, and met with an accident, receiving severe injuries.

The number of accidents reported in Table II. of factories, engineering works, &c., again shows an increase over the previous year, and is double the number of two years ago. The increase is probably due to the extended use of electrical energy in factories, and possibly more attention has been paid by occupiers to the necessity of reporting accidents under the Notice of Accidents Act, 1906. There is little, if anything, new in the circumstances of the accidents.

One of the fatal cases was due to the absence of any protection on a three-phase medium pressure motor starting switch. The switch was in a works and not in a motor-room or switch-room accessible only to authorised persons Owing to the nature of the industry, the floor at the switch would always be wet. There would, therefore, always be the risk of a fatal accident to anyone touching a "live" part of the switch. The installation was put in, and the power supplied by an authorised undertaking, subject to Board of Trade regulations. Under these regulations the switch should have been so enclosed and protected as to prevent danger of shock in the ordinary handling. This regulation had, however, been entirely ignored. The victim of the accident certainly had no business to touch the switch, and was not authorised to do so, but it should have been impossible for anyone to have touched any live part.

Table II.

Reported Electrical Accidents in Factories, Engineering Works, &c., other than Electrical Generating Stations and Sub-stations, 1907.

Description.	Non-fatal.	Fatal.
Arcing of switches	17	—
,, fuses	26	—
Arcing at fuses when replacing fuse wires ...	24	—
Unprotected conductors, switches, terminals, fuses, &c.	29	3
Faulty apparatus (other than switches)... ...	55	2
Working on live conductors: Skilled persons	24	—
Working on live conductors: Unskilled ,,	20	1*
Flashing at motor brushes when adjusting ...	3	—
Electric travelling cranes: Unprotected electrical apparatus in driving-cage..	6	—
Electric travelling cranes: Faulty apparatus	8	—
Electric travelling cranes: Carelessness	7	—
Miscellaneous accidents in testing electrical apparatus in course of manufacture	23	1
Miscellaneous	16	1†
	258	8

* Fall following shock. † Due to a practical joke.

Another fatality shows the necessity for properly protecting insulated wires in engineering works where they are liable to damage. The insulation of a conductor was cut through by the edge of a piece of iron which a man was carrying. Although the pressure was only 250 volts, alternating-current, the man was killed. Another fatality was due to a man touching with an iron rod the frame of an arc lamp working at high pressure, the frame of the lamp forming part of the circuit. Another accident again exemplifies the danger of alternating current at low pressures. It occurred in an engineering works. A man was engaged at a saw bench where hot metal was being cut up by a circular saw. The saw was driven directly by a three-phase motor working at 350 volts per phase and, therefore, probably only 200 volts above earth. After cutting a piece of metal the man, while still holding it with tongs on the saw bench, told his assistant to switch off the current. Immediately the switch was pulled off the man at the saw received a shock and was killed. The saw bench had become electrically charged through a trifling breakage at the switch. A spring of the switch broke and made contact with the metal cover. This cover was connected by a wire to the lead-covering of the cable leading to the motor, and which rested on the motor-frame. Another wire connected the lead-covering of the cable to a bolt passing through a piece of wood in such a way that when screwed up the end of the bolt was forced against a metal column of the building, which it was supposed would form an efficient earth connection. The earth connection proved useless, probably because the bolt had not penetrated the coating of paint on the column. It is, however, a question whether earthing to a column of a steel-frame building is in any case sufficient. There were a large number of similar columns supporting the roof of the shop, all more or less in electrical connection with each other, and it might reasonably be thought that such an "earth" would be adequate. The columns, however, do not go far into the ground, which may be dry, and they rest on concrete blocks. In the case of fall following a shock, the victim, a labourer, was sent to adjust a trolley contact at a great height from the ground, the pressure not having been previously switched off. In the test-room fatality, no satisfactory explanation could be offered as to why the deceased person, an apprentice, should have got into the position in which he was found, grasping live terminals, 440 volts, alternating current. The case of the practical joke again emphasises the danger of alternating current of low voltage, 200 volts. A wire was connected from a wall plug to a door handle. The victim took hold of the handle and received a fatal shock. No doubt the perpetrators of the "joke"

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had no idea that the ordinary lighting supply voltage could be dangerous. The medical evidence in this case showed that the deceased person was not in good health, but other cases of fatal shock at low pressures with alternating current show that the danger exists even when the person may be quite sound. Another fatality was due to a faulty hand-lamp. The metal-work of the lamp, including the wire-guard to the lamp, became live. The man was in connection with earth, and received a shock. He could not let go the lamp, and was killed. The pressure was 250 volts alternating current.

Mr. Ram continues :—The danger in the use of hand-lamps as ordinarily constructed is seldom realised, and can so easily be guarded against that I propose to refer to the matter at greater length. The danger arises from the construction of the lamp being such that any metal-work used is very liable to become electrically charged. If, therefore, a person holding such a lamp happens to be standing on metal-floor plates, or on damp ground, or is otherwise in connection with earth, he may get a shock, and in all probability he will be unable to release his hold of the lamp, and a fatal result will ensue. The accompanying photograph, Fig. 3, shows three hand-lamps, each of a different pattern, and each of which has been the cause of the death of a man under the circumstances indicated above. In each case the current was alternating and low pressure. Each lamp has an insulating handle, but this has not prevented a fatal accident. The lamps A and C have each a brass tube passing through the handle. The end of the brass tube is screwed into the lamp holder, and the other end into a ferrule, which serves to hold the insulating handle in position and provides an attachment for the metal hook, by means of which the lamp may be hung up. In each of these lamps, if there occurs any defect by which any part of the metal-work should make contact with the conductors, the whole of the metal-work will become live. Although a person may be grasping the wood handle in the proper way, he is liable to touch the brass ferrule at one end or the gallery of the protecting cage at the other. If he is at the same time standing on "earth," he will get a shock which may prevent him dropping the lamp; in fact, he will probably grasp it all the tighter, although the actual point of contact between his hand and the charged metal at one end or other of the handle may be very small. Lamp B is similar, but has no brass tube passing through the handle. The handle, however, is not large, and a man holding it is liable to have his thumb upon the brass socket into which the handle fits. This socket terminates in a short brass tube, which screws into the lamp-holder, and is consequently in metallic connection with the lamp-holder, the gallery, and cage. Should these parts become live through any defect, the person holding the lamp may again be unable to release his hold. In the case of each of these lamps, the metal-work became live when the persons holding them were in connection with earth, and were consequently unable to let go and were killed. Examination of the lamps shows the following defects by reason of which the metal parts became "live." In lamp A the flexible wires pass from the lamp-holder through the brass tube inside the handle and out at a hole in the side of the brass ferrule. The edge of this hole is bushed with insulating material, but the edge of the end of the brass tube inside the ferrule is not so bushed and has a sharp edge. The insulating covering to the flexible wires appears to have been cut through at this point, thus causing the whole of the metal-work to become "live," and hence the accident. In the case of lamp C, the flexible wires pass out through the end of the brass ferrule, and this, of course, is again a weak spot, the covering of the wires being liable to be injured at this point. This, however, does not appear to have been the cause of the metal-work becoming "live" in this case. There is another defect which I have indicated in Fig. 1. The lamp-holder is screwed on to the end of the brass tube, which passes through the handle, the flexible wires passing through this brass tube to the terminals fixed in the porcelain block in the holder. The fit of the threads in the holder and the brass tube is very easy, and the holder cannot be firmly fixed unless it is screwed on the brass tube, or rather the brass tube is screwed into the holder as far as it will go. This, until the flexible wires are in position, means that the brass tube is screwed in so far that it becomes jammed against the porcelain block. The holes in the porcelain block, into which the ends of the flexible wires are threaded, are somewhat wider apart than the diameter of the brass tube. Consequently, when the flexible wires are put in place, the brass tube is screwed hard up against them, nipping them between its sharp edge and the porcelain block. As there is no grip upon the flexible wires elsewhere within the handle, and as the lamp may be frequently carried about by means of the wires, the whole weight will be taken by the latter at the point where they are nipped. Under such conditions it is practically a foregone conclusion that the insulation, even if it should escape damage in the first instance, will be cut through after the lamp has been in use for a short time. In the case of lamp B the same defect occurs, although it appears that it may have been considered in the original design, the brass tube being only a short one fitted into the end of the brass socket, into which the handle fits, this socket forming a shoulder against which the lamp-holder can be tightly screwed. The brass tube, however, is just too long, and before the holder can actually be screwed hard up against the shoulder the end of the brass tube is already cutting into the wires against the porcelain in the lamp-holder. These may appear very trifling defects, but it is nevertheless upon such that the life of the man using the lamp may depend. There is no difficulty whatever in constructing a lamp which should be free from these defects, and under ordinary circumstances absolutely safe.

The two most important points to be borne in mind in the design of a lamp for use in dangerous places, *i.e.*, where the user is in connection with earth, are (1) that there shall be no metallic connection between the lamp-holder and any other metal part of the fitting, and (2) that the flexible wires in passing from the lamp-holder shall not be taken through a metal tube or be otherwise touching any metal part of the fitting. Fig. 2 shows a very simple and inexpensive type of lamp, of which a number are in use, and which is very much safer than any of those shown in Fig. 3. The body is made from a piece of oak, about 3½ in. in diameter at one end and turned down to form a handle. The flexible wires pass through a hole down the centre to the lamp-holder, and are clamped near the end of the handle, so that no strain can be put upon the connection in the lamp-holder, which is of the "batten" type, and is screwed to the flat disc end. The wire cage is attached by screws to the outside of the disc. There is no metallic connection between the lamp-holder and the wire cage, and there is no other metal used in the construction of the fitting, except the hook at the end of the handle used for the purpose of hanging up the lamp. This hook should, however, be replaced by a leather or other non-metallic loop, as with constant use it might injure the insulating covering of the flexible wires where it rubs against them just beyond the end of the handle. With this slight alteration this lamp would be entirely free from the defects described in reference to those shown in Fig. 3, and would probably be cheaper. As a result of my remarks on this subject in my last report, the lamp shown in Fig. 4 has been brought out. In this case again the body of the lamp is of wood. The lamp-holder, which is of the "cord-grip" type, is fixed in a vulcanite ring or cylinder, which is extended so as to form a guard or sheath completely surrounding it. The wire cage is attached to a metal ring, which is screwed to the outside of the wood base. There is no possibility of any metallic contact between the cage and the lamp-holder. The lamp-holder is supported in such a way as to give a large insulating surface between it and the metal cage-ring in view of preventing leakage by a film of moisture if the lamp is used in a damp situation. The only weak spot appears to be in the metal hook, which, however, can, without any difficulty, be replaced by a leather or other non-conducting loop.

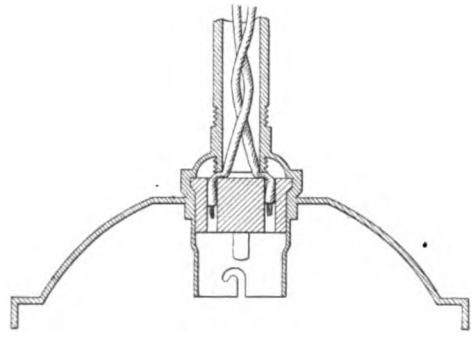

FIG. 1.—DEFECTIVE ATTACHMENT OF LAMP-HOLDER, SHOWING FLEXIBLE WIRES NIPPED BETWEEN PORCELAIN AND END OF BRASS TUBE.

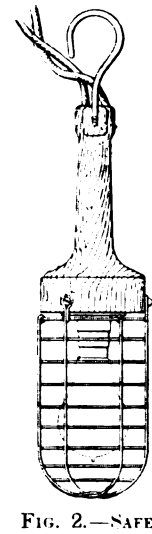

FIG. 2.—SAFER PATTERN OF LAMP.

In the course of inspections during the year further examples of dangerous conditions of electrical plant, such as have been described in previous reports, were met with. These are enumerated as follows :—

Switches designed so that the hand may touch live metal when grasping the handle; switches and fuses fixed to the same base in such a way that in switching on the operator's knuckles will touch the bare fuse metal; oil cups, requiring frequent filling up, placed close to high-pressure brush-gear on generators; on main switchboard of authorised undertaking, main fuses fixed at back of board behind bus-bars; extra-high pressure rubber-covered cables, not otherwise protected, fixed in generating station basement amongst steam and exhaust pipes, and in the way of making joints in the same; switches for alternating current, medium pressure, in factories, without any protection, in some places over wet floors; earth wires of motors, &c., connected to gas pipes; motor switches in factories fixed behind

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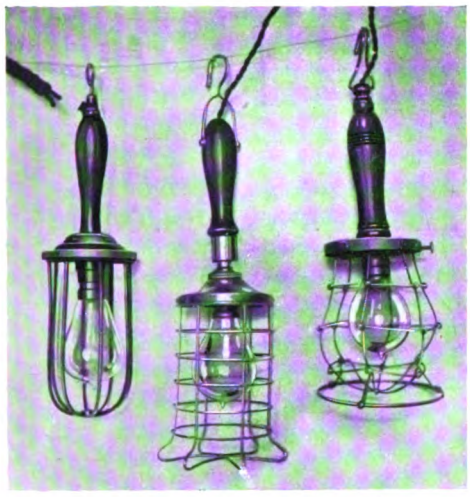
running belts; iron foot-plates behind switchboards having bare conductors; extra-high pressure coils of generators and motors unguarded; medium-pressure switchboards placed one behind the other with bare metal on both sides of the narrow working space; high-pressure alternators with no protection at high-pressure collectors and terminals where likely to be accidentally touched; high-pressure and medium-pressure switchboards with insecure floor at back; extra-high pressure isolating switches, worked by attendant from a ladder in a dangerous position instead of by a pole from the floor level; extra-high pressure



A B C

FIG. 3.—HAND-LAMPS WHICH HAVE CAUSED FATAL ACCIDENTS.

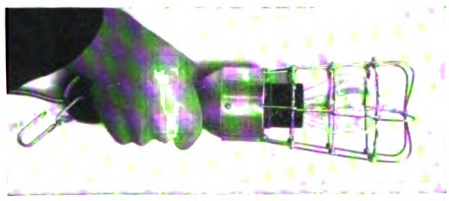


FIG. 4.—IMPROVED DESIGN OF HAND-LAMP.

switchboard passage-way only 16 in. wide, having live metal exposed; high-pressure sub-station fitted up in a dangerous manner "temporarily" on emergency, still in the same condition after four years.

The following table, showing the voltages and system of supply in the fatal case reported under the Factory Acts, is of interest :—

Table III.

Electrical Fatalities reported under the Factory Act, 1907.

No.	Month.	Place.	Voltage of system.	Probable voltage of shock.	System. A = Alternating. C = Continuous. 1 = Single-phase. 2 = Two-phase, &c.
1	Jan. .	Ravensthorpe... ...	400	—	A 3
*2	Feb. .	Jarrow-on-Tyne ...	440	—	A 3
3	April	Middlesbrough ...	250	250	A 2
4	April	Manchester	440	—	A 3
5	May..	Sheffield	200	200	A 1
6	June..	Birmingham	1,000	—	C
7	July..	Middlesbrough ...	11,000	—	A 3
8	Sept..	Wednesbury	350	200	A 3
9	Oct....	Blaydon	250	250	A
†10	Oct....	Kingston-on-Thames	2,000	2,000	A 1

* Fall following shock. † Suicide.

Electricity from Peat in Germany.—The Siemens Schuckertwerke and the Siemens Elektrische Betriebe Akt.-Ges. have been granted a concession for 75 years by the Prussian Government for the generation and distribution of electrical energy in the East Friesland peat district. A power station consuming peat only will be built near Aurich, and energy will be distributed in the surrounding district, and also to the towns of Emden, Leer, and Wilhelmshaven. The above company will lay cables up to the outskirts of the towns, but the distribution network in the towns will be laid by the town corporations.

THE PARIS TELEPHONE SYSTEM

WE published in our issue of June 25th an account of the position with regard to telephone matters in Paris, which showed that the benefits from the reconstruction of the exchange system, recently put in hand, are not yet apparent. One of the difficulties seems to be that in Paris the subscriber himself provides his instrument, and that, in consequence, a variety of patterns are in use, several of which are quite unsuitable for use with the central battery working that is being inaugurated. An amusing incident was recorded in a daily contemporary a short time ago. The *Figaro* advised all its readers who had trouble with their calls to ring up M. Simyan, the Under-Secretary for Posts and Telegraphs, at his private house. The first complaint call was at seven o'clock in the morning, and was answered by M. Simyan himself, and it is stated that between that hour and eleven o'clock on the following night 1,300 calls for his number were registered. M. Simyan's number was then changed.

The *New York Times* has suggested that part of the troubles is due to the similarity of the French numerals when heard through the telephone: thus "six" and "dix," "vingt" and "cinq." The possibility of error in this connection, our contemporary suggests, is increased by the fact that the exchanges or districts bear numbers instead of names. Thus M. Simyan's number was 525,59, and telephone men will certainly realise the difficulty of successfully transmitting the sibilants in cinq cent, vingt cinq, cinquante neuf through an inefficient microphone; possibly the 1,300 calls in two days would have been largely increased if the number had been an easier one.

A Parisian technical contemporary gives a few notes on the technical work of the reconstruction of the Sablons exchange, which replaces the Passy exchange, and also takes part of the lines for the Avenue de Wagram exchange. Some structural alterations in the building were necessary chiefly on account, it appears, of the extra weight of the new central battery equipment, and the usual difficulty with subscribers having extension instruments was probably heightened by the fact already alluded to that the subscribers have put in their own instruments. It is stated that the central battery has an E.M.F. of 12 volts only, but this, we think, must be an error or a misprint. The battery is charged through a motor generator connected to the supply company's mains, and a petrol motor set is used as a standby.

Five new exchanges will be required, as well as one now under construction, and three hundred new junction lines are to be provided. There is considerable agitation also for additional trunk lines, especially between the larger towns. The tariff is also a hot question for dispute; it is stated that after deciding upon a reduction, the Administration withdrew the proposal owing to the impossibility under present conditions of connecting up the large number of new subscribers that it would attract.

Local Authorities' Accounts.—The Finance Committee of the London County Council has had under consideration, in so far as it relates to the London County Council, the report of the Departmental Committee, appointed by the President of the Local Government Board in January, 1906, to inquire and report with regard to the accounts of local authorities. This committee dealt with (1) the systems on which the accounts of local authorities are at present kept; (2) the system on which the accounts of local authorities should be kept; (3) the regulations which should be made in regard to the accounts of local authorities. In a long report they discuss as to how far the present method of keeping the Council's accounts falls in with the recommendations of the Local Government Board Committee, and make the following recommendations :—(1) That all the rate fund accounts and estimates should be placed on the income and expenditure basis instead of the present receipts and payments basis. (2) That arrangements should be made for notifying the comptroller promptly of all orders issued by spending departments for goods to be supplied or work done, and of moneys due to be received. (3) That a monthly return of expenditure and liabilities incurred under each annual vote should be furnished by the comptroller to each committee. (4) That the General Purposes Committee should be requested to revise the regulations as to stores. (5) That the Money Bill tables and schedules, and other similar statements, should be prepared on the same basis as is proposed to be adopted for the rate fund accounts and estimates. With regard to the additional work which the alterations will involve, it is estimated that thirteen additional assistants will probably be required in the Comptroller's Department at an estimated cost for the first year of £840, and in the fourth year £1,125, apart from the cost of office accommodation. The committee, however, are strongly of opinion that the Council will be fully justified in incurring the additional expenditure proposed, and that the advantages accruing from the stricter accounting methods will more than compensate for the additional cost of the new scheme.

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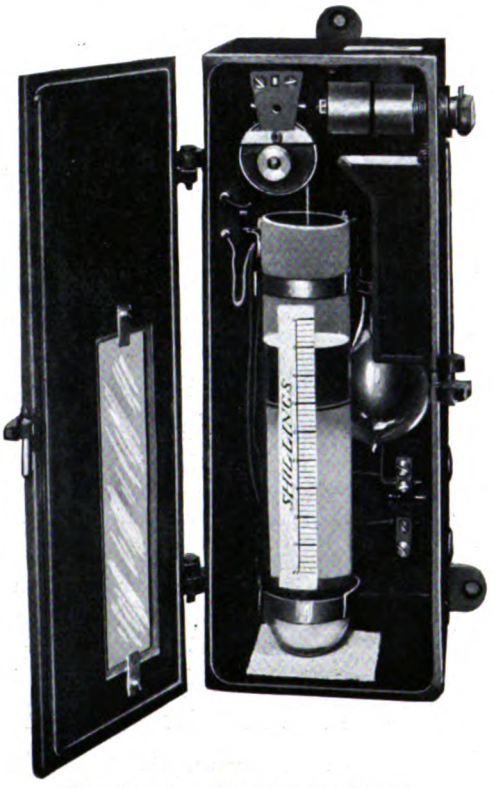
A NEW ELECTROLYTIC PREPAYMENT METER

IN small installations, and particularly in such cases where free wiring by the supply authorities is undertaken, the disproportionate cost of the meter is a very serious matter. For many small installations also a prepayment meter is to be preferred to the ordinary recording meter, and there is a considerable field for a cheap and satisfactory prepayment meter. An electrolytic prepayment meter has been brought out by the Electrical Apparatus Co., Ltd., of Caxton House, Westminster, which, besides having some features of interest, is worthy of consideration owing to its low cost. This meter, which is illustrated below, depends for its operation on the electrolysis of water. Briefly, the action is as follows :—A voltameter filled with a caustic soda solution has one electrode permanently fixed to the side and the other suspended in the centre, and is directly in series with the consumer's lamps. The passage of the current electrolyses the solution, and lowers its level in proportion to the amount of current flowing. When the level of the solution falls



ELECTROLYTIC PREPAYMENT METER.

below the suspended electrode, the circuit is broken and the supply of electricity stopped until the suspended electrode is lowered and again immersed in the solution. The above is the principle of the meter, but a few modifications were necessary to render such a meter fit for practical use. By the introduction of a third fixed electrode into the voltameter, the circuit is not broken when the level drops below the suspended electrode, but a lamp inside the meter is put in series with the consumer's lamps, thus indicating when it is necessary to lower the electrode. It will be noticed that the meter consists of three component parts : the voltameter, the drum suspension for the electrode and the coin-freeing mechanism, and the lamp used as a dimming resistance.

The containing vessel of the voltameter is a plain glass cylinder. The fixed electrodes are not fused into the glass, but consist of two nickel strips bent over the edge at the top, which run to the bottom of the container, where they are kept in place by an insulating separator, to which they are rivetted. Suspended in the voltameter by a nickel wire, which also leads in the current, is a bell which carries the main electrode. This bell has a hole through the centre, and contains the main electrode at which the break takes place. This is of great importance, as the gas which is given off at the electrode rises up into the bell, and escapes through the top. The other gas does not rise into the bell, but escapes round the edge. The nickel wire which holds the bell and leads in the current passes round a drum which is connected by a simple worm gear to one half of a slotted cylinder. The other half of the cylinder is attached to the outside handle. The insertion of a shilling connects the two halves of the cylinder, and allows the outside handle to be rotated through 180°, when the shilling drops. The rotation of the drum lowers the bell by a definite amount, in accordance with the stated rate of charging, and also displaces solution. Several shillings can be inserted at one time. Evaporation from the surface is prevented by a thin layer of high flash paraffin oil. The meter is constructed to take about 45s. before requiring to be refilled. The refilling is a very simple matter, and is effected by winding up the bell by means of a milled nut and filling the tube with plain water. The diameter of the tube can be varied to suit the rate of charging in force, the diameter being so chosen that a drop of one-eighth of an inch, produced by a half turn of the drum, corresponds to one shilling's worth of electrical energy. The insertion of two shillings, that is, a complete turn of the drum, will immerse the electrode so far that two shillings' worth of energy can be obtained before the dimming lamp is put in circuit. Energy consumed while the lamps are dimmed is paid for by the next shilling inserted, as the level is falling all the time current is passing, the electrolysis taking place between the two fixed electrodes.

ARC-LAMP STANDARDS FOR THE CITY

THE accompanying illustration is that of a model arc-lamp standard especially designed for use in the City of London. The height of the standard from the base to the centre of the lamp-globe in the full size standard would be 28 ft. The present design includes no provision for lowering the lamp, but sufficient space between the lamp and the base of the bracket for lowering the globe is allowed. The cleaning and adjustment would thus necessitate the use of a tower, as is already the practice in Oxford Street (Marylebone) and in Cannon Street. Some few feet from the base will be noticed the switch and fuse-box, the four sides of which are decorated with the City arms. The design, which is registered, is the property of Messrs. Thomas Elsley, Ltd., of 28 Great Titchfield Street, W., and was submitted to the electrical engineer to the City, Mr. A. A. Voysey, as a possible design for the lamp standards in the City. There is considerable field for a really artistic standard for use in the streets of the City of London, although there are a number of cases where the streets are narrow in which preference may be given eventually to the cross-wire suspension system as is used in Cannon Street, or to some form of wall bracket. We are indebted to Mr. A. A. Voysey for permission to photograph the model.

DESIGN FOR ARC-LAMP STANDARD FOR THE CITY OF LONDON.

Breakdown in a Water Power Station.—A remarkable mishap, by which the plant in the Cazadero station of the Portland Railway, Light & Power Co. was almost completely wrecked, is described in the *Electrical World* (New York). It appears that the governor on one of the water wheels stuck in some way, allowing a full head of water to rush through the turbine driving the generator, which straightway proceeded to speed up. When the attendant endeavoured to shut the emergency gate, this was found to be jammed and inoperative. The generator was soon revolving at a terrific pace, which dislodged some of the pole pieces and threw the revolving-field structure out of balance, so that the entire generator burst asunder in a very short time. The governor of the adjacent machine was struck by a piece of flying metal and rendered useless. As a consequence the gate flew wide open and the generator "ran away," meeting the fate of the first machine. Pieces of this second generator were hurled through the building and the remaining generator suffered destruction also. The complete demolition of the electrical gererating apparatus was brought about in three minutes. The water wheels, from all reports, were undamaged save for the breaking of the shafts, and shortly after the accident were stopped from the head gates. One end of the station contained a temporary wooden floor and wooden roof for convenience in installing additional machinery. This end of the station was set on fire by the wreckage which flew in that direction. The switchboard end of the station was undamaged. All of the 18-in. shafts were broken off and twisted. There was no interruption to the service resulting from the destruction of the station, for at the time of the accident, about 6 o'clock in the morning, very few lamps were in use and few cars were running. The apparatus of an auxiliary steam station was immediately brought into service, and is now running overloaded to take care of the load.

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THE ELECTRICAL EQUIPMENT OF THE STANNINGLEY IRONWORKS

AMONGST the many industries which have effected considerable economies in their working by the adoption of electric driving under conditions of a public supply the trade or business of "engineers," with its

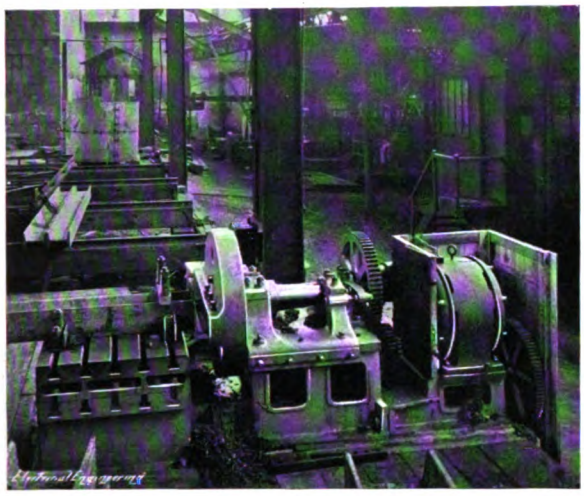

FIG. 1.—ELECTRICALLY-DRIVEN MILLING MACHINE FOR GIRDER ENDING.

many branches, is one of the most prominent. The demand for power is of so intermittent a character that the cost of a ready-to-serve supply of steam is proportionately very much higher than in the case of

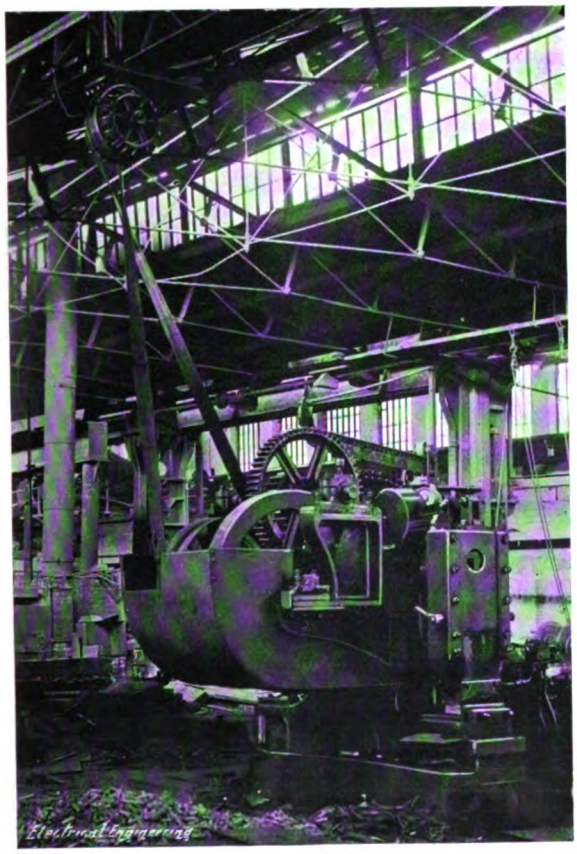

FIG. 2.—PUNCHING MACHINE DRIVEN FROM MOTOR OVERHEAD.

trades where the demand is of a much steadier character. Furthermore, the cost of a self-contained supply is, in many cases, considerably increased from the fact that the business requires a large amount of ground space for storage and easy manipulation, necessitating either a number of isolated steam plants or a large amount of heat-wasting piping.

These unavoidable increases in cost are entirely eliminated where the power is derived from a public source, and one of the latest of these conversions is to be seen in the case of Messrs. John Butler & Co., Ltd., of Stanningley Ironworks, near Leeds, who have for many years been one of the foremost engineering firms connected with bridge building and similar construction work. A group of boilers and a number of engines of varying capacity were originally used for driving the machinery in connection with the work turned out; but on the conversion of the works to electrical driving, these have been dispensed with and the boilers removed.

The works are now electrically driven from the mains of The Yorkshire Electric Power Co., whose

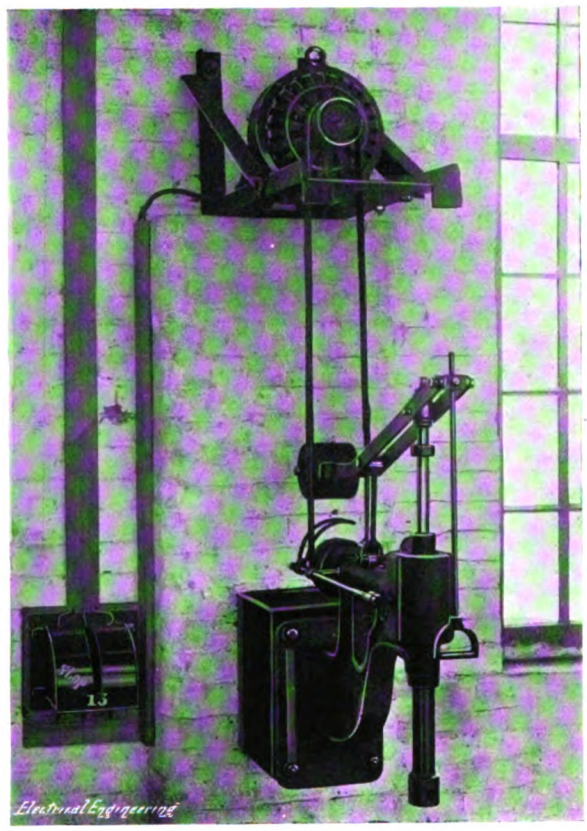

FIG. 3.—WOOD BORING MACHINE.

Thornhill power station is $14\frac{3}{4}$ miles away. The supply is given on the three-phase alternating current system, the pressure being transformed on Messrs. Butler's premises from 10,000 volts to 400 volts, 50 cycles. A duplicate supply is provided for by means of two ·05 sq. in. three-core paper insulated L.S.W.A. Callenders cables teed from the Yorkshire Electric Power Co.'s trunk mains. Each service cable terminates in a three-pole non-automatic oil switch through which the bus-bars and transformers are supplied. The transformers, meters, and switches were supplied by the British Thomson-Houston Co., Ltd., of Rugby. The transformers are 10,000/400-volt with delta connected primaries and star-connected secondaries, and are installed in two banks, each bank being controlled on the extra high tension side by one three-pole 10,000-volt automatic oil switch and on the low tension side by a 500-ampere, three-pole knife switch. Each trans-

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former is capable of being readily disconnected on the extra high or low tension sides, should the variation of the load or any other reason justify the exclusion of one or more transformers. The quantity of electrical energy consumed is registered on the low tension side by three 1000-ampere, 230-volt Ferranti meters fed through current transformers, the pressure coils being connected to the earthed neutral of the power transformer.

The transformers, switches, meters, and other gear are contained in a two-floored sub-station, the upper portion being devoted to the power company's switchgear, whilst the lower portion is divided into two parts, one containing the transformers and the other Messrs. Butler's low tension switchboard, and the meters of The Yorkshire Co. The 10,000-volt switchgear on the upper floor is completely enclosed in brick cells provided with sheet-iron screens. The switches are mounted on the front wall of the cell with the operating links carried through and the handles mounted on the outside.

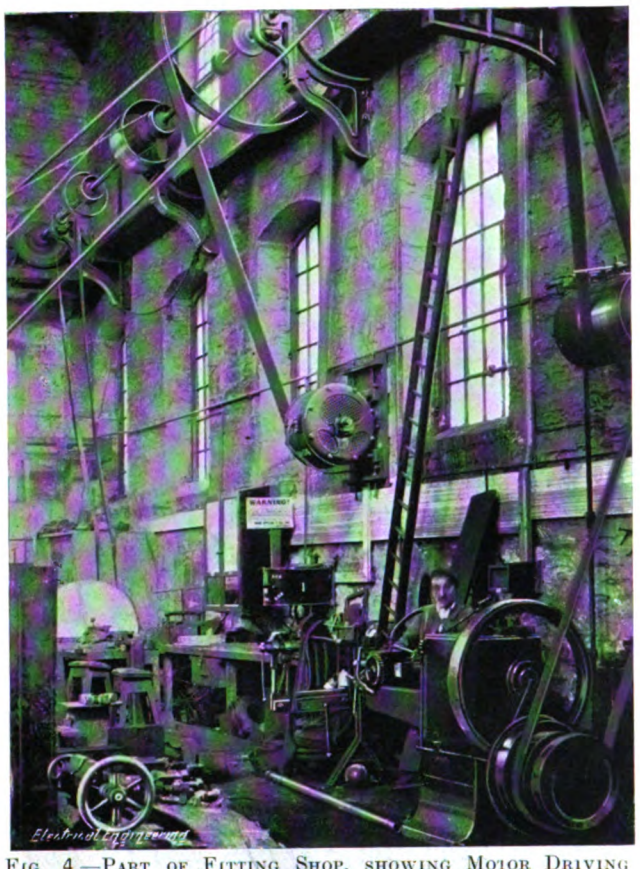

FIG. 4.—PART OF FITTING SHOP, SHOWING MOTOR DRIVING SHAFTING.

The contractors for the installation were Messrs. Wilson Hartnell & Co., Ltd., of Kirkstall Road, Leeds, one of the oldest-established firms of electrical contractors in this country. The supply is controlled by Messrs. Butler & Co., from the main distributing board in the lower floor of the sub-station already mentioned, from which emanate six separate circuits designated as A, D, E, H, K, and L respectively, the sub-distributing boards from each of these circuits being fixed in convenient positions for the control of a group of motors, each motor being on its own separate circuit, and fused from the sub-distributing board which controls it.

Circuit "A" consists of seven motors with a total horse-power of 100. Among these are the milling machines for girder ending shown in Fig. 1, the cold saws, and various drills. Circuit "D" comprises 11 motors totalling 147 h.p. Examples of these are a punching machine shown in Fig. 2, and the wood-boring machine in Fig. 3. Other machinery electrically driven from this circuit includes horizontal rolls, &c., in one of the machine shops, plate edge planers, &c., and a considerable amount of other machinery. Circuit "E" consists of seven motors of 135 h.p. driving, blowers, drills, punching and shearing machines, &c., in the girder shop, waggon shop, and new smith's shop. Circuit "H" has 18 motors, with a total capacity of 250 b.h.p., there being nearly 100 machines for various purposes and of varying sizes in this circuit. Fig. 4 shows the method of mounting the motors on the wall of the fitting shop, and the convenient position of the starter. "K" circuit has 1–10 h.p. motor driving a crane, and "L" circuit two motors of 100 and 140 b.h.p. respectively, driving an accumulator and air-compressor. A small steam-driven air-compressor now driven electrically is also on this circuit.

Altogether, in the six circuits there are 52 motors of a total capacity of 962 b.h.p., varying from 2 to 140 h.p., running at speeds of from 470 to 1,410 revs. per minute. The plant has now been at work for a period of about nine months, and is working so satisfactorily that it should be the means of inducing many others to consider seriously changing over to the electric drive.

New Telephone Charges.—The Committee appointed by the Associations of Chambers of Commerce to deal with questions relating to the new telephone charges has adopted a suggestion by the Postmaster-General, and will nominate a deputation to meet the Post Office and the National Telephone Co., with a view to obtaining figures and arguments in support of the new telephone charges.

Duty on Tramcars into Finland.—The Finnish Customs Department has decided that imported electric tramcars shall be dutiable as follows:—Ready mounted, on axles and wheels, with electric motors attached, £32 each (N.B.—The motor, which is dutiable separately, pays at the rate of 6s. per cwt.); ready mounted on axles and wheels, but without motors, £32 each; with wheels and axles, and electric motors separate, cars are dutiable as those with motor attached.

Light Railways.—The Board of Trade has confirmed (1) the Portmadoc, Beddgelert and South Snowdon Railway (Light Railway) Order, 1908, authorising the Portmadoc, Beddgelert & South Snowdon Railway Company to reconstruct, construct, and work the railways authorised by the Portmadoc, Beddgelert and South Snowdon Railway Acts, 1901 and 1904, as a light railway under the Light Railways Act, 1896, and authorising the construction of a light railway in the county of Carnarvon, from the termination of the railway authorised by the said Act of 1901 near Beddgelert, to Bettws-y-Coed, and amending and consolidating the capital and borrowing powers of the company, and for other purposes. (2) Portmadoc, Beddgelert & South Snowdon Railway (Light Railway Extension at Carnarvon) Order, 1908, authorising the construction of light railways in the borough and county of Carnarvon, being a deviation and extension of the authorised undertaking of the Portmadoc, Beddgelert & South Snowdon Railway Company, from Dinas to Carnarvon, and the abandonment of a part of the said undertaking.

"Indestructible" Cables.—We have received some particulars of a form of cable which has been developed by the "Indestructible" Cable Company, of 47–51, Park Street, S.E., in order to obviate the insulation troubles which are often encountered under severe conditions of exposure to weather or acid fumes, &c. The inventor, Mr. Hackethal (Telegraph-Director of the Imperial German Post Office), found out after careful and long experiments that a mixture of minium or red lead and linseed oil which *per se* is a good rust preventative, offers in its hardened condition a great resistance against atmospheric and chemical influences. It has been found possible to embody this material in the insulation of a variety of forms of cable and wire, and to thus produce an insulating covering of great durability. These wires are particularly recommended for fire alarm, electric clock, and other signal installations which are apt to touch or interlace one another in exposed situations, and also for telegraph and telephone lines crossing overhead power circuits, as well as for chemical works, accumulator rooms, &c., where fumes harmful to ordinary insulation abound. It is claimed that exposure to air, so far from causing the insulation to deteriorate, increases its hardness and durability as well as its insulating property. We understand that material of this description is in extensive use in the Simplon tunnel, and has been found particularly suitable for tropical climates.

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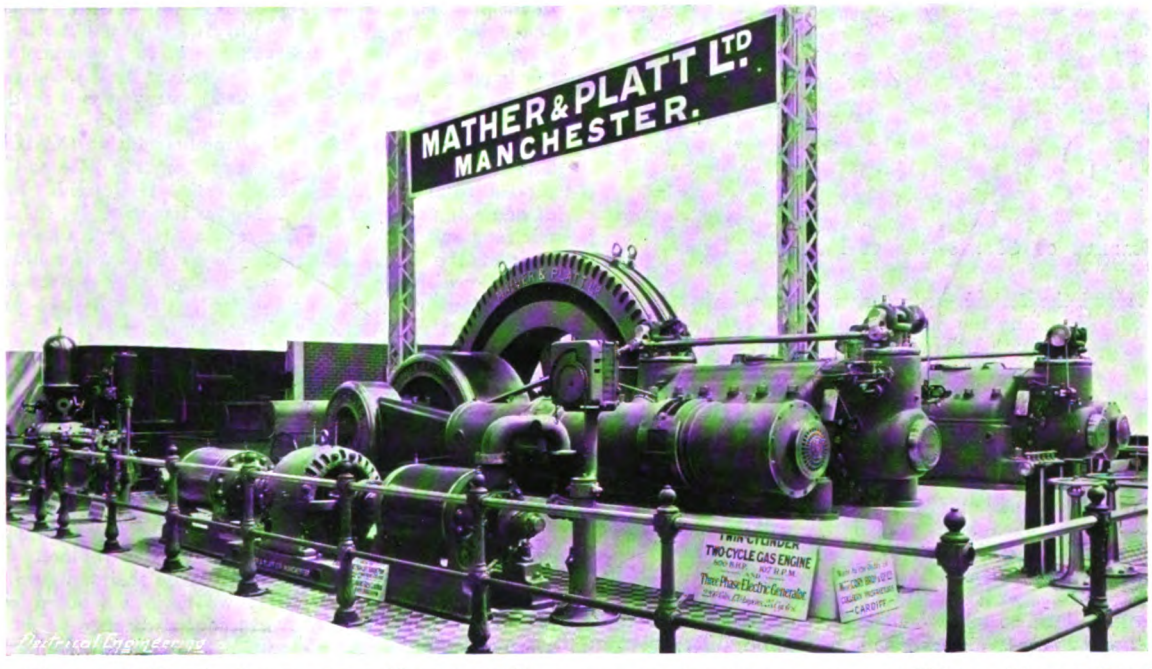
ELECTRICAL ENGINEERING AT THE FRANCO-BRITISH EXHIBITION

THE features of electrical engineering interest in the Franco-British Exhibition include not only the exhibits themselves, but also the arrangements for the supply of current throughout the exhibition, the lighting, and the various applications of electrical power. In our issue of May 7th (ELECTRICAL ENGINEERING, Vol. III., pages 687 to 690), just before the opening of the exhibition, we described pretty fully the arrangements for the distribution of current supplied by the Hammersmith Borough Council and the Notting Hill and Kensington Electric Supply Co., and the utilisation of this supply for power and lighting. We also indicated at the time the extent of some of the principal examples of generating plant that were being erected for taking part in the supply within the exhibition. A further article, published on June 18th (ELECTRICAL ENGINEERING, Vol. III., pages 930 to 934), described some of the particulars of some of the principal French and British electrical engineering exhibits which were then complete, and also the electrical features of the science section, and on pages 23 to 28 of ELECTRICAL ENGINEERING of July 2nd a full illustrated account was given of the collective exhibit organised by the electric supply companies of London. We now propose to supplement these articles by calling attention to some additional electrical engineering exhibits which we have not been able to describe before, and to give a few further notes on the principal examples of power plant in the Machinery Hall, and some of the more notable cases of the application of electrical power in the exhibition.

We have already referred (ELECTRICAL ENGINEERING, Vol. III., page 931) to the imposing stand of Messrs. MATHER & PLATT



MESSRS. MATHER & PLATT'S STAND IN THE MACHINERY HALL, SHOWING ALTERNATOR DRIVEN BY 800-H.P. KÖRTING GAS ENGINE.

near the entrance to the Machinery Hall, and are now able to give an illustration of the group of machinery exhibited by this firm. Specially prominent is the generating set consisting of a three-phase flywheel alternator, designed for an output of 170 amperes at 2,200 volts 25 cycles at a power factor of 0·8, with its rotor mounted on the crank shaft of a fine twin-cylinder two-cycle gas engine of the Körting type, capable of developing 800 B.H.P. continuously at 107 r.p.m., with a gas supply equivalent to about 140 B.Th.U. per cubic foot. The other exhibits, including examples of the Zoelly turbine, have already been alluded to.

In our description of the collective electrical exhibit, we referred briefly to the apparatus exhibited by the REASON MANUFACTURING CO., of Brighton, in the reception room, and are now able to give some further particulars of this company's exhibit. The firm point out that the advent of the metal filament lamp renders accurate registration of small currents a matter of even more importance than it was before, and that with the possible initial falling-off of revenue from private lighting that may occur before the full effect of their benefit to the supply industry is apparent, increased economy in the meter department of central stations will be sought for. It is claimed that the new type of Reason electrolytic meter materially reduces such expenditure, and a full complement of patterns of this description of meter are on view. These are hermetically sealed, and the entire absence of clockwork is claimed to be an important factor in keeping down the cost of maintenance. Notwithstanding the use of glass containers, they are in no way more fragile than the customary motor-driven meters, with their train of fine glass-hard steel pivots and gear-wheels. The present design of Reason electrolytic meter has passed the tests of the Board of Trade, and embodies improvements which have overcome the troubles experienced with some of the early electrolytic meters. The electrolytic chamber is a glass bulb containing electrodes of mercury separated by an annular glass partition. The gases given off rise to the top of the bulb and cause the liquid to be displaced and to drive down an indicating column of mercury in a U tube. The action can be studied in a special demonstration meter with the case removed, which is effectively illuminated from behind. In addition to these meters, the Reason Co. show a selection of the manufactures for which they are noted, and which includes prepayment meters, maximum demand indicators of thermal and electro-magnetic type, time switches, &c. They also have a series of their different patterns of arc lamps, five of which, burning in series off a 500-volt circuit, are to be found over the motor section of the Supply Co.'s exhibit, and two miniature enclosed arcs, run off a 220-volt alternating circuit, are mounted on the two pillars which flank the entrance of the reception room. The centre of the Reason Co.'s main exhibit is occupied by a glass-case containing test-room and other apparatus designed by Mr. Clark Fisher, amongst which is a specimen of the compensating type potentiometer with which his name is connected, and now solely manufactured by the Reason Co. under his supervision.

Another stand forming a part of the collective exhibit of the electric supply companies of London, to which we have only referred briefly, is that of the WESTMINSTER ENGINEERING CO., of Victoria Road, Willesden Junction. On this stand are exhibited samples of the firm's enclosed arc lamps, consisting of the brake-feed pattern as used on the

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Central London Railway, Great Western Railway, Metropolitan Railway at Baker Street and South Kensington, also by the General Post Office. A small enclosed lamp of a slightly different pattern, taking a current of 3½ amperes, and particularly suitable for lighting small shops, corridors, waiting-rooms, &c., is also shown. A lamp of this kind, fitted with a silk shade, hangs in the middle of the stand for the general lighting of the exhibit, and has a very pleasing effect. The display also comprises a number of "Westminster" photographic arc lamps, the speciality being a large lamp burning singly on a 500-volt continuous-current circuit. The arc in this lamp is about 6" long, and the actinic power of the light is very high. A half-size model of a very handy printing frame, with arc lamp and light shade on the top, is shown. A lamp and frame such as this enables the photographer to do the whole of his printing quite irrespective of the state of the weather; in fact, we are told that photographers who get used to printing by artificial light are often inclined to give up daylight altogether, the exposures being so much more easily managed by artificial light. Another object of interest on the stand is the firm's new pattern limit switch. This switch is for use in places where, for one reason or another, it can take the place of a meter; for instance, in large blocks of flats or offices, it is found convenient by the Supply Co. to put one large meter at the point of entrance of the supply, and a limit switch to each tenant of a flat or offices, the tenant is then charged so much per annum for current, his maximum not to exceed a specified amount; if this maximum is by accident exceeded, the limit switch operates by opening and closing the circuit, so causing the lamps to blink violently until the current is reduced to the normal value. The arrangement of the switch is shown diagrammatically in the accompanying figure. When the maximum current is exceeded, the armature

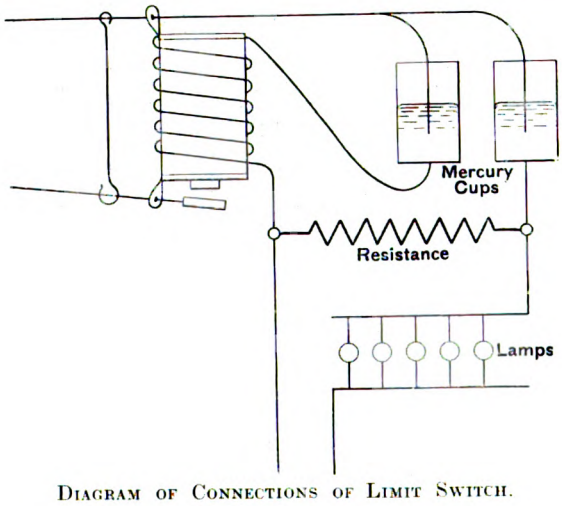

DIAGRAM OF CONNECTIONS OF LIMIT SWITCH.

is pulled up and the forked contact arm is jerked sharply out of the mercury, breaking the main circuit. The current at once takes the alternative path through the resistance, and the lamps are dimmed. As no current now passes round the magnet, the armature falls and the forked contacts dip again into the mercury. This continues till the current is reduced by switching off the excess lights. The particular novelty of this switch is the shunting resistance, which is found necessary in order to make it suitable for use with metallic filament lamps. Such lamps have a low resistance when cold, and take a large momentary current when switched on. It will be seen that, without the resistance, if the switch is started by excess of such load the lamps will be momentarily extinguished, and on making contact again there will be a rush of current, so that a great part of the load must be taken off before the switch would stop working. The by-pass resistance gets over this difficulty by dimming the lamps only instead of extinguishing them. A number of photographs are shown illustrating work done by the "Westminster" photographic lamps, and also illustrating other of the manufactures of the company, which include dynamos, motors, electric welding machinery, electric ventilating fans, switchboards, &c.

An exhibit in the furnished flat, forming part of the collective electrical exhibit, which we did not refer to in our previous article is the small table lamp which is to be found in the bedroom on a small table by the bed, and is represented in the illustration below. This table lamp has been brought out by the LONDON ELECTRIC TRANSFORMER CO., of 10 City Road, E.C., and is a modification of the "Adapter Transformer," which was fully described on page 698 of ELECTRICAL ENGINEERING, Vol. III. The main object of these transformers is to render possible the use of low-voltage, low-candle-power, high-efficiency metal-filament lamps on high-voltage supply circuits. The continuous capacity of the standard type is somewhat over 20 watts, and they are wound for transforming down from a primary pressure of 100 to 250 volts to a secondary pressure of 25 or 50 volts. The table lamp illustrated contains one of these transformers in its pillar, and is also fitted with the turn-down device described

TABLE LAMP CONTAINING SMALL TRANSFORMER FOR LOW-VOLTAGE METAL FILAMENT LAMP.

in the previous article. There are three positions: full, medium, and a mere glow. The possibility of reducing the light in this way, with corresponding economy in current consumption, makes the lamp a specially ideal lamp for bedrooms, nurseries, and sick-rooms. A neat switch in the primary circuit renders it unnecessary to remove the socket plug to switch off the light, and the brilliancy is regulated by simply rotating the lamp shade. The transformer may be detached from the base and used suspended from an ordinary lamp socket if desired. In the case of house installations with a high-voltage supply, in which electric fans and heating appliances are employed, a general change over of the whole house circuit to 25 volts would be inadmissible; with the aid of these "adapter" transformers, 25-volt metal filament lamps can be used, the reduced consumption amply justifying the cost of the transformers.

A stand, forming part of the collective exhibit, which has been completed since the press view upon which our article of July 2nd was based, is that of Messrs. DUNCAN, WATSON & Co., of 102 Charing Cross Road, who have a display of high class metal work as applied to electric lighting, including some artistically designed fittings in various styles and ornamental flush switch and bell push plates with door furniture to match. Another exhibit is a form of self-contained electrically-driven vacuum cleaner for home use, known as the "Aspirator." This is compactly arranged in a small wooden cabinet.

One or two new items have also made their appearance in the reception room. Among these we noticed a board erected by SIMPLEX CONDUITS, LTD., forming a display of examples of every possible variety of component parts and fittings for their well known and very completely thought out system of conduit wiring. Samples are also shown of the Simplex metal filament lamp.

Another new exhibit in the reception room is that of the PASTIAN METER COMPANY, which consists of a board upon which are shown seven examples of various sizes of the well-known Pastian electrolytic meter.

Another new electrical exhibit in the Machinery Hall close to the collective display, although not actually forming a part of it, is a 14-cell accumulator battery of a capacity of 120 ampere-hours, manufactured by the HART ACCUMULATOR CO., which is shown on the stand of Messrs. JOHN BARKER & Co., alluded to in our previous description in connection with the Kennedy patent pipe bending machine.

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In addition to the exhibit relating to "Liconite" cables on the stand of Messrs. GEIPEL & Co., in the Machinery Hall, are several examples of a new pattern of the Geipel rapidity steam trap, including a model showing the actual working parts in section. In this trap, which differs slightly from the earlier patterns, the brass tube, which constitutes the inlet and should be connected to the vessel to be drained, is at the bottom of the trap. The iron tube, which constitutes the outlet for the discharge, is at the top as in the ordinary Geipel trap. The valve is held normally on its seat by the steam pressure combined with the pressure of a light spring. When the trap is cold or full of water, the valve is depressed from its seat by the valve spindle, which abuts against the end of the lever. When steam enters the brass tube, the latter expands and moves the valve casing upwards. The steam pressure and light spring then close and hold the valve tight until water has again entered the brass tube and cooled it, upon which the brass tube contracts and moves the valve casing downwards until the valve spindle impinges on the valve and forces it open. As soon as the valve is open the rush of water, so to speak, forces or wedges the valve upwards, thus making the large opening which gives the rapid discharge. The valve is separate from the valve spindle and is therefore not held fast by the friction of the stuffing box; further, being provided with veins, it is caused to rotate whilst discharging, and consequently to grind itself in at each discharge so that the seat is kept in good order. The action of the trap is such that there is no dribbling, but as soon as ever the trap commences to discharge the valve is forced well open; a sharp blow-through then occurs until all water is discharged, when the trap is as suddenly shut. Examples of the traps are seen at work on the steam range supplying the Parsons turbo-generator.

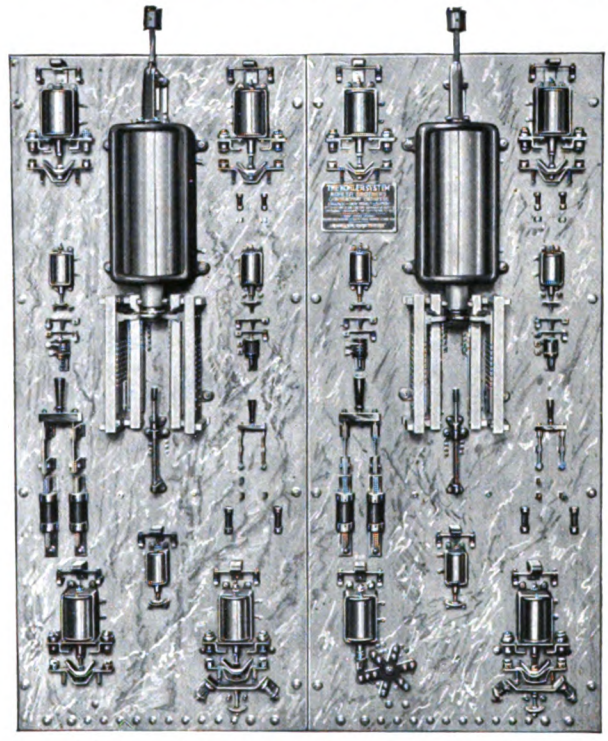
An effective stand in the centre of the portion of the Machinery Hall running across between the British and French wings is that of the UNITED FLEXIBLE METALLIC TUBING CO., LTD., represented in the accompanying illustration. The struc-

DISPLAY OF FLEXIBLE METALLIC TUBING.

tural part of the pavilion and the arches surmounting it are most effectively arranged from samples of the firm's well-known flexible tubing composed entirely of metal without any other packing material, and suitable alike for high temperatures and pressures, or the conveyance of oils or greasy liquids which quickly attack indiarubber and similar material. Particular attention should be paid to the arrangement of the incandescent lamps outlining the arches, the wiring of which is entirely enclosed in flexible metallic tubing used in conjunction with special lamp holders.

A few new electrical exhibits have made their appearance in the French section since our last description, but even now there are many incomplete stands in this part of the exhibition. Near the entrance is a stand of the SOCIÉTÉ ALSACIENNE DE CONSTRUCTIONS MÉCANIQUES, of Belfort. This well-known firm exhibit a series of motors exemplifying their continuous current and three-phase standard patterns, and also a large three-phase automatically-controlled booster transformer with movable windings. Another object of special interest on the stand is a 50 h.p. single-phase traction motor, complete with gearing for 500 volts 25 cycles, and a normal speed of 500 r.p.m. Another new stand completed recently in this section is that of a firm styled the FRANCO-BRITISH ELECTRICAL CO., who show examples of a very effective system of decorative lighting with small incandescent lamps arranged in festoons with glass beads and small transformers for enabling low voltage metal filament lamps to be used on alternating currents of the ordinary supply voltages.

An important application of electric driving is represented by the large octuple web perfecting press manufactured by Messrs. R. HOE & Co., for the *Daily Mail*, and exhibited working in the pavilion of that newspaper. The press, which is capable of producing 100,000 eight-page papers per hour, is operated by the "Kohler" electrical continuous-current control system. The equipment, which was supplied by Messrs. KOHLER BROS., of 56 Ludgate Hill, E.C., consists of two 60 h.p. and two 10 h.p. motors, and the standard "Kohler" four-motor controller with sixteen push-button control stations at various points about the press. The main 60 h.p. motor is coupled direct to the press-shaft, and the auxiliary 10 h.p. motor is connected to this press-shaft through a worm gear and free wheel. The auxiliary motor



KOHLER FOUR-MOTOR CONTROLLER FOR THE "DAILY MAIL" NEWSPAPER WEB PRESS.

is used for operating at slow speed when dressing the press and leading in the paper web. The main motor takes up the load and over-runs the small motor when operating at printing speed.

The whole of the manipulation of the controller is carried out from any one station, permitting the operator to start, stop, run up the speed, or slow down, and also to lock the controller at any given speed or to lock it at the stop position. Thus absolute control of the movements of the press is placed in the hands of the operator from the point where he is working. For example, when putting on fresh plates, &c., the operator can make his adjustments and move the press just exactly to the point required without leaving his position, and when in that position he can lock the control so that the press cannot be moved until he has completed his task. This printing press can be used either as a whole to produce papers of 24 to 32 pages, or as two separate presses producing papers of 4 to 16 pages. Therefore, two separate motors and control outfits are provided, and these can be run either as two sets or as one set; in the latter case the motors and push buttons are automatically paralleled when the mechanical clutch connecting the press is placed in gear. The accompanying illustration is a photograph of the four-motor controller used with this press, and a photograph of one of the push-button control boxes is reproduced below. The chief features of the "Kohler" system of control are as follows:—For putting on blankets or plates, the cylinders can be brought to any desired

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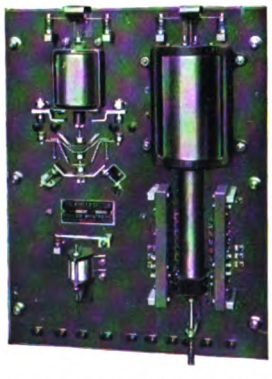
position, and a movement of only $\frac{1}{8}$ of an inch can be made. Again, the speed of the plate cylinders can be varied from ten revolutions per minute through twenty intermediate speeds to the maximum speed. While a press is being made up, and a pressman is working on any part of it, he can make it impossible for anyone to start the press by pressing the "safe" button. To start the machine he must press the "run" button. The "safe" button only prevents any alterations being made to the existing conditions; thus, pushing this button when running at a certain speed prevents increase or decrease of speed. To accelerate, the "on" button is pressed, and to slow down the "off" button is pressed. Pushing the "stop" button stops the machine in a few seconds. Whenever the machine is stopped the controller automatically returns to the starting point. The control circuit, including push-buttons, solenoids, &c., is operated at the motor voltage off the supply circuit. The control boxes are well insulated, and a resistance are connected in series with the solenoids to limit the control current to the necessary value.

The press is first started up on the small 10 h.p. motor through the worm gearing by pressing the "run" button, which releases a plunger, seen in the centre of either of the boards illustrated. The plunger descends slowly, cutting out the starting resistance of the small motor; its descent can be arrested by pressing the "safe" button. If allowed to descend further, the small motor reaches its maximum speed, and the large 60 h.p. motor takes up the load. The contacts behind the plunger belong to the starting resistance of the small motor, and the side contacts belong to that of the larger motor. On pressing the "off" button, the plunger rises slowly, reducing the speed and eventually, unless arrested, transferring the load on to the smaller motor in case it is desired to run at a slow speed or to move the rollers to any particular position. The starting resistances for the large motor would have to be abnormally heavy if it was necessary to run this at the slow speeds; and, moreover, the small and certain movements rendered possible by the use of the small worm-geared motor would be impossible to attain with the large motor only.

The other solenoids on the boards illustrated are connected with the control system, and means for paralleling the control circuits of the two machines and the four motors is also provided. The main switches, shown in the bottom right-hand corners of the two boards, are controlled by the "stop" button and the overload and no-voltage cut-outs. When the main switches open, they short-circuit the motors at the same time, which brings the machines to rest in one or two seconds. The power to drive this press, as well as that for lighting the pavilion, is obtained from a 95-kw. E.C.C. continuous-current generator driven by a two-cylinder Diesel oil engine adjacent to the press.

Printing machinery under electrical control on the "Kohler" system can also be seen at the stand of Messrs. BEMROSE & SONS, of Derby, who are producing there the daily programmes, &c., for the exhibition. The plant consists of two flat-bed printing machines, two folders, two guillotines, and the necessary



KOHLER STANDARD CONTROLLER FOR FLAT BED PRESS.

PUSH-BUTTON OPERATING SWITCH, AS USED ON THE "DAILY MAIL" PRESS.

wire-stitching machines for binding the programmes. All these machines are driven by Westinghouse continuous-current motors. The two printing presses and folding machines are operated by means of "the Kohler System" of multiple push-button control. On each of the four machines there are two control stations. These stations give absolute control, and the machines start immediately the "On" button is pressed and come to rest immediately the "Stop" button is pushed in; the action is so far under control that the machine tables can be moved half an inch at a time. They can also be accelerated up to full speed in any given time, slowed down gradually to dead slow, or stopped immediately. The board illustrated below is the standard type for operating flat-bed presses. It contains a plunger and single set of contacts, which act in a similar manner to those of the larger controller. The main switch, armature short-circuiting switch, and overload cut-out are also visible. No matter how the operator may handle his push-buttons, he cannot harm either the machine he is operating or the motor driving it. The controllers for several machines may be grouped together in one place quite remote from the machines, and are thus not subject to the abuse or damage from vibration and dust, but, on the other hand, are so placed that they can have complete and efficient supervision without holding up the presses.

This system of control has been in use at the printing offices of the London *Morning Post* and the *Manchester Chronicle* for some four years, and it is now being adopted by the *Daily Mail*, *Daily Mirror*, and *The Times* in this country, by *Le Matin* in Paris, by the *Rotterdamsche Courant* in Holland, and in America by many of the leading newspapers and printers. We understand that there are over five hundred of these outfits in use, and that many have been in use for several years, giving very satisfactory results as to expenses of maintenance.

In the *Daily Mail* Pavilion is also to be seen a complete set of the Pollak-Virag writing telegraph instruments. The principle of the receiving and writing instruments is as follows: The movement of a small mirror is controlled in two directions at right angles to one another by two electro-magnets; this mirror reflects a ray of light on to sensitised paper. Two movements in either direction are possible; the larger movement is produced by sending current through the magnet winding for a slightly longer period. By combining these four movements, the ray of light can be made to write in very uniform and easily legible characters. The sending instrument consists of the perforator (a form of typewriter) and the transmitter proper. A strip of paper is passed continuously through the "perforator," and the operator uses the buttons in the ordinary way. For each letter a group of small and large holes is punched in the strip. When the strip passes through the transmitter, these holes allow current to flow for short and long intervals respectively, which produce corresponding movements of the mirror. Current through both "vertical" and "horizontal" electro-magnets simultaneously produces a sloping line. The speed of operation of the perforator is, of course, the same as that obtained with an ordinary typewriting machine, but the speed of the transmitter and receiver is some 40,000 words per hour. The sensitised paper, after being exposed to the action of the light ray, is passed through a developing bath and finally a fixing bath incorporated in the body of the instrument, so that messages are delivered written and legible. The instruments shown are connected by a combined resistance, inductance and capacity corresponding to a distance of 400 miles. Two wires only are needed to connect the instruments.

The Korn system of reproducing photographs at a distance is represented by a complete set of transmitting and receiving instruments at the *Daily Mirror* Pavilion. This system, which depends for its action on the alteration of the electrical resistance of selenium under the influence of light, was described in ELECTRICAL ENGINEERING, Vol. II., page 766.

Disputed Tramway Coils.—At the Clerkenwell County Court on Thursday last week Messrs. D. Santoni & Co. (1906), Ltd., sued the Farringdon Engineering Co., of 29 Red Lion Street, Clerkenwell, for £49 16s. 10d., the price of 314 armature coils for use on the Birkenhead tramway system. The defence was that when tried upon the tramways in question the coils short-circuited and would not bring the cars out of the yard. The hearing before the County Court Judge lasted nearly two days, and the Judge decided in favour of the defendants, expressing the opinion that the coils supplied were not reasonably fit for the purpose of tramway traction.

A Works Manager's Salary.—In the Birmingham County Court last week Mr. J. H. Koeller, late works manager to the General Electric Co., Ltd., at Witton, sued the company for £100 alleged to be due to him as a bonus. The plaintiff was engaged in 1906 at a salary of £700 per annum, with a bonus to be fixed at the discretion of the directors. In the first year he received a bonus of £100, but subsequently complained to the resident director of the company, Mr. M. Railing, that, as he had been receiving £900 per annum in New York, he could not in justice to himself remain in England for less. He claimed that it was then verbally agreed that his bonus should be increased to bring his salary up to £900 a year, but he had only received £100, leaving a balance unpaid of £100. For the defence this verbal agreement was denied. Judgment was reserved.

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ELECTRICAL TRANSMISSION FOR MAIN MARINE PROPULSION

AT the Congress Hall of the Franco-British Exhibition on Saturday evening, at a special meeting of the Institute of Marine Engineers, Mr. W. P. Durtnall read a Paper on the generation and electrical transmission of power for main marine propulsion and speed regulation. The Paper dealt in a general way with the application of the "Hart-Durtnall" three-phase electric power transmission system (see ELECTRICAL ENGINEERING, Vol. I., page 147) to marine propulsion, and sought to emphasise the great possibilities of electrical power transmission and speed regulation as applied to steam propelled vessels, and the economies obtainable. The steam turbine for marine propulsion has secured a very strong hold, but in this case it labours under a few but important disadvantages. First, when it is direct coupled to the propeller, it has to be designed to run at very low speed in order to permit of the use of a propeller of high efficiency, consequently the weight per B.H.P. developed is increased to a very large extent, and owing to large diameter of rotor and casing, proportionately large blade clearance must be allowed in order to meet the conditions of expansion and contraction, &c., with consequent higher steam leakage and consumption per horse-power developed. Other disadvantages of the direct-coupled steam turbine are the difficulty of reversing for manœuvering and going astern, and the lack of economy in steam when working below full load and speed. This inconvenience, although of perhaps little importance with steamships making long continuous runs, is very important for those making short voyages, starting and stopping, and manœuvring in and out of harbour several times a day, or for ships of war, in battle or manœuvring in squadrons, and in order to get these very necessary qualities, separate astern turbines have to be installed, but with only generally about one-third the ahead power, and these usually only applied to two out of three or four shafts as the case may be.

Mechanical gear has been tried in connection with small-power turbines, but the results, generally speaking, have been far from satisfactory, on account of the great noise and heavy cost of up-keep. Electrical power transmission has, however, the very elements that are required in order to take advantage of high-speed turbines; thus saving turbine weight and also securing high economy in steam by utilising these to drive electric generators, the current so generated being used to supply low-speed electric motors, coupled to high efficiency, moderate speed, and large-bladed propellers. Further, this method of power transmission does not necessitate the cost of installation or operation of reverse turbines.

Owing to the very fine control which is possible, advantage can be taken of complete operation from the bridge, or other suitable position, by means of motor operated switches, and the main circuit need only be broken under no voltage conditions.

In the author's opinion, electrical power transmission can be only successfully carried out by means of polyphase alternating currents with synchronous generators, and squirrel cage induction motors, not only on account of the great simplicity of these machines, their low cost, and low weight per horse-power developed, but also because the use of continuous-current machines with commutators and brush gear would be next to impossible for such high powers as would be necessary.

The electrical efficiency of turbo-alternators varies from 85 per cent. to 98 per cent., and their weight per kilowatt output for continuous rating between 35 to 22 lb., according to speed and other circumstances, while the steam consumption per kilowatt hour in 7,500 kw. sizes at, say, 750 r.p.m., running condensing and at 160-lb. steam pressure, with 150 degrees superheat at the stop valve, with about 27½-in. vacuum, is about 13·5 to 14 lb. (including auxiliary plant), while a 2,000-kw. set running at 1,500 r.p.m. under similar circumstances consumes about 15·5, and it is also interesting to note that a 500-kw. set at 3,000 r.p.m. uses only 23 lb. of steam per kilowatt hour.

It is quite within the range of possibility to design and construct three-phase squirrel-cage motors for marine work, of from 1,000 to 10,000 horse-power, which would weigh from 35 to 20 lb. per horse-power developed, and this for continuous rating and without sacrifice of any efficiency, which would in these cases be about 93 to 97 per cent.

Let us assume that we wish to know what will be the steam capacity of the boilers for a vessel fitted for electrical transmission. For four propellers each requiring to rotate them, 1,000 B.H.P. at 250 r.p.m., the motors would be of the polyphase induction type, with squirrel-cage rotors, and with stators wound for full, half, and quarter speeds. The generators would in this case consist of two turbo-alternators and exciters capable between them of generating and supplying 3,250 kilowatts, and running at a speed of 1,500 r.p.m. with steam at, say, 150-lb. pressure and 150 degrees F. superheat. These alternators would be, say, two-pole machines; therefore, if the motors are wound for 12 poles (for top speed) it will be equal to a 6 to 1 reduction. For half-speed, the second winding would be arranged for 24 poles, 12 to 1 reduction with two sets of windings in parallel, and for quarter speed this winding would be arranged for 48 poles, 24 to 1 reduction; the synchronous speeds would thus be full speed 250, half speed 125, and quarter speed 62½ r.p.m.

For the top speed the above turbo-alternators would be coupled up in parallel, and when supplying the motors with current would generate 3,250 kw., and the consumption would be, say, 16 lb. per kilowatt, or 50,400 lb. of steam per hour, or 15 lb. per shaft horse-power, which compares, in my opinion, very favourably with what would be required with direct-coupled turbines working under similar speed and circumstances, which would be more of the order of 22 lb. per shaft horse-power, or 88,000 lb. The difference in steam consumption is 36,000 lb. per hour, representing a saving of no less than 41 per cent. in boiler capacity. Now, at half speed, we will close down one of the turbo-alternators altogether, and we shall probably only require, say, 600 shaft horse-power at this speed; therefore, I will estimate the efficiency of the motors at this half-speed and load 60 per cent.—740 kw., the turbo-generator would use, say, 24 lb. of steam per kilowatt hour with this load, but would run at top speed, although at half vessel speed, and this is equal to 17,760 lb., while the direct-coupled turbines would each run at half-speed, and the consequent steam consumption would be not less than 47 lb. per shaft horse-power, or 28,200 lb. of steam. Under these circumstances there would be a saving of no less than 11,880 lb. per hour, or 37 per cent.

Assuming these estimates to be approximately correct, it may be asked, what will be the relative weights of the two systems? so we will take first the electrical equipment :—

4,000 B.H.P. at 35 lb. per h.p. developed, say	62½	tons.
Conductors, switchgear, &c.	6	,,
Two turbo-generators as above . .	70	,,
Condenser for above	19	,,
Steam, piping, &c.	13	,,
Air pump and motor	6	,,
Circulating pump and motor . . .	7½	,,
Total	184	tons.

The weight of the direct-coupled turbines and part of the propeller shafts, shaft tunnels, &c., including condenser, steam-pipes, &c., air and circulating pumps—which would have to be arranged to deal with the 88,000 lb. of steam—would be at least (taking the speed of the turbines at 250 r.p.m.) 148 tons, showing that the electrical machinery would be about 25 per cent. heavier; but it is here necessary to point out that that only applies to the plant from stop valve to propeller shaft connections.

We will now look into the possible saving in operating costs and weight at the other side of the stop valve. Let us take the data that have been published, as regards the weights of cylindrical boiler, stoke-hold equipments, &c., which are as follows, when taking reciprocating engine vessels into account :—For good cylindrical boilers, including small and large mountings, fire box and funnel (boiler empty) with forced draught, pipe-work, including all pumps, water, steam, and exhaust pipes, gratings, platforms, &c., the weight per I.H.P. in boiler-room reaches 180 lb. Therefore, the weight of the boiler-room equipment of a vessel in which would be installed, say, two reciprocating engines running condensing would approximately be as follows :—

Taking 180 lb. boiler equipment weight per I.H.P., then 4,700 I.H.P., with a mechanical efficiency of 85 per cent., would equal 4,000 B.H.P., and would account for a weight of 377 tons, and in order to get at the steam consumption per ton of boiler weight, we will allow, say, 16 lb. of steam used per I.H.P., including steam required for auxiliaries and losses due to radiation, &c., or a total of 75,200 lb. of steam, or 200 lb. of steam per hour per ton of boiler-room equipment. Under these circumstances the boiler-room equipment would weigh for the 52,000 lb. of steam that will be required for the electrically-driven vessel 260 tons, while for the direct-coupled turbine-driven vessel the boiler equipment would weigh

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not less than 440 tons, or a saving in weight in boiler-room equipment for the same propeller h.p. of not less than 180 tons, or 40 per cent.

Now, as regards coal consumption, and comparative saving in this direction, we will take it that with hot feed, clean flues, and with good Welsh coal, it is possible to evaporate, say, 10 lb. of water per lb. of coal burnt, so that we have in the direct-coupled turbine vessel a coal consumption of 8,800 lb., and in the case of the electrical vessel 5,200 lb., or a saving of 1·6 tons per hour, which equals in a ship running for six days a net saving in favour of the electrical scheme of no less than 230 tons. This important matter will be surveyed with somewhat close interest by cargo vessel owners, as it may be at the same time observed that the propellers are run at about the same low speed as is necessary and usual in these slow vessels, in order to secure economy at the propeller.

The Paper will be discussed at a future meeting of the Institute.

CORRESPONDENCE

ACCUMULATORS FOR PEAK LOADS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—It is with much reluctance that I trespass upon the hospitality of your columns, but it is to correct a mistake of some considerable importance, and one that tells very adversely against batteries, and this must be my excuse. The comment of practically everyone who has hitherto criticised my paper has been that the use of cells is doomed to discontinuance directly any station acquires a decent load factor. In the case of the large majority of our municipal systems, it would be most unsafe to predict that the load factor will exceed 30 per cent. in the course of the next ten years. If, then, it can be shown that, as far as *fixed* charges are concerned, the battery can compete with steam additions, even where there is a good load factor, the only question remaining is whether, in the matter of *running* expenses, this saving is not wiped out by the inefficient battery. An analysis of the Neptune Bank mid-winter peak for 1903 (see Merz's paper, April, 1904) shows that, by putting in a battery on a three-hour rating, it would be practicable to take up 40 per cent. of the peak. The capital cost would be £15 per kilowatt, and the annual *fixed* charges £2·4 per kilowatt of maximum demand per annum, as against £4·6 per kilowatt, with reciprocating engines, or, say, £4·2 per kilowatt, with turbines to the battery curve, as already explained at Nottingham. It may here be remarked that it is the high value of *other* fixed charges than capital costs which tells against steam. The *running* charges will also be less (although the load factor at Neptune Bank must have been quite 50 per cent.), because the battery enables certain engine and boiler units to be shut down altogether on account of the all-night load being so much less than the day load. The diagram given with my paper shows a net saving of some 4,750 tons of coal per annum for a station which is mostly a lighting station. On a station with a large power load this would no doubt be considerably reduced; but there would certainly still be a saving, even where steam turbines were employed, on account of the reduced number of boilers under commission. Surely there are many municipal stations that have yet to beat the power load possessed by Neptune Bank in 1903-4.

Is it too much to hope that the above simple example, which anybody can check for themselves, will at least cause engineers to consider whether the continuance of the use of batteries does so entirely depend on the obtaining of a power load, and whether the all-night load, and the sizes of steam units employed, do not have something to say in the matter?

Yours faithfully,
A. M. TAYLOR.

Avondale, Ashfield Road, King's Heath.

AUTOMATIC STOKERS.

To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—In your issue of the 9th inst., you published the report of a very interesting lecture delivered by Mr. H. Richardson, Chief Engineer of Dundee, at the thirteenth Convention of the Incorporated Municipal Electrical Association at Nottingham, on the subject of "Design in Generating Stations." In the discussion that followed the reading of Mr. Richardson's Paper, Mr. Brydges, Borough Electrical Engineer for Eastbourne, in his reference to the underfeed type of stoker, for which he has an avowed preference, stated that he considered this stoker had a great advantage over the chain grate, as it would burn practically any sized coal, including smudge and duff, and that he did not think there was any other chain grate or automatic stoker that would burn this coal satisfactorily. He had also found that the repairs were not as large as they were with other types.

Now, Sir, as the oldest and premier firm of stoker-makers in this country, we would suggest to Mr. Brydges two or three points for his consideration in connection with the system of underfeed stoking He has certainly made large claims for the system, while he has omitted to point out any of its drawbacks. For instance, it is well-known by those who use this type of machine that nearly one-third of the furnace grate is taken up with the coal feed, and that the air requisite for burning the coal has to be passed through the mass of fuel which has been rammed semi-solid by the action of the underfeed ram, so that little available air for combustion can percolate through this portion of the grate. For coal combustion purposes, therefore, the underfeed system gives only two-thirds of the grate surface, which ought to be available in the furnace. Again, owing to the disposition of the fire-bars in the underfeed machine, it has been objected by the supporters of the overfeed type of stoker, that the cleaning action is not effective, and the bars gradually accumulate clinker and ash at the two sides of the furnace, which has to be cleaned out by hand at the end of a period depending upon the amount of clinker and ash in the fuel.

The principle of action of the underfeed suggests lighting a coal fire at the top in an ordinary grate. It is common knowledge that if you light a fire in this way it takes a very long time to burn up and glow brightly, because the hydrocarbon gases distilled from the coal, coming through the incandescent fuel on the top, have a greater affinity for the oxygen in the air than the carbon, so that the temperature is lowered at the very point where it should be highest, and it is difficult to prevent a certain amount of carbonic oxide being formed, with the consequent lowering of the furnace temperature and loss in efficiency The underfeed machine was originally constructed in America with a view to burning anthracite coals, and it is an excellent machine for this purpose—anthracite containing as a rule a very small proportion of ash or clinker—but with the bituminous fuels generally used, the underfeed system for all practical purposes is nothing like so efficient as the overfeed type.

We may here point out that, apart from these considerations, it is a slow process getting up steam on the boilers with underfeed stokers. The rapidity with which steam can be produced is certainly a vital element in steam economy. It is also necessary to remember that a fan and air ducts are necessary with the underfeed system, which considerably adds to the initial expense as well as to the costs of maintenance. A consideration of these principles will, we think, result in a conviction that the disadvantages resulting from the adoption of the underfeed stoker are very serious. Of course, we are not here referring to any special make of underfeed machine, but to the underfeed principle. With regard to Mr. Brydges' observation that he did not think any other automatic stoker, chain grate or otherwise, would burn smudge and duff, the lowest grades of coal, satisfactorily, in answer to this observation we can only say that if Mr. Brydges will give us the opportunity we shall be very pleased to conduct him personally over leading boiler-houses in all parts of the country where smudge and duff and other pit rubbish are the only classes of fuel burnt, and where the thermal efficiency obtained is very considerably higher than is possible to the underfeed type. Again, with regard to the chain grate, we should like to ask Mr. Brydges whether he is alluding to the old type of grate which threatens to become obsolete, if it is not altogether so at the present time. We could certainly assist him in compiling a list of the disadvantages of that ancient machine, but at the same time we should like to introduce him to the latest improved class of stoker, in which the old disadvantages are altogether abolished and a number of marked advantages introduced, that now render the chain grate stoker one of the most useful on the market. It is quite possible with this new type to burn very low-grade and cheap fuels and yet to obtain a high evaporative duty from the boilers, but perhaps Mr. Brydges will give us the opportunity and the pleasure of showing him for himself these new grates in operation, doing regularly far more than we intend to claim for them, and by a recent installation bringing down coal costs in one of the most famous electricity works in Great Britain.

We are, dear sir,
Yours faithfully,
For ED. BENNIS & CO., LTD.,
ALFRED W. BENNIS.

28 Victoria Street, S.W.

Wireless Telegraphy.—The Mersey Docks and Harbour Board have decided to arrange for the hire of two sets of Marconi apparatus, one for the North-West Lightship and the other for Bidston Lighthouse and Telegraph Station. The hire is to be for one year certain, subject to three months' notice at the expiration of that period.

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ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY

IN the German Patent 199265 (1908), W. A. Hirschmann describes an electrical method for maturing and ageing wines and spirits. A very high potential induction current is caused to pass through the fluid, a spark gap or vacuum tube being placed between the inductor and the fluid. The electrodes which carry the current are placed deeply into the liquid, and as far apart from each other as possible, so that the whole of the fluid is under the action of the electrical stress. It will be interesting to know whether this process is as satisfactory as the process of ageing and mellowing of wines and spirits by means of a current of ozone.

We understand that interesting experiments are being carried out at Marseilles Exhibition in connection with the forcing of early fruit and vegetables, particularly asparagus and strawberries, by means of electricity. Instead of heating the forcing frames by means of hot air or steam as usual, conductors are passed through the soil, being buried at various depths and through these currents varying from 1½ to 5 amperes are passed. The forcing frames are kept separated in order that parallel experiments may be carried out.

In the *Journal of Physical Chemistry*, **12**, 155, H. J. Barnes and G. W. Shearer describe a hydrogen peroxide cell. They first recapitulate previous work upon the subject by H. M. Tory and G. H. Cole upon the behaviour of aluminium and magnesium electrodes in water which contains dissolved air, oxygen, or hydrogen peroxide. Many metals show a potential difference when one electrode, the anode, is placed in oxygen free water, and the other, the cathode, in water containing dissolved oxygen, the E.M.F. being particularly great (about 1 volt) in the case of aluminium. When two electrodes of different metals are employed, the action is additive. For example, aluminium and magnesium in oxygen-free water give an E.M.F. of 0·02 volt, but when oxygen is led through the water the E.M.F. rises to about 1 volt. The best cell, that is, the one which gives the highest potential, is $Mg \mid Al_2(SO_4)_3 \mid Al$. When hydrogen peroxide is added to this cell the potential rises to 1.7 volt, and ultimately to 2·1 volts. On closing the circuit the E.M.F. first rose to a maximum, and then gradually fell off. Fresh addition of hydrogen peroxide again caused it to rise to the maximum value. With an outside source of current the cell behaved in a normal manner, in so far as the E.M.F. rose to a maximum when the cathode was aluminium, and fell to a lower value when the anode was of this metal. This explains the rise to a maximum on closing the circuit, but hardly explains the high value obtained. According to Bancroft, this may probably be due to the formation of hydrogen peroxide when aluminium is placed in water containing oxygen, thus :—

$$2Al+6H_2O+6O=2Al(OH)_3+3H_2O_2.$$

The authors actually find that hydrogen peroxide can be detected in oxygenated water in which aluminium has been allowed to remain for some hours. The reaction is particularly strong when aluminium foil is made the anode and a current passed, but when the anode is platinum and the cathode aluminium, then no hydrogen peroxide is produced. It follows, therefore, that the addition of hydrogen peroxide to the cell with aluminium and magnesium electrodes, simply increases the potential. By electrolysis with aluminium cathodes the hydrogen peroxide is reduced, consequently the quantity decreases, therefore a further addition will bring the E.M.F. back to its original value. Other metals behave in a similar manner to aluminium, particularly iron and zinc. In the case of other metals, however, it was not found possible to prove the formation of hydrogen peroxide, therefore if it is produced the quantity is too small to detect analytically, in spite of the fact that the reactions for hydrogen peroxide are exceedingly delicate.

In the June number of the *Electrochemische Zeitschrift*, F. Schmiedt describes experiments which he has carried out upon the electrolytic oxidation of copper when it is employed as anode in solutions of sodium hydroxide. E. Muller and F. Spitzer think that the oxide produced is Cu_2O_3, and that this is very unstable in sodium hydroxide solutions, consequently it decomposes, and it is therefore extremely difficult to obtain analytical results. Schmiedt has not only analysed the product, but he has measured the oxygen evolved, by which means he was able to calculate how much of the oxygen produced by the current had been used up for oxidising purposes. The loss in weight at the anode was also measured. Taking all these factors into consideration, he thinks that the oxide formed is a mixture of Cu_2O_3 and CuO_2, but that probably also Cu_2O is produced. By increasing the temperature during the electrolysis the amount of oxygen liberated increased, and this was probably due to the instability of the peroxide, which at elevated temperatures breaks up into oxygen and cupric oxide.

In the *Comptes Rendus* (1908), 146 and 329, E. Doumer publishes a note upon the Electrolysis of pure Hydrochloric Acid. He proves that when the pure acid is electrolysed a portion of the water in which it is dissolved is likewise decomposed, and that consequently at the anode oxygen is evolved along with the chlorine gas. The production of oxygen is further due to the direct electrolysis of the water, and not to the liberated chlorine.

ELECTRICAL SCIENCE

British and American

Magnetic Properties of Hadfield Alloys.—In the June *Proceedings* of the Royal Society is an account of an investigation by E. Wilson, V. H. Winson, and G. F. O'Dell into the hysteresis and other magnetic properties of two iron alloys invented by R. A. Hadfield. One was the alloy called "stalloy" (which contains about 3 per cent. of silicon), and the other was a transformer iron called "lohys." The specimens were in the form of rings built up of stampings, and were wound over with primary and secondary coils for the ballistic method of testing. The alloys are found to differ considerably from pure iron in their magnetic nature. For instance, it is well known, from Rayleigh's work, that for Swedish iron the permeability is very nearly constant for all field values between 0·00004 and 0·04 C.G.S. In the case of both these alloys the value of μ rises rather quickly in the range of field values just mentioned. Stalloy is somewhat remarkable in that it very readily yields unsymmetrical hysteresis loops. For example, as an extreme case, the field was reduced from 63 to 0·712 C.G.S. units, and a loop obtained with the latter figure as the maximum H. If in the unsymmetrical loop thus drawn the axis of H is placed so that the coercive forces are equal, the positive and negative values of B remain very unequal, though the positive and negative values of the residual magnetism are equal. This effect persists after some hundreds of reversals, and was removed only by reapplying the larger force and reducing the field slowly through many reversals. The Steinmetz coefficients for both materials have been worked out from the usual definition : ergs lost in hysteresis per cu.cm. per cycle $=\alpha B\beta$, but β was found to vary through a wide range in each of the materials.

Continental

High-Potential Direct Circuit.—The secondary current of an induction coil worked with a Wehnelt interrupter becomes unsymmetrical when a spark-gap is introduced; and when the gap is of any but very small size, the current becomes practically a direct pulsating current. O. M. Corbino, in the *Physikalische Zeitschrift* for June 15th, gives hints for obtaining such currents in a convenient manner. The secondary of a small induction coil is discharged through a spark micrometer and a condenser and inductionless resistance mounted in parallel. The Wehnelt interrupter may be used with small coils if an inductance and pretty high resistance is put in the primary. The current in the secondary circuit is the break current only, and 2,000 pulses per second are easily attained. Instead of a spark gap, a small vacuum tube may be used. It is best to keep the spark-gap so short that the secondary current is only just uni-directional, and that any further reduction of the spark-gap would make it alternating. The current obtained by the author with the aid of a paraffin-paper condenser was 30 milliamperes. With suitable condensers there is no reason why the voltage should not be very high. With two Ruhmer condensers in series the author got as high as 6,000 volts.

Thermoelectric Detectors.—In connection with the employment of crystalline contacts for detecting electromagnetic waves, C. Tissot announces in the *Comptes Rendus* for July 6th that almost any two substances may form a detecting combination without any outside source of E.M.F. The only requisite is that the area of contact should be very small. The further apart in the thermoelectric series the bodies are situated, the better is the effect, and this indicates that the effect is really of purely thermoelectric nature. Such substances as pyrites and manganese dioxide in the form of pyrolusite may be associated with any pure metal, the latter being strongly electropositive with respect to those minerals. On the other hand, the natural sulphide of copper (Chalcasine), as well as the fused artificial sulphide, or selenium and tellurium, are strongly electronegative towards metals. If the contact has a high resistance, the detector must be placed at a ventral segment of tension of the receiving system. If low, at a ventral segment of current. A copper point pressed against copper pyrites is just as effective as a point pressed against tellurium. The reading is done by the telephone.

Repeating Autoballistic Galvanometer.—The method of repetition, in which the same measurable action is exerted at successive throws of the galvanometer in the same direction, in order to accumulate its effects, has not been much used hitherto on account of the difficulty experienced in timing the action properly. A method of doing this is described by A. Guillet in the *Comptes Rendus* of July 6th. Just above the movable weight suspended by the torsion wire is fixed a light cylinder on which a cocoon fibre is wound up as the deflection starts from zero. The cocoon fibre, which only gets into action at the middle of the swing, opens a light contact which controls the action to be measured. The cocoon fibre may be avoided by attaching a disc very near the top of the torsion wire. A projection on the disc moves between two contacts which are very close together, and can be adjusted so as to establish or break contact at any desired phase of the throw. The apparatus is specially adapted to the study of eddy currents, or of damping in any shape.

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NEW TELEPHONE APPARATUS

THE International Electric Co., of 55 Red Cross Street, Barbican (works, 115 Salusbury Road, Kilburn), have brought out a new catalogue of their telephone apparatus. A new type of instrument which they are putting on the market is an inter-communication set with "auto-release," in which the button,

FIG. 1.—FIVE LINE "AUTO-RELEASE." INTERCOMMUNICATION SET.

pressed to connect up any station, also serves to send a ringing current. Fig. 1 shows the internal appearance of a five-station set. Pressing in the button for the wanted stations corresponds with an upward motion of the button. When this is pressed

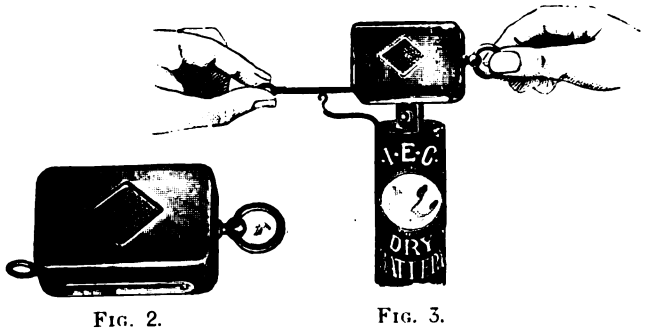


FIG. 2. FIG. 3.

POCKET TESTING INSTRUMENT FOR CELLS OR CONTINUITY.

home, it makes contact with horizontal bars above it which are connected to the battery circuit, and on being released, it catches on a lower bar, which makes contact with the telephone circuit, and keeps the button down until the telephone is hung

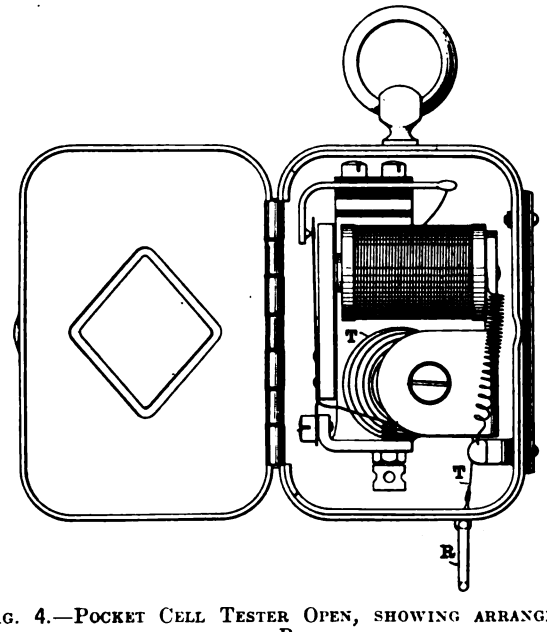


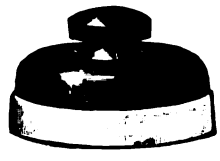
FIG. 4.—POCKET CELL TESTER OPEN, SHOWING ARRANGEMENT OF BUZZER.

on the hook again. On the telephone being replaced on the hook, this bar is rocked in the usual way, and releases the button so that the connections are restored in order to receive the next incoming call.

Figs. 2, 3, and 4 show an interesting little cell tester, which is a very useful and also a cheap device. As seen by Fig. 2, it is in the form of a match box, at the bottom of which the ring *R* of a metallic spring tape *TT* projects. To test the cell, the tape is pulled out slightly and held against one terminal, while an insulated metal plate at the side of the box is rested on the other terminal as shown in Fig. 3. A small buzzer inside the box is actuated if the cell is in order. As seen in Fig. 4, which is drawn to scale, the whole arrangement is extremely neat.

A NEW BRANCH SWITCH

THE accompanying illustration represents a new branch switch which has been introduced recently by Simplex Conduits, Ltd. The switch is of the turn pattern with quick break, and will recommend itself not only on account of its neat appearance and low projection, but also because of its quick independent action. Inside the cover is a specially shaped fibre disc which is actuated by the milled knob on the outside. This fibre disc is arranged to work the spring in the base of the switch. The centre piece which holds the spring revolves and puts the spring in tension; the latter, however, has no effect until it has passed the centre, when it comes into action immediately, giving a rapid make and break. The cover is not fixed by screwing on, but by two springs fitting into special notches in the porcelain base; to remove the cover, a small screw-driver should be inserted between base and cover opposite either rivet head, or a special key is supplied.



NEW SIMPLEX SWITCH, ½ FULL SIZE.

CATALOGUES AND PAMPHLETS RECEIVED

INCANDESCENT LAMPS.—The Stearn Electric Lamp Co. have issued for the use of dealers and contractors stocking their lamps a booklet and calendar entitled "Useful Hints to Electric Light Users," containing some particulars of tests of Stearn British-made incandescent lamps, and some general notes on the arrangement of lamps for the best economy in house lighting. The firm have also produced an attractive show card calling attention to their lamps.

IGNITION BATTERIES.—A leaflet is to hand from the Hart Accumulator Co., of Stratford, giving prices and particulars of a number of types of ignition battery for motor-cars, motor boats, and motor cycles. These cells are of a type specially designed for the purpose, and vary in capacity from 4 to 200 ampere hours. They are contained in strong celluloid boxes, with sealed lids, vent plugs, and non-corrosive terminals. The large sizes are usually supplied in sets in teak crates, and all can be supplied at an extra price, if desired, in metal cases.

DRAWING OFFICE MATERIALS.—A pamphlet from A. E. Mallandain, of 51 Cheapside, contains a sample of a special tracing paper, and particulars of a neat form of pocket slide rule. Prices are given for executing photo copies of tracings.

ELECTROPLATING AND ELECTROTYPING.—A leaflet from the Langbein-Pfanhauser Works, Ltd., Birmingham, calls attention to plant and materials for electrotyping and electroplating, including motor generators, polishing motors, and all accessories required for nickel, brass, zinc, gold, silver, and copper deposition.

OVERHEAD TRAVELLING CRANES.—Messrs. Vaughan & Son, of Manchester, are issuing a very handsome catalogue giving particulars of a variety of types of travelling cranes, including multimotor electric travelling cranes, light load electric travelling cranes, platform hand power travelling cranes, self-sustaining hand-power travelling cranes, pulley block and trolley travelling cranes, &c. A large number of excellent illustrations are given, and some useful notes are included on the choice of speeds for electric travelling cranes, position of control and electric power generally as applied to cranes.

ELECTRIC LIFTS AND HOISTS.—An attractive pamphlet from Messrs. W. Wadsworth & Sons, of School Hill, Bolton, describes several types of their electric passenger and goods lifts. The gear is of the usual worm and wheel type, but either drum or sheave drive can be had. There are three methods of control from which to choose, namely, hand rope, car-switch, or push-button control. Illustrations of the control and driving gear, and also of various designs for cars, both plain and ornamental, are given. Various systems for operating and controlling small electric dinner and service lifts are also described. Another pamphlet from the same firm deals with electric lifts suitable for use in hotels, offices, warehouses, and particularly those for heavy goods work. Both direct and belt-driven lifts are illustrated from photographs of lifts actually installed under various conditions. The "Wadsworth" type of self-landing and delivering hoist is also fully described, and a large number of illustrations show its application to various sorts of work.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published July 16th, 1908

A full list of these was published in our last issue. The following are abstracts of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

6,528. **Multiple-unit Control.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). A system of multiple-unit control in which each of the motor-cars of the train is provided with a motor controller, the motor controllers in turn being operated by means of relays in an independent control circuit consisting of two wires running the length of the train and batteries on the cars. The master controller has two forward and two backward positions. In the backward positions the polarity of the control circuit is reversed. On the first position of the master controller the motors are connected to the supply in series; on the second position the motor controller progressively cuts out the starting resistance and then connects the motors in parallel. This progressive action can be arrested at any desired point by moving the controller back to the first position. Four claims, three figures.

15,335. **Alternating-current Load Equalising Arrangement.** J. S. PECK. This consists of two single-phase commutator motors mounted with a flywheel upon a common shaft. The armature winding of one motor and the field winding of the other motor are supplied from one phase, and the field winding of the one motor and the armature of the other motor are supplied from the second phase, of a two-phase supply obtained by means of a motor generator, or by phase transformation, from the supply circuit. The equalising action is obtained by automatically varying the field strengths of the motor. Four claims, three figures.

23,708. **Control of Single-phase Commutator Motors.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). The torque and current of an alternating-current series motor fall off less rapidly with increase of speed than in a direct-current motor, so that an alternating-current motor designed for the same starting torque as a direct-current motor tends to overload itself at high speeds. According to the present invention such motors are so connected that the shunt excitation is automatically increased as the speed increases, thereby reducing the speed for a given current. On a locomotive, with two such motors, this effect is obtained by producing a phase displacement between the voltages at the armature terminals of the two motors, and impressing on the fields a shunt voltage corresponding in amount to this phase displacement. This phase-displacement increases with increase of speed, so that the shunt excitation will automatically increase with the speed. The shunt voltage is nearly 90° out of phase with the motor terminal voltage, and consequently the shunt field current is nearly in phase with the motor terminal voltage. Six claims, three figures.

1908 Patents

3,986. **Electrically-driven Rolling Mills.** ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT. It is often necessary to operate motors driving rolling mills at a somewhat reduced speed. When three-phase induction motors are used, the reduced speed is obtained by inserting resistance in the rotor. The speed of such motors varies with the load, and it is usual to automatically regulate the resistance in the rotor circuit by means of a centrifugal governor mounted on the shaft of the motor. According to this invention, the governor is geared to the motor by a variable ratio gear, so that, although the motor may be running at a reduced speed, the governor may be caused to rotate at its original speed, and so have the same regulating effect at reduced speeds of the motor as at the normal speed. Two claims, one figure.

6,587. **Microphone Transmitter.** C. E. EGNÉR and J. G. HOLMSTRÖM. In microphones consisting of particles of carbon bearing freely against each other, the variations in current strength are caused by the varying resistance of the air films between the particles. According to the present invention, the microphone chamber is hermetically sealed, and is filled with an active gas, such as hydrogen or any hydrocarbon gas, at a pressure approximately equal to that of the atmosphere. The amplitude of the current oscillations are said to be greatly increased by this means. One claim, no figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Summaries of the more important of these patents will appear in our next issue.

1907 Patents

12,220 JOHNSON (*Badische Anilin & Soda Fabrik*). Production of currents of high periodicity.

12,260. RHODE. Combined electric and gas lamps.

14,649, WYDTS & JEUDI. Electric battery.

14,713, HATFIELD & LEWIS. Arc lamps.

14,745, FESSENDEN. Method of storing energy.

14,831, THORPE. Electric prepayment meters.

15,100A, STRAY. Electric secondary clocks.

15,234, DAWSON & BUCKHAM. Electric signalling.

15,262, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Controlling mechanism.

15,311, WEGUELIN. Automatic circuit closers.

15,363, GESE. Electrically-driven pulley blocks.

15,365, KITCHEN & VON BERNUTH. Power-generating systems.

15,510, DEUTSCHE GASGLUHLICHT AKT.-GES. Manufacture of lamp filaments.

15,922, POLLITT. Electric winches.

19,010, WALKER. Brushes and brush-rockers.

20,061, STELJES. Electrical pendulum.

20,639, CLAREMONT. Filling cable joint boxes.

21,646, COOK & SOKAL. Storage batteries.

22,204, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Valves.

23,980, HALLOWELL. Brakes for tramcars.

24,138, JONES. Electric arc lamps.

24,707, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Refractory conductors.

25,987, FELTEN & GUILLEAUME-LAHMEYERWERKE AKT.-GES. Brake-operating mechanism of electric lifts.

26,642. CREIGHTON. Protection of electrical systems.

26,754. BAILEY, HOLT, & DITTMAR. Valves.

27,105. WILKINS. Standardisation of service meters.

27,809, MARKS (*Parker-Clark Electric Co.*). Incandescent electric lamps.

27,989, WOLTMANN. Electric railway installations.

1908 Patents

1,913, THOMPSON. Train controlling mechanism for automatically applying the brakes.

2,354, BONNER & BONNER. Railway rail joints.

2,375, HOWARD. Alternating current relays.

5,279, ALI-COHEN. Insulating, impregnating, and protective compositions.

7,045, NOEGGERATH. Homopolar machines.

8,646, KOCH. Ignition of miners' safety lamps.

8,888, SCHMIDT. Valves.

9,760, SCHUBERT. Lighting devices for street gas lamps.

12,908, EYQUEM. Sparking plug for explosion engines.

Complete Specifications open to Public Inspection before Acceptance.

1908 Patents

9,636, SIEMENS-SCHUCKERTWERKE-GES. Fittings for glow lamps.

13,092, AKT-GES. BROWN, BOVERI, ET CIE. Transformers.

13,734, CORNARO. Electrodes for electric furnaces, radiators, or lamps.

13,741, SCHERL. Single track vehicles.

13,865, FESSENDEN. Electric signalling.

Application for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of July 15th, 1908.

16,269 of 1906, **Electric Induction Furnace.** THE GRÖNDAL KJELLIN CO., LTD., and J. HÄRDÉN seek leave to amend the specification numbered as above, for "Improvements Relating to Electric Induction Furnaces," on account of the doubtful validity of the first claim. The amendment consists in striking out this claim, and making a slight alteration in the text of the specification.

Expiring Patents

The following patents expire during the current week after a life of fourteen years :—

14,246 of July 24th, 1894, **Three-phase to Two-phase Transformation.** C. F. SCOTT. The well-known method of transforming three-phase alternating current to two-phase, or *vice-versa*, by connecting the two phases of the two-phase system to the primary windings of two transformers. One secondary winding is connected to approximately the middle point of the other secondary winding, and the remaining three terminals are connected to the three-phase line.

14,602 of July 30th, 1894, **Controller for Electric Motors.** J. B. CANET and A. HILLAIRET. A controller for motors operating lifts, winches, and other apparatus with limited travel or movement. Different running speeds are provided for, and a magnetic clutch within the controller case releases the handle, breaks circuit, and short-circuits the motor when the lift or other apparatus reaches the limit of travel.

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NEW COMPANIES

BAUXITE REFINING CO.—This company was registered on June 27th, with a capital of £100,000 in £1 shares, to carry on the business of manufacturers of and dealers in alumina or other materials or ingredients used in the production of aluminium, owners of mines and minerals, winners and workers of mineral substances, &c. The subscribers are C. J. Lunn, W. Moir, G. C. Pullman, A. G. Ratcliff, H. Barnes, W. Graham, and W. Newbert. No initial public issue. The number of directors is not to be less than two nor more than five; the first are Hon. Sir James Sivewright, K.C.M.G., J. E. Davidson, and R. S. Portheim. So long as the United Alkali Co., Ltd., or their nominees hold 1,000 shares, they may appoint a director. Qualification (except such director), £100. Remuneration while only three directors, £500 per annum, divided; when more than three, proportionate increase. Registered office: Pandon Building, Newcastle-on-Tyne.

BROWN-MACKENZIE SIGNAL CO.—This company was registered in Dublin on July 3rd, with a capital of £1,000 in £1 shares, to acquire certain British patents for improvements in electric signalling on railways, and also any patent granted in any other country with respect to the same invention. The subscribers are G. H. Brown, W. J. Mackenzie, W. R. McMurray, and H. Brown, jun. Private company. The first directors are G. H. Brown, W. R. McMurray, and H. Brown, jun. Registered office: 1 Marcus Ward Street, Belfast.

CHISHOLM, GRAY & CO.—This company was registered on June 23rd, with a capital of £7,000 in £1 shares, to acquire the business carried on in Birmingham as the "Chisholm Manufacturing Co.," to acquire the patents granted to A. Cripwell for improvements in electric switches, portiere rods, plugs for sink wastes and sanitary socket connections, to adopt agreements (1) with the said A. Cripwell, and (2) with D. Whamond and the said A. Cripwell, and to carry on the business of brassfounders, electricians, manufacturers of electrical accessories, appliances, and machinery, &c. The subscribers are:—G. Chisholm, R. Gray, D. Whamond, D. Clarke, E. G. Chisholm, T. Gardiner, E. S. MacLaren. No initial public issue. The number of directors is not to be less than two nor more than four; the first are G. Chisholm (managing director) and R. Gray. Qualification 1 share. Remuneration of G. S. Chisholm not less than £250 per annum, with an increase of £25 per annum for four years; of other directors as fixed by the company. Registered office, Providence Works, Fleet Street, Birmingham.

CHIPPING NORTON & DISTRICT ELECTRIC LIGHT & POWER CO.—This company was registered on June 29th, with a capital of £10,000 in £5 shares (1,000 preference), to acquire the undertaking and assets of the Chipping Norton Electric Light & Power Co., Ltd., and to carry on the business of an electric light and power company in all its branches. The subscribers are C. A. Bernard, L. Gatrall, F. J. Cole, F. Boulding, J. R. Smith, C. F. Butcher, and W. B. Murray Thomson. Minimum cash subscription 10 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first. Qualification, 10 shares. Remuneration as fixed by the company. Registered office: The Power Station, Chipping Norton, Oxon.

A. C. COSSOR.—This company was registered on July 2nd, with a capital of £3,500 in £1 shares, to take over the business of a scientific and electrical instrument maker, manufacturer of incandescent electric lamps, electrical apparatus, vacuum tubes, mercury pumps, McLeod gauges, X-ray tubes and apparatus, and electro-medical apparatus, experimental and electrical glass-blower, &c., carried on by A. C. Cossor at 54 Farringdon Road, E.C. Private company, with only two subscribers, viz., A. C. Cossor, Fawley Cottage, Fawley, Hants, scientific instrument maker, and W. R. Bullimore, 16 Linthorpe Road, Stamford Hill, N., electrical engineer, each taking one share. The number of directors is not to be less than two nor more than three; the first are A. C. Cossor (chairman), W. R. Bullimore (managing director), and Mrs. A. Cossor. Remuneration, £141 per annum, divisible. Registered office: 54 Farringdon Road, E.C.

DODD & OULTON.—This company was registered on June 23rd, with a capital of £20,000 in £5 shares (1,000 preference), to acquire the business carried on in Liverpool, Manchester, and elsewhere, as "Dodd & Oulton," to adopt an agreement with G. Oulton and W. F. B. Oulton, and to carry on the business of brassfounders, manufacturers of, and dealers in, gas and electric light fittings, silicate paints and sanitary appliances, electrical engineers, &c. The subscribers are:—G. Oulton, W. F. B. Oulton, Mrs. K. C. Dodd, Miss Annie Dodd, Miss Ada Dodd, A. N. Oulton, J. B. Kidwell. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are G. Oulton, W. F. B. Oulton, A. N. Oulton, and J. B. Kidwell. The trustees of the late T. Dodd may, while holding 50 ordinary shares, appoint a director in the place of J. B. Kidwell. Qualification (except first directors), £250. Remuneration of G. Oulton, £520 per annum; of W. F. B. Oulton, £400 per annum; of A. N. Oulton and J. B. Kidwell as fixed by company. Table "A" mainly applies. The total amount secured by debentures outstanding shall not, without the consent of the holders of three-quarters of the preference shares, exceed £5,000.

ELECTRIC TAXICAB CO.—This company was registered on July 3rd, with a capital of £300,000 in £1 shares, to carry on in London and elsewhere the business of proprietors of motor-cabs, cars, carriages, and vehicles (particularly electric cabs), garage proprietors, electricians, electrical engineers, &c. The subscribers are Rt. Hon. Lord Westbury, Sir David Lionel Goldsmid-Stern-Salomons, Bt., Sir Bache Cunard, H. Willmott, W. M. Rolph, C. L. Samson, T. G. Chambers, W. C. West, E. N. Ruddock. Minimum cash subscription, 60,000 shares. The first directors are Rt. Hon. Lord Westbury, Sir David S. Goldsmid-Stern-Salomons, Bt., Sir Bache, Cunard, Bt., H. Willmott, W. M. Rolph, C. L. Samson, and T. G. Chambers. Qualification, 200 shares. Remuneration (except managing director), £250 each per annum (chairman, £500). Registered office, Dashwood House, New Broad Street, E.C.

ERNEST SCOTT & CO.—This company was registered on July 3rd, with a capital of £30,000 in £1 shares, to acquire the business carried on by E. Scott at London, Manchester, and Glasgow, as "Ernest Style & Co.," and to carry on the business of mechanical and electrical engineers, machinery manufacturers, &c. Private company, with only two subscribers, viz., E. Scott, 8 Frognal, Hampstead, N.W., Engineer; and H. J. Pooley, 65 Elm Park Road, Finchley, N., Engineer, each taking one share. The number of directors is not to be less than 3, nor more than 7; the first are E. Scott (Chairman and Managing Director), and others to be appointed by him. Qualification, £200. Remuneration of E. Scott, £1,000 per annum. Registered by Hillearys, 5 Fenchurch Buildings, E.C.

J. P. HALL & CO., LTD.—This company was registered on June 27th, with a capital of £35,000 in £1 shares, to carry on the business of electrical and mechanical engineers and machinists, manufacturers of electrical and other apparatus and appliances, boiler and economiser makers, motor-car manufacturers, carriers of passengers and goods, &c. The subscribers are J. P. Hall, A. G. Hall, Mrs. H. L. G. Duncuft, J. Duncuft, Mrs. M. A. Hall, E. Trustram, and A. E. Marland. No initial public issue. The number of directors is not to be less than two nor more than six; the first are J. P. Hall and A. G. Hall (both permanent); special qualification, £500 shares. Qualification of ordinary directors, £200. Remuneration, £300 each per annum. Registered by Waterlow Bros. & Layton, Ltd., Birchin Lane, E.C.

HYDRO-ELECTRICAL GEAR CO.—This company was registered on June 30th, with a capital of £6,000 in 5,000 participating cumulative preference shares of £1 each, and 20,000 deferred ordinary shares of 1s. each, to adopt an agreement with Col. Boddam, and to carry on the business of lift manufacturers, engineers, builders of machinery and electrical apparatus, &c. The subscribers are Col. E. T. Boddam, H. R. Reynolds, W. P. Hewett, R. P. Hornby, C. R. Cooledge, F. N. Reckitt, and A. E. Goddard. No initial public issue. The first directors are Viscount Molesworth, C. E. Peczenik, and R. P. Hornby. Qualification (except first directors), 100 shares. Remuneration, £125 each per annum (£25 extra for the chairman). Registered office: 11 Pancras Lane, E.C.

MALTA TRAMWAYS.—This company was registered on July 9th, with a capital of £140,000 in £1 shares, to acquire the tramway undertaking and passenger lift carried on in Malta by Macartney, McElroy & Co., Ltd., to construct and equip tramways, railways, lifts, waterways, and other means of communication and transit in Malta and elsewhere, and to carry on the business of carriers of passengers and goods, railway, tramway, and lift proprietors, generators, accumulators, and distributors of electricity, &c. The subscribers are J. F. Macartney, J. A. McElroy, Major O. Lovell-Wright, F. A. Scadding, H. C. Holt, E. A. Nuttall, and F. A. Mitchener. Minimum cash subscription, 100 shares. The number of directors is not to be less than two nor more than nine; the first are J. F. Macartney, J. A. McElroy, and F. H. Carter. Qualification, £200. Remuneration, £300 per annum, divisible. Registered office:—Caxton House, Westminster, S.W.

NORFOLK ELECTRICAL CO.—This company was registered on July 6th, with a capital of £2,000 in £1 shares, to acquire the business carried on in Birmingham as the Norfolk Electrical Co., and to carry on the business of dealers in electrical goods and appliances connected with the application of electricity for lighting, heating, motive power or otherwise, &c. Private company, with two subscribers, viz., G. W. Holt, Norfolk House, Cannon Street, Birmingham, merchant, and J. A. Dale, 12 Bennett's Hill, Birmingham, solicitor, each taking one share. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first. Remuneration as fixed by the company. Registered office: Norfolk House, Cannon Street, Birmingham.

RAILLESS ELECTRIC TRACTION CO.—This company was registered on July 7th, with a capital of £5,000 in 4,750 shares of £1 each and 5,000 shares of 1s. each, to adopt an agreement with M. Schiemann and F. Momber, and to carry on the business of engineers, electricians, suppliers of electricity for light, heat, motive power or otherwise, manufacturers of and dealers in electrical apparatus, &c. Private company, with only two subscribers, viz., F. D. Fox, 56 Moorgate Street, E.C.,

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C.E., and T. G. Gribble, 8 Dagmar Road, Stroud Green, N., C.E., each taking one ordinary share. The number of directors is not to be less than three nor more than seven; the first are T. G. Gribble, H. O. Foster, F. D. Fox, and B. D. Fox. Remuneration, £150 each per annum (chairman, £300).

METROPOLITAN ELECTRIC TRAMWAYS BILL

The Commissioner of Police and London Tramways

AN unusually interesting discussion took place before the Unopposed Committee of the House of Commons on Thursday in connection with a report by the Home Office, in conjunction with the Commissioner of Police, upon the Metropolitan Electric Tramways Bill. The primary object of the Bill, which has been passed by the House of Lords, is the construction of a short extension of the Harrow Road and Paddington tramways. The extension in question is within the County of London, and the County Council has given its consent to the Bill on the understanding that the new line shall not be constructed without its permission, and that if the Council itself should decide to promote a line along the same route instead of the company, the latter shall not oppose. All this has been agreed between the parties.

The contentious portion of the Bill arose upon the consideration, as mentioned above, of a report by the Home Office and the Commissioner of Police, which dealt with certain important matters affecting tramway authorities, as it is the intention of the Home Office to ask for similar powers in relation to all tramway bills promoted in the future in the area of the Metropolitan Police. It may be stated that in resisting the proposals of the Commissioner of Police—as the Home Office really made its report on his behalf—the Metropolitan Electric Tramways, Ltd., had the support of the London County Council.

The first point raised was that in the clause of the Bill authorising the company to lay down temporary rails either for purposes of reconstruction or repairs, it should be specified that such rails must be on a level with the roadway. This, the promoters contended, would be quite impracticable, and would mean the laying of a permanent tramway for temporary work. Evidence was given on behalf of the Commissioner of Police to the effect that this request was made on account of the large number of accidents which have occurred during the reconstruction of the London County Council tramways, when temporary rails laid on the surface of the roadway were largely made use of. An instance was mentioned of an omnibus which was overturned and thrown into the trench dug for the conduit, and of a van which met with a similar fate, whilst, it was said, there were records of hundreds of accidents directly attributable to the raised rails used during the reconstruction of the tramways in London. The Chairman, after consultations, announced that the Committee did not think the suggestion a practicable one.

Another point raised was as to calling the attention of the Board of Trade to the condition of tramway tracks, it being asked that the Commissioner of Police should have authority to do so, and to set the Board of Trade in motion. The present position is that the road authority or twenty ratepayers may do this—it is very seldom done—but that when, hitherto, the Commissioner of Police, as responsible for the regulation and safety of the traffic, has gone to the Board of Trade on the question of the condition of a particular section of track, it has been pointed out to him that he has no statutory powers to do so, and that the Board of Trade cannot act upon his information. At the same time, the Board of Trade concurred in the suggestion now made. Mr. Whittaker Thompson, the Chairman of the Highways Committee of the London County Council, gave evidence against the proposal, contending that it created another authority to keep a watch over the tramways. The Commissioner of Police at present, he pointed out, could summon the tramway authority in a court of summary jurisdiction, and this fact, coupled with the right of the road authority or 20 ratepayers, to go to the Board of Trade, was, in the opinion of the London County Council, sufficient protection for the ordinary traffic. In many cases the cause of the tramway rails projecting above the surface of the ordinary level of the road was due to the road authority not having kept their portion of the roadway in a proper state of repair. The Committee, however, by a majority, decided in favour of the Commissioner of Police.

The next point was with regard to parcel carrying upon the tramways proposed in the Bill, which the Commissioner of Police objected to. It was pointed out for the promoters that they already had powers to carry parcels over the whole of the remainder of their system—although, as a matter of fact, they had never been put into force—and that similar powers had been granted in numerous cases, and were in operation in many towns. In fact, they were in operation upon the system of the South Metropolitan Electric Tramways & Lighting Co. within the area of the Metropolitan Police, and no complaint had been received. The view of the Commissioner of Police upon this point was that there was a possibility of dividing the attention of the driver—at whose end of the car the parcels were to be placed—between looking after these and driving the car, that such parcels would impede him in his driving duties, and, further, they might block up the doors of the car at the driving end, and prevent their use by the passengers in case, say, of fire. During the discussion reference was made to the carrying of parcels upon the system of the Dublin United Tramways Co., the Potteries Electric Traction Co., and the Manchester Corporation without any complaint. Eventually, the Committee, by a majority, allowed the company the clause in question.

The final point raised by the report of the Home Office and the Commissioner of Police was a request to be allowed the use of the tramway standards for affixing direction notices for traffic, &c., in the same way that lamp standards are now used. The company was willing to agree to this in so far as it related to standards used by the public authority for street lighting, but beyond this the promoters objected to being interfered with. A suggested clause put in by the Home Office was of a very wide character, and might have allowed the use of the standards for all manner of purposes, and to this the Committee objected, although favourable to the principle of the suggestion. Mr. James Devonshire, the Managing Director of the Company, stated that he was not opposed to the principle, but wished for some protection as to the manner of carrying it out. The Chairman thereupon announced that, looking to the fact that the Bill only related to a mile of tramway, and that the question had been raised by the Home Office at a very late period of the session, they did not think it necessary to go into the question on this occasion. There had been a strong expression of opinion on the Committee that the Commissioner of Police should have the powers suggested, and the matter should be discussed on another occasion when there was more time for considering the wording of the clause. The proposal, therefore, was agreed to, subject to that observation.

We may point out that the reason for the somewhat belated proposals of the Commissioner of Police, so far as this session is concerned, is that he has recently been asked to consider what further precautions are necessary in the interests of London traffic generally. It is the intention to ask that the points conceded on this Bill shall also be conceded in connection with every future tramway Bill affecting the Metropolitan Police area.

LONDON UNITED TRAMWAYS BILL

Tramways Over Kew Bridge

THIS Bill was considered by a House of Lords Committee, presided over by Lord Donoughmore, on Tuesday. The Bill proposes to confer powers upon the London United Tramways, Ltd., for constructing tramways and widening and altering streets and roads and for other purposes, but, as when the Bill was before the House of Commons, only one part of the Bill was opposed, namely, the proposed tramway, three furlongs in length, over Kew Bridge. As a result of the proceedings in the House of Commons, it was decided that the company should pay £500 per annum each to the Middlesex and Surrey County Councils for the use of the bridge. Since then the two County Councils in question have proposed a clause giving them a veto as to the system of traction which should be adopted upon the bridge, but counsel for them was quite frank in stating that they preferred the conduit system, or, any rate, were opposed to the overhead system. The argument of the company against this was that it would be physically impossible to construct an underground conduit system upon the bridge; but this was met by the evidence, on behalf of the County Councils, of Mr. C. A. Brereton, who designed the bridge, and who expressed the opinion that a conduit tramway could quite well be constructed upon it. Another factor in the question, the company said, was the Richmond Corporation, who, although under the Bill they have a veto as to the system which shall be adopted in their district, *i.e.*, on the Surrey side of the bridge, there was every probability of an agreement being come to for the use of overhead trolley system. Therefore if the Richmond Corporation agreed to the trolley system, it was an unreasonable proposition, Sir Clifton Robinson said, to have the overhead system on both sides of the bridge and the conduit or surface-contact system over the bridge itself, necessitating two breaks. There was no evidence, however, put in as to the Richmond Corporation agreeing, and after deliberation the committee approved of the principle of the County Councils deciding as between the overhead or any other system of traction, but refused to adopt the wording of a suggested amendment, which would have given the County Councils the right to specify which particular system of electric traction should be used. On the consideration of clauses, the committee rejected an amendment by the County Councils compelling the company to submit plans of their proposed work upon the bridge before they were commended, being satisfied that sufficient protection is already given to the County Councils by reason of the fact that the Board of Trade would have to sanction the plans under the general law. With these modifications, the preamble of the Bill was passed.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1906	1907	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	7%	10½—11	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10⅜	
Do. 6% Cum. Second Pref.	10	6	6%	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	100—103	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5⅛	5⅛%	4⅛—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co., Ltd.	5	10	10%	7—8	
Do. 7% Cum. Pref.	5	7	7%	6¾—7¼	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross. W. E. & City E. S. Co.	5	5	5%	3¾—4¼	
Do. 4½% Cum. Pref.	5	4½	2½%	4—4⅛	
Do. 4½% Deb. Red	Stock	4	4%	94—97	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3⅝—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	4½%	3—3⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	+1
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	+1
City of Durham E. P. Dis. Co.	5	4	2%	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ltd.	10	5	5%	7⅜—8¼	
Do. 6% Cum. Pref.	10	6	6%	10½—11	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	+1
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	98—101	
Edmunson's Electricity Corp., Ltd.	5	4	1/6*	⅛—⅜	
Do. 6% Cum. Pref.	5	3½	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	61—71	−2
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	98—101	+1
Hove Electric Lighting Co., Ltd.	5	9	8½%	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	10%	8—9	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	4	2½%	⅞—1⅛	
Do. 6% Pref.	5	6	6%	4½—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—92	
Metropolitan Elec. Supply Co., Ltd.	5	8	6⅔%	4⅝—5½	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—4⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. D	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	5	5%	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	8	8%	5⅜—5¾ xd	−⅛
Do. £2 Paid	5	8	8%	2¼—2⅜ xd	−⅛
Do. 5% Pref. (fully paid)	5	5	5%	4⅞—5⅛ xd	
Do. £2 Paid	5	5	5%	2⅛—2⅜ xd	
Notting Hill Elec. Ltg. Co., Ltd.	10	7½	7%	12—13	
Oxford Electric Co., Ltd.	5	7	7%	5¾—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98 xd	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	7⅞—8⅛	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	+3
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	nil	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%	79—84	
South London Elec. Sup. Corp. Ltd.	5	3	4%	2⅜—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	1/-	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7%	1—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5%	¾—1⅛	−½
Do. 5% Cum. Pref.	5	5	5%	2⅜—2⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	−5
Westminster Elec. Sup. Corp., Ltd.	5	12	10%	7⅜—8¾	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅜—5⅝	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	90—92 xd	
Central London	Stock	4	3%	68—71	−4
Do. 4% Preferred.	Stock	4	4%	88—90	
Do. Deferred.	Stock	4	2%	53—56	−1
Do. 4% Debentures.	Stock	4	4%	101—104 xd	−2
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	81—84	+1
City and South London Cons.	Stock	2½	4½%	33—36	−3
Do. 4% Perp. Deb	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	5%	113—116	
Do. 5% Perp. Pref. 1896	Stock	5	5%	112—115	
Do. 5% Perp. Pref. 1901	Stock	5	5%	110—113	
Great Northern & City Pref. "A"	10	4	11.6d.	¾—1¼	
Gt. Northern, Piccadilly & Brompton	10	4	4%	7—7½	+¼
Do. 4% Perp. Deb.	Stock	4	4%	90—92	
Mersey Cons.	Stock	nil	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	nil	—	3—6	
Metropolitan Cons.	Stock	1	1%	34½—35½	−2
Do. 3½% Preference	Stock	3½	3½%	86—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	nil	—	11—12	−½
Do. 6% Perp. Deb.	Stock	6	6%	115—120	
Do. 4% Deb.	Stock	4	4%	71—75	
Do. Perp. Extension Pref. (5%)	Stock	nil	—	21—26	
Ass. Ext. Pl. Guar. by U. E. Rls. Co.	Stock	3	3½%	44—48	
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	5%	40—44	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	5	1/-	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅛—⅜	
Do. 4½% Deb. Red.	Stock	4½	4½%	88—89	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91 94	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅜	
Do. 6% Cum. Pref.	10	6	6%	4¼—4½	
Do. 5% Perp. Deb.	Stock	5	5%	95—98	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—79	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4⅜	
City of Birmingham Trs. Co. 4%. 1st Mort. Deb.	100	4	4%	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1906	1907	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%	%		
Dublin United Trams Co.	10	6	6%*	12¼—13½	
Do. 6% Pref.	10	6	6%	12¼—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3¼—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	1½	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Street Tramways Co.	4	4/9	4/6	1⅛—1⅛	
London United Trs., Ld., Cm. Pf.	10	5	5%	7—8	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	79—84	
Metropolitan Elec. Trams, Ltd., Def.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	10	2/-	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	nil	—	¼—¾	
North Metropolitan Trams Co.	£4 10s.	1/-	1/-*	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	4%	½—⅝	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	93—96	
Provincial Tramways Co. Ltd.	10	3¾	4%	4⅜—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	—	6%	¾—1	
Do. 4% Deb. Red.	Stock	—	4%	76—80	+1
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	75—80	
Yorkshire (West Riding) Elec. Trams	5	nil	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	nil	—	3⅜—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3⅜	15/-*	57—60	−1
Do. 6% Pref. Crd.	Stock	6	30/-*	103—104	−1
Do. Def. Ord.	Stock	1¾	1%	15/-—16¼	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	83—86	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3¼	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4¼	4/-*	13½—14	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	98—100	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	100—102	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	7/6	12⅜—13¼ xd	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	+½
Eastern Telegraph Co.	Stock	5¾	7%	132—135 xd	−1
Do. 3½% Pref.	Stock	3½	3½%	83½—85½ xd	−1
Do. 4% Mort. Deb.	Stock	4	4%	101—103	
G. N. Tel. Co. (Copenhagen)	10	20	20%	27—29	
Indo-European Telegraph Co. Ltd.	25	13	65/-	56—59	+1
Marconi Wireless Telegraph Co. Ltd.	1	nil	—	⅞—1⅛	
National Telephone Co., Ltd., Pref.	Stock	6	6%	110—112	+1
Do. Deferred	Stock	5½	6%	120—122	+2½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—12½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10—12	−½
Do. 5% 3rd Pref.	5	5	5%	5⅝—5¾	+¼
Do. 3½% Deb. Red	Stock	3½	3½%	97½—99½	−½
Do. 4% Deb. Red.	Stock	4	4%	100½—102½	
Western Telegraph Co., Ltd.	10	7	7%	13⅜—14¼	+⅛
Do. 4% Deb.	Stock	4	4%	99½—101½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	nil	—	7/32—11/32	
Do. 6% Cum. Pref.	1	6	6%	3/32—5/32	
Babcock & Wilcox, Ord.	1	20	1/7½*	3⅛—3⅜	−⅛
Do. 6% Pref.	1	6	7½d	1/16—1/8	
British Insulated & Helsby Cables, Ltd.	5	10	10% & bonus	6¼—6¾	+¼
Do. 6% Cum. Pref.	5	6	6%	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	102—105	+2
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	—	4½%	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	nil	—	1/16—1/8	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	
Brush Electrical Engineering Co.	2	nil	—	0—½	
Do. 6% Pref.	2	nil	—	3/16—1/4	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	53—58	
Callender's Cable and Const. Co., Ltd.	5	15	15/-	9¼—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3	3½%	⅜—½ xd	
Crompton & Co., Ltd.	3	5	5%	1⅜—1⅝	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	90—93	
Dick, Kerr & Co., Ltd.	1	10	10%	1¼—1⅜	
Do. 6% Cum. Pref.	1	6	6%	1—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A." £3 paid	5	4½	2/6	½—¾	
Do. do (fully paid)	5	4½	4/2	1½—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	¼—½	
Do. 7% Cum. Pref.	2	7	—	1½—2	+¼
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70 xd	+3
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7⅛—8	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	84—87	−3
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	15%	10¾—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	+1
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½ xd	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	15	17½%	31—33 xd	
Do. 4% Deb. Bds. Red.	100	4	4%	100—102	
Willans & Robinson Ord. Shres.	1	nil	5%	¾—1⅛	
Do. 6% Cum. Pref.	5	nil	6%	3½—3¾	
Do. 1st Mtg. Deb. 4% Red.	100	4%	4%	72—76	

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LOCAL NOTES

ACTON: *Electricity Accounts.*—Mr. S. Lord, accountant to the Urban District Council, has submitted to the Electricity Committee an exhaustive "commercial" report on the accounts of the undertaking for the year ended March 31st. The accountant in his report reviewed the principal differences between the position of a company and that of a local authority owning an electricity undertaking. He remarked that there were many companies which set aside nothing for depreciation. The average amount provided during 1906 for depreciation and reserve per £100 of capital was, in the case of metropolitan companies, £1·45, and of the provincial companies only £0·78, whilst the equivalent sinking fund charge made against local authorities' undertakings was, in the metropolis, £1·82 per cent., and in the provinces £2·76 per cent. Acton Council, for the same year, provided £2·98 per cent. Any deficiency resulting from the year's working must be charged by local authorities upon the current rate, whilst a company would probably accumulate the deficiencies for ultimate discharge out of profits. Upon a "commercial" basis the result of the past year's working showed a gross profit of £1,082, there being left, after the deduction of bad debts, &c., a profit of £1,053. An allowance of £0·78 for depreciation was altogether inadequate, and a fair charge based upon the respective "lives" of the constituent assets would probably be £1,792 (equal to 2·69 per cent.); the result would be a net deficiency of £180. As regards the capital account, the assets undoubtedly stood at less than would be the case if the undertaking had been owned by a company. Further, it was not an uncommon practice for companies to permanently maintain in the balance-sheet the accumulated deficiencies of the first few years' working as "goodwill."

ALDERSHOT: *Electric Lighting Charges.*—The Council has resolved that on and after October 1st next, a flat rate of 3d. per unit shall be charged for energy consumed by arc lamps used for external lighting of business premises, provided that such premises are lighted internally by electric light, and that the consumers provide a separate circuit and pay 2s. per quarter for the hire of the meter to register the special consumption.

AUSTRALIA: *Sydney: New Telephone Switchboard.*—The first section of the new telephone switchboard has been erected in the Sydney Telephone Exchange. This is the first central battery board to be erected in Australia.

Perth: Purchase of Electric Lighting Co.—The City Council have given six months' notice to the Perth Gas Co., of their intention to purchase its electric lighting and gas business.

AYR: *Electricity Accounts.*—There is a debit balance of about £1,000 on the working of the electricity undertaking for the past year, and it has been agreed that £326 at the credit of special reserve revenue account shall be applied towards reducing this deficit. The increase in the coal bill and reduction in the price of lighting are put forward as the reason for this bad result. A special meeting is to be held to consider the question of charges for electricity supply.

BECKENHAM: *London Power Bills.*—A petition is to be presented against the London and District Electric Supply Bill in the House of Commons.

BELGIUM: *National Electricity Supply.*—The *Financial News* states that negotiations have been commenced in certain quarters in Brussels with a view to forming a national electricity company for the purpose of supplying light and power over the whole of Belgium. It is further stated that the Government has approved the general principle of the scheme.

BEXLEY: *Tramway Intercommunication.*—It is anticipated that a working agreement will shortly be arrived at between the District Council and the Erith Council for the through running of the respective tramway systems, the Council having resolved to accept Erith's offer of 6½d. per car mile upon a minimum of 68,000 car miles per annum. It has also been decided to enter into an agreement to lease to the Erith Council the Bexley tramway from a point in Market Place, Bexley Heath, to Northumberland Heath on a yearly tenancy, this being, of course, subject to various conditions.

BIRMINGHAM: *Tramway Extensions.*—Considerable discussion is taking place in the district of Stechford as to whether the Birmingham Corporation should be asked to promote a Bill authorising the construction of tramways in that district, as an extension of the Birmingham system. One section of the residents is urging the District Council to memorialise the Corporation in favour, whilst the other section is opposed to the proposition.

BROUGHTY FERRY: *Electricity Charges.*—The charge for electricity for lighting purposes has been reduced from 6d. to 5½ per unit, and the charge for power has been reduced by one penny per unit.

CHICHESTER: *Electric Lighting Works.*—The Chichester Electric Light & Power Co. have notified the Council of their acquisition of a site on the canal basin for an electric light works.

CHIPPING NORTON: *Electricity Supply.*—The Chipping Norton and District Electric Light & Power Co., Ltd., have given notice of their intention to apply to the Board of Trade for a Provisional Order to supply electrical energy for public and private purposes throughout the borough.

COATBRIDGE: *Tramways.*—The local Tramways Committee has had a conference with a deputation of the Glasgow Town Council with regard to extending the Glasgow Tramways from Bailleston to Langloan, Coatbridge. The local committee is to make overtures to the County Council, and will also memorialise the Glasgow Corporation, asking for the extension of the line in question.

CROMER: *Repayment of Loans.*—Correspondence has taken place between the engineer, Messrs. Edmundson's Electricity Corporation, and the Town Clerk with reference to the decision of the Local Government Board as to the loan for past and prospective expenditure, and an application has been made to the Board to extend the period for repayment of loans to twenty years from the present time.

CROYDON: *Tramway Accounts.*—The annual report of Mr. T. B. Goodyer, the General Manager of the Corporation tramways system, shows a revenue of £74,132, the working expenses amounting to £55,806. Adding bank interest, the gross balance is £19,257. Interest, sinking fund, &c., amounted to £16,428, leaving a balance of £2,829. The reduced net balance in comparison with the previous one is attributed to the decrease in traffic receipts, £1,785; loss on Thornton Heath route, £2,150; increase in current charges, £2,850; increase in permanent way charges, £2,460; and increase in capital charges, £2,000, making a total of £11,245. The amount earned per car mile has been 9·20d., compared with 9·88d., and adding the advertisement rental, the average receipts per car mile amounts to 9·44d. This decrease is due to carrying less passengers at the higher rate of fares, and the low average receipts per car mile, namely, 8·45d. upon the Thornton Heath route, and it is recommended that this route should be discontinued. The number of passengers carried was 16,277,318, an increase of 83,416 over the previous year. The total number of units used for traction, car lighting, and grinding out rail corrugation was 2,247,586, an increase of 428,292 units over the previous year. The consumption and cost per car mile works out at 1·19 units and 2·38d. respectively, with 1·01 and 2·02d. last year. Complaint is made in the report that although close upon 2¼ million units have been consumed, the price still remains at 2d. per unit, and the current costs amount to no less than 30 per cent. of the entire working expenses of the department. It is calculated that the Croydon tramway department pays 42 per cent. more for its energy than the average of all other metropolitan systems. The overhead wire along the main line from Norbury to Purley has been renewed during the year at £1,214. The percentage of expenditure to receipts is 74·45. The department has now 70 cars in stock; the sinking fund stands at £11,927, and the renewals fund at £15,418, whilst £18,100 have been applied in reduction of debt.

DARWEN: *Electricity and Tramways Accounts.*—The Borough Treasurer of Darwen, in his annual report issued on Saturday, mentions a surplus of £104 in the electricity works, and £242 on the Darwen section of the electric tramways. On the Hoddlesden section there was a deficiency of £605. The revenue of the electricity department shows a gross profit of £3,391, the net profit of £104 reducing the adverse balance from £1,370 to £1,266. The number of units sold was 675,527, compared with 660,812 for 1907, an increase of 1·93 per cent. After allowing £900 for depreciation, there was a gross profit of £4,068 on the Darwen section of the tramways and a net profit of £242 10s. 9d., compared with a gross profit of £4,169 and a net profit of £477 for the previous year, a decrease of £235. On the Hoddlesden section, after debiting £150 for depreciation, there was a gross profit of £212, but with interest and sinking-fund charges a net loss was shown of £605. The net loss now standing to the debit of this section is £2,522 14s. 10d., towards which a sum of £1,600 has been transferred from rates during the year, leaving the adverse balance £722.

DUNDEE: *Extension of Supply Area.*—The expenses in connection with obtaining the Provisional Order for making the area of supply co-extensive with the enlarged city boundaries amounted to £239.

Third Party Risks.—The Tramways Committee has decided that the department shall be its own insurers against third party risks, and £1,000 per annum is to be allocated for this purpose.

DUNFERMLINE: *Power Company's Mains Assessment.*—A special meeting is to be held for the purpose of deciding whether the Fife Electric Power Co.'s cables passing through the borough shall be placed upon the assessment roll.

GILLINGHAM: *Water-softening Tests.*—The Council have recorded their appreciation of the good results which have been achieved by the senior shift engineer in connection with some water-softening tests recently carried out by him.

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HARROGATE: *Excess Expenditure.*—Mr. H. R. Hooper held an inquiry at Harrogate last week respecting an application by the Corporation for sanction to borrow £16,500 in connection with the electricity undertaking. During the course of the proceedings the inspector remarked upon the excess of expenditure over the sanctioned loans, and suggested that the best thing to do was to take the capital expenditure up to the year ended March 25th last and see how they stood, and then the Corporation could deal with the sum required from March 26th, 1908. Mr. G. Wilkinson, Borough Electrical Engineer, agreed that this would be the best way to deal with the matter, as it would make a new starting point, which he himself would appreciate.

HASLINGDEN: *Tramways.*—At the Town Council on Thursday, a letter was read from the Board of Trade approving of the agreement between the Corporations of Haslingden and Accrington for the running of cars between the two boroughs. A further letter from the Board of Trade was read, stating that they could not fix a date for the inspection of the tramways until they are informed that the lines in question and their electrical equipment were complete in all respects.

HASTINGS: *Sunday Trams.*—The Tramways Co. have made an application to the Corporation for consent to run the trams on Sunday. There appears to be no objection to Sunday running, but there is a point of difference between the Company and the Council as to whether, in the event of the purchase of the tramways by the local authority, Sunday profits shall be taken into consideration in fixing the price. The Council at its last meeting decided to agree to Sunday trams on condition that Sunday profits were excluded.

HEREFORD: *Electricity Accounts.*—The report of the Electric Lighting Committee for the year 1907-8 shows a net profit of £219 after meeting interest and sinking fund. The number of units sold was 286,591, compared with 214,621 for the previous year. The income amounted to £4,679 and the expenditure to £3,208. The estimates for the coming year are: income, £4,520; expenditure, including capital charges, £4,421.

ISLE OF THANET: *Electric Lighting.*—The Rural District Council has received a letter from Messrs. Foote & Milne, giving notice of their intention to apply for an electric lighting Provisional Order.

JOHNSTONE: *Electric Lighting.*—In reply to a communication from the Paisley Town Council relating to the supply of electricity in Johnstone, the Council has decided not to take advantage of the offer owing to the heavy capital expenditure involved.

KIRKCALDY: *Tramway Accounts.*—It was reported at the last meeting of the Council that the tramway accounts show a deficit of £580 for the last completed year, and the electric lighting accounts a deficit of £302.

LINTHWAITE: *Condition of Tramway Track.*—The Huddersfield Corporation has complained to the Urban District Council with regard to the bad condition of the tramway track, which the Council is under agreement to maintain. The complaint stated that a large number of cars have had to be withdrawn owing to the damage caused by the bad condition of the track. The Council claim that the cars are defective and not the track, and a reply has been sent to the Huddersfield Tramways Committee that the Council has inspected the rails and that all necessary repairs in its opinion are being carried out.

LIVERPOOL: *First-class Tramcars.*—In spite of the opposition, the proposal of the Tramways Committee to run first-class tramcars was agreed to by the County Council on Thursday.

Libel Action.—Mr. Justice Pickford and a special jury commenced the hearing last week of an action for conspiracy and libel brought by Alderman Smith, Deputy Chairman of the Tramways Committee, against Messrs. Skelton, Stoddart & Yates, all of whom are members of the Liverpool City Council. According to the pleadings, plaintiff claims damages for letters written to the local papers and statements made between October 1st, 1907, and March 10th, 1908, which are alleged to cast reflections upon his conduct as chairman of the Electric Lighting Committee, to which he was appointed in November, 1894, and as a deputy chairman of the Tramways Committee, which position he has held since 1898. On Monday the jury found that the plaintiff had not proved malice, and returned a verdict for the defendants with costs.

LLANDUDNO: *Electricity Charges.*—The accounts of the electricity undertaking show a profit of £1,480. The recommendation by the Electricity Committee to reduce the charges upon the maximum demand system from 7d. and 2½d. to 7d. and 2d. per unit, and the contract rate for consumers taking 1,500 units from 4½d. to 4d. per unit, has been approved.

LONDON: *London County Council: Tramway Employees.*—The London District Council of the Tramway and Vehicle Workers' Association, which represents the whole of the members of the Association who are in the employment of the London County Council tramways department, have passed the following resolution:—"That taking into consideration the unnecessary delay of the London County Council in dealing with the programme for improved conditions of labour placed before them by the tramway employees in May, 1907, the Executive Council be requested to forward an ultimatum to the London County Council that if a satisfactory reply is not received within 21 days, due notice be given (as per rule) that the Executive Council will take a ballot of the members with a view to withholding their labour."

Improvement in Steam Valves.—The General Purposes Committee report that Mr. E. W. Dickinson, superintendent at the Greenwich power station, has designed an improvement adaptable to steam valves which has greatly improved the working of the machinery at the Greenwich power station. The Highways Committee concur with the suggestion of Messrs. Hopkinson & Co., the makers, that the device should be patented, subject to the condition that the Council may use the patent without payment, should they so desire.

Bermondsey: Electricity Accounts.—The estimates for the year ending March 31st, 1909, anticipate a surplus of £1,298. The financial statement for the year 1907-8, which has just been issued, shows that up to March 31st, £145,899 had been borrowed in respect of the undertaking, the amount of loans repaid being £6,812. On the revenue account, the total working expenditure was £10,043, and the total income £19,914. For private lighting £14,395 was received. Public lighting brought in an income of £4,115. There is a net profit, after the payment of interest on mortgage debt and bank overdraft and instalments of principal of money borrowed, amounting to £888, which is to be carried forward. Provision has been made for standing charges (such as interest on mortgage debt, &c.) accrued, but not due for payment until after the close of the year, to the amount of £2,659, and this is treated for the present as a charge on the reserve fund. During the year ended March 31st, current sold totalled 2,672,617 units (public lamps, 569,678 units; private consumers, 2,102,939 units), as compared with the previous year's figures of 1,906,489 units (public lamps, 504,094; private consumers, 1,402,395).

Lewisham: Underground Wires.—At the Clerkenwell Police Court on Friday, the case of the Lewisham Borough Council *v.* the Postmaster-General was heard, the point in dispute being whether certain wires connecting up fire-alarm points in eight streets in Lewisham with fire stations, should be carried on poles or put underground. The Postmaster-General insisted that poles should be made use of on the score of expense, whilst the Lewisham Borough Council argued that the wires should be placed underground from the point of view of the amenities of the district. Sir Robert Hunter, solicitor to the Post Office, stated that a saving of £670 would be effected by the use of poles, the cost by this method being £178 against £800 if the wires were placed underground. The decision of the magistrates was reserved until he has inspected the roads in question.

MAIDENHEAD: *Electricity Accounts.*—There was a loss of £657 upon the Council's electric supply undertaking for the past year.

MANCHESTER: *Sub-station Inspection.*—The Electricity Committee has made a tour of inspection of several of the sub-stations in the city, and at the close of the tour satisfaction was expressed with the condition of the stations and the efficiency of the work carried out.

MANSFIELD: *Electricity Accounts.*—The gross profit upon the electrical undertaking for 1907-8 amounted to £3,979, and, after deducting capital charges, there remains £553. The sum of £500 is to be handed over towards the relief of rates.

MARLBOROUGH: *Electric Lighting.*—The Marlborough Electric Supply Co. have notified the Council of their intention to apply for a Provisional Order to supply electricity for public and private purposes.

NEWPORT: *Tramway Accounts.*—A discussion took place at the last meeting of the Town Council upon the annual report of the Electric and Tramways Committee. Mr. F. Phillips, chairman of the committee, said that, if looked at from the point of view of a company, the undertaking had made a profit of 4 per cent.

PLYMOUTH: *Electricity Accounts.*—The Treasurer's statement in regard to the finances of the electricity undertaking during the past year shows an income of £24,611, whilst the working expenses amounted to £13,147. After deducting interest and sinking fund and transferring £1,300 to the rates, the balance of £833 has been placed to reserve, bringing this fund to £10,053.

PORTLAND (U.S.A.): *Wireless Telegraphy.*—Wireless telegraph stations, under control of the U.S. Navy Department, are now in operation at Cape Blanco, North Head, Columbia River, Tatoosh Island, near Cape Flattery, and at Bremerton naval depôt.

Electric Railways.—According to latest available reports there are 286 miles of electric railway in Oregon, two-thirds of which are in Portland. In Washington there are 330 miles.

RHONDDA: *Tramway Opening.*—The Rhondda Valley Tramways Co. commenced their service on Saturday. Col. Druitt, on behalf of the Board of Trade, inspected the system last week. Arrangements have been made with the Pontypridd Urban District Council for a "Stand-by" supply.

ROSSENDALE: *Tramways Electrification.*—It was reported at the monthly meeting of the Rawtenstall Town Council on

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Thursday that the Corporation had agreed to pay the Rossendale Valley Steam Tramway Co. £21,750 for their undertaking in the borough of Rawtenstall. Contracts have been let to the extent of £95,000 for the electrification of the system, and the total spent to date on the electricity and tramways undertaking is £115,000. It has been decided to extend the system from Crawshawbooth to Loveclough.

SOUTHPORT: *Electricity Accounts.*—The accounts of the Corporation electricity undertaking for the past year show a net profit of £4,000.

SWINDON: *Extensions.*—With regard to the proposed extensions to the generating plant at an estimated cost of £6,252, the Electricity Committee recommend that this proposal should be deferred until November.

Advertising Electricity.—The sub-committee of the Electricity and Tramways Committee has been instructed to prepare a pamphlet setting forth the advantages of electricity, especially having regard to the economy of metal filament lamps.

WILLESDEN: *Tramway Road Widenings.*—The Urban District Council has received a letter from the Metropolitan Electric Tramways, Ltd., stating that the widenings of Harrow Road would shortly be completed, and suggesting an inspection in order that the bond may be surrendered to the company. The General Purposes Committee, however, are of opinion that the whole of the work should be completed before this is done, and that a further extension of three months be granted the company to enable them to complete.

WOLVERHAMPTON: *Electricity Accounts.*—The accounts of the electricity undertaking for the year ended March 31st, 1908, show a gross profit of £15,122 12s., equal to 7·7 per cent. on the capital expenditure. Capital charges absorb £11,797 5s., leaving a net profit of £3,325 7s. This is somewhat lower than that of last year, for the following reasons:—Additional capital to the extent of £34,334 was expended during the year, the greater portion being in respect of the recent extensions to the main generating station at Commercial Road. These were practically completed early in March last, but no revenue was obtained from the new plant during the period covered by these accounts. The additional interest and sinking fund incurred and the absence of compensating revenue is more than sufficient to account for the reduced profit. The cost per unit still remains at a low figure, although during the past 12 months the cost of repairs and maintenance has been considerably increased. Moreover, in accordance with the dictates of the Local Government Board, the wages of all permanent employees when engaged on capital work have to be charged to revenue account, and all meters and indicators are now purchased out of revenue, owing to the refusal of the Local Government Board to grant a loan for a longer period than five years in respect of these articles. During the year ended March 31st, 1908, the total units generated at the destructor station were 957,329, representing a total revenue of £1,396. The output of electrical energy for private consumers for lighting and motive power purposes increased by 32 per cent., but this rate of progress is being considerably exceeded during the current financial year. The total number of motors connected to the mains on March 31st last was 283, representing an aggregate of 2,135 brake horse power. This is an increase of 586 brake horse power installed during the 12 months ending March 31st, 1908. The total number of units sold was 4,554,457, of which 1,563,776 units were for traction. The maximum load upon the station was 2,450 kw.

WORCESTER: *Powick Generating Station.*—The Electricity Committee has passed a resolution authorising the chairman to sell, at the best prices that can be obtained, the old plant which is to be removed from the Powick generating station. This has been agreed to by the Corporation.

YARMOUTH: *Electricity Accounts.*—The accounts for the year ended March 31st, 1908, show a capital expenditure during the year of £5,156. The total capital account now stands at £97,125, and there is a balance of unexpended loans of £1,019. The working expenditure during the year amounted to £12,442, whilst the income amounted to £19,523. After deducting interest and sinking fund, &c., there is a small deficit of £14. The number of units sold were 1,513,937, of which 213,137 were for public lamps, 655,366 for tramways, 17,235 under contract, and 628,199 for private consumers. There are now 181 public arc lamps and 100 Osram lamps.

ZANZIBAR: *Wireless Telegraphy.*—Wireless telegraphy has been installed between the principal ports of the two islands, a distance of about 68 miles. The system adopted is Lodge-Muirhead, which is found to work successfully, and has proved of great advantage to both the Government and the mercantile community.

Electric Light.—The Electric Light Co. has, during 1907, considerably increased the scope of its activity, and in addition to the Sultan's Palace, Government offices, and the public streets, now lights most of the European and some of the Indian residences. It is gratifying to know that the dynamos and most of the materials employed are of British manufacture.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Miscellaneous

LONDON: *London County Council.*—The Highways Committee recommend that tenders should be invited for the lighting of Westminster Bridge by electricity. The committee state that the bridge is illuminated at present partly by gas and partly by electricity, at a total cost of £512, but that the substitution of arc lamps for the existing gas lamps would reduce the annual cost to £436, whilst adding largely to the general illumination of the bridge.

Battersea.—Electric light services are to be laid at a cost of £50 15s., and the mains are to be extended in Lavender Hill at a cost of £150.

SWINDON.—The Electricity Committee recommend that application be made to the Local Government Board for sanction to borrow £1,800 for extensions to the public arc lighting.

YORK.—Tenders are invited for the following requirements during the two years ending November 30th, 1910:—Carbon brushes, arc lamp carbons, ampere-hour meters, motors, motor starters, incandescent lamps, electrical accessories for wiring department. Particulars from the City Electrical Engineer, and tenders by July 27th.

Generating Stations, Sub-stations, Mains, &c.

CHESTER.—Mr. H. R. Hooper held a Local Government Board inquiry last week into the application by the Council for sanction to borrow £30,500 for electrical extensions. The amount is made up as follows:—Buildings, £3,000; generating sets, £20,700; mains services and public lamps, £4,300; meters, £1,500. A further application is being made for £1,500 for wiring. There was no opposition.

DEWSBURY.—Tenders are invited for a storage battery reversible booster and switch gear and tramway cables. Particulars from the Borough Electrical Engineer, fee, £1 1s. returnable, and tenders to the Chairman of the Electricity Committee by August 3rd (see advertisement this week).

HULL.—Tenders are invited for a 900-kw. direct-current generator (500-550 volts) with Belliss high-speed engine. Firms tendering must have made generators of equal or larger size for coupling to high-speed engines for traction purposes. Particulars from City Engineer (fee £1 1s., returnable), and tenders to the Chairman of the Tramways Committee, Town Clerk's office, by Monday, July 27th.

ILFORD.—The Local Government Board's sanction has been received to the borrowing of £27,000 for extensions to the electricity undertaking.

LONDON: *Islington.*—Mains are to be extended at a cost of £60 to supply current for power to Messrs. Sutton, Sons & Co., Brandon Road.

NEW ZEALAND.—The electrical engineer to the Lyttleton Council recommends that the present system of electric supply shall be changed over to the three-wire system of distribution. He also suggests additions to the plant, involving an expenditure of £15,500. The Council has approved of the proposal, and a loan of £17,000 is to be raised.

RUGBY.—Application is to be made to the Local Government Board for sanction to borrow £1,500 for the provision of an additional 150-kw. generating set.

TAUNTON.—The Local Government Board has sanctioned a loan of £1,670.

WOLVERHAMPTON.—A recommendation of the Electricity Committee that the Tettenhall Road and adjoining area should be lighted electrically at an estimated cost of £740, has been adopted.

Wiring

LONDON.

E.C.—Alterations, &c., to premises in Bridewell Place. Builders, Read & Wilkinson, 20 High Street, Wandsworth.

Extensions to premises in Bread Street, for William & Son, trimming manufacturers. Builders, Hall, Beddall & Co., Pitfield Wharf, Waterloo Bridge, S.E.

N.—Extensions to police station at Islington; approximate cost, £4,400. J. Dixon Butler, surveyor to Metropolitan Police, New Scotland Yard, S.W.

Buildings at Spring Hill, Hackney. Architect, J. Hamilton, 23 Wormwood Street, E.C.

N.W.—Addition to St. Luke's Church, Kilburn. Architect, J. T. Lee, 26 Gt. James' Street, W.

S.E.—Extensions to "The Standard" public-house, 88 High Street, Woolwich. Architects, Gardiner & Theobald, 110 Great Russell Street, W.C.

Working class dwellings by Camberwell Borough Council in Pitman Street. Mr. Oxtoby, Borough Surveyor, Town Hall, Peckham Road, S.E.

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S.W.—Storehouse for Metropolitan Water Board at Battersea (£4,000). Wm. B. Bryan, Chief Engineer.

Eleven houses, Wimbledon Park Road, Wandsworth. Architect, W. C. Poole, 62 Belleville Road, Wandsworth Common, S.W.

Architect has prepared plans for a bottling store in Britten Street, Chelsea, for Whitbread & Co. A. Dixon, 16 Holland Villas Road, Kensington.

New street in Church Street, Chelsea. Architects, Elms & Jupp, 25 Sackville Street, W.

New divisional offices for the L.C.C. Education Department at St. John's Hill, Wandsworth (£4,340). Builder, H. L. Holloway, Church Street, S.E.

Twenty houses at Clapham Common, West Side, and seventeen houses in Bowood Road, Battersea. Builder, W. H. George, 10 Broomwood Gardens, West Side, Clapham Common, S.W.

Nineteen houses in Canford Road, and four houses at Clapham Common, West Side, S.W. Builder, S. Rashleigh, 23 Tregothnan Road, Stockwell, S.W.

W.—Dickens & Jones, Ltd., silk mercers, 230-244 Regent Street, W., are to extend their premises to 226 and 228.

Marylebone Borough Council are to erect depôt buildings in Grove Road. J. P. Waddington, Borough Surveyor.

Alterations and additions at the Baptist Church, Castle Street, Oxford Street. Architect, T. Jay Evans, 61 Munster Road, Fulham, S.W.

Extension works to St. Peter's Church, Cranley Gardens, Kensington. Builders, Collins & Godfrey, The Cross, Tewkesbury, Glos.

No. 46 Oxford Street, W., is about to be converted into a depôt for the Aerated Bread Co., Ltd., 24 Eastcheap, E.C.

Improvements at the Cavalry Club Buildings, 125, 126, and 127 Piccadilly, W. Architects, Mewes & Davies, 6 Dean Street, Soho, W.

Buildings are to be erected in Ecclaston Place, St. George, Hanover Square, W. Architect, S. F. Monier-Williams, 83A Chester Square, Victoria, S.W.

W.C.—Recreation of Freemasons' Hall and Tavern, Great Queen Street, W.C. Architects, Brown & Barrow, 12 Norfolk Street, Strand, W.C.

PROVINCES.

ABERTRIDWR.—Council school for Glamorgan County Council (£6,000). County architect, D. Pugh-Jones.

BARNES.—Depository in Arundel Terrace. Architect, W. G. Hunt, 17 Vicarage Road, W.

Development of Blind Lane Estate. Architects, Tyers & Jago, 10 John Street, Adelphi, W.C.

BECKENHAM.—New art school by District Council (£1,960); alterations to Technical Institute (£750). Clerk to Council: F. Stevens.

BLACKPOOL.—J. S. Brodie, Borough Engineer and Surveyor, has prepared plans for the erection of a police station.

CHESHUNT.—Herts County Council school at Cheshunt (£4,540). Builders, Clark & Son, Cambridge.

CHICHESTER.—Secondary school for girls (£9,000). Architect, H. P. Roberts, Horsham; builder, F. Privatt, Southsea.

COSHAM (HANTS.).—Disinfecting establishment, mortuary, and quartermasters' quarters at the Alexandra Hospital, War Office.

DARTFORD.—Additional workroom accommodation, Darenth Asylum. W. T. Hatch, Chief Engineer, Metropolitan Asylums Board.

DUDLEY.—Public library in St. James Road. Architect, George H. Wenyon, Owen Street, Tipton; builders, Mark Round & Son, 18 New Street, Dudley.

EAST DEREHAM.—Secondary school (£6,000). F. H. Millington, Chairman of Norfolk Education Committee, T. A. Cox, secretary.

EAST HAM.—Six houses in Blenheim Road. Builder, Mr. T. Watson, 74 Ruskin Avenue, Manor Park, E.

Four shops and houses are in High Street, North. Builder, J. Harding, 42 Heigham Road, East Ham, E.

FAILSWORTH (Lancs).—New Congregational Church in Ashton Road (£2,500). Architects—Ogden and Hoy, Manchester.

FEATHERSTONE.—Public baths (£6,000). District Surveyor, Fredk. B. Rothera.

FINCHLEY.—Nine houses at Finchley. Builder, Mr. H. F. Nicholls, Holden Road, Finchley.

FROME (Somerset).—Extensions to the Isolation Hospital. District Surveyor, F. W. Jones.

GLOUCESTERSHIRE.—School at Camomile Green (£3,500). County Architect, Gloucester.

HARROW.—Six shops to be erected in Middle Road. Architect, Mr. E. K. Purchase, 20 Maddox Street, W.

Sixteen houses in Rutland Road. Builder, Mr. W. T. Batchelor, 1 Grove Terrace, Squires Lane, Finchley.

Northwood Urban District Council is to erect new Council offices.

HESTON.—The Heston and Isleworth Education Committee has decided to provide an infant school. A. L. Lang, Architect to Committee.

HILL END (Herts).—The County Asylum is to be enlarged. Builders, Wm. Moss and Sons, Ltd., Loughborough.

HINCKLEY.—The Urban District Council is to expend £2,650 on public baths. District Surveyor, E. H. Crump.

HODDESDON.—County Council School at Rye Park (£2,528). County Surveyor, Herts County Council.

HULL.—New Wesleyan Church at Marfleet (£2,000). Architects, Gelder & Kitchen, 76 Lowgate, Hull; builders, Geo. Jackson & Sons, Witham Street, Hull.

Extensions to the Hull Town Hall (£67,606). Architects, Russell & Cooper, 11 Gray's Inn Road, W.C.; builders, Quibble, Son and Greenwood, Sculcoates Lane, Hull.

LIVERPOOL.—The Midland Railway Co. has lodged plans with the Corporation for the erection of an hotel, &c. (£500,000).

WESTOFT.—Messrs. Spiers & Pond, Ltd., [illegible] extension works to their motor garage, Kirkley Cliff Road.

MELTON MOWBRAY.—Improvements at the cattle market (£3,500). District Surveyor, E. Jeeves.

MITCHAM.—Wesleyan Church. Builder, G. E. Everitt, 79 Windmill Road, Croydon.

NEWCASTLE-ON-TYNE.—The Walker Hospital is to be extended at an estimated cost of £5,500.

NORBURY.—The London County Council is to erect 65 cottages at Norbury. Builders, W. Smith & Sons, Croydon.

NORTHFIELD (Birmingham).—Business premises in Bristol Road and Bell Lane (£1,640). (G. Huins & Son, Pool Place, Redditch, builders); business premises in Bristol Road (£850). (G. A. James, Saw Yard, Northfield, builder). Architect, B. Perrins, Evesham Street, Redditch.

PENCOED.—Infants' school (£2,880), for Glamorgan Education Authority. Architect, D. Pugh-Jones, Cardiff; builder, Stephen Shail, Station Road, Llandaff.

PONTYCYMMER.—Higher elementary school (£7,750), for Glamorgan Education Authority. Architect, D. Pugh-Jones, Cardiff; builders, F. W. Lougher & Co., Pontycymmer, Glamorganshire.

ROCHDALE.—Police station (£1,420). S. S. Platt, Surveyor to Corporation, Rochdale.

SALOP.—Schools are to be erected (1) at Ludlow (£5,000), and Whitchurch (£6,000). E. C. Peele, secretary County Education Committee, Shrewsbury.

SMETHWICK.—Corporation depôt buildings (£4,050). Borough Surveyor, C. J. Fox, Allin.

STEVENAGE (HERTS).—School with accommodation for 336 boys. County Surveyor.

SUTTON.—Church of England at Burgh Heath (£5,000). Builders, L. H. & R. Roberts, Islington.

SWANSEA.—Alterations at Oxford Street National Schools.

Six houses in Hazel Row. Builders, W. Williams & Sons, 31 Oxford Street, Swansea.

Additions to the Orphan Home in Northampton Lane.

WEST HAM.—Hall and Sunday school is to be erected for the Rev. Canon Pelly (£3,150). Architect, Percy K. Allen, Lyndhurst Gardens, Tunbridge Wells.

West Ham Education Committee has decided to enlarge St. James's and Custom House Schools. F. E. Hilleary, clerk to the Education Committee.

WILLESDEN.—Addition to Langley House Laundry, 5 Bourke Road, for C. Batty.

Two warehouses in Salusbury Road, Willesden. Architects, Scott & Fraser, 10 Basinghall Street, E.C.

WOLVERHAMPTON.—New schools (£30,000); new public baths (£10,200). The Corporation.

WOOLWICH.—Buildings on the common for the Royal Army Medical Corps (£12,500). H.M. Office of Works, Storeys Gate, S.W.

YORK.—Mr. W. H. Brierley, 13 Lendal, York, is the architect for a secondary school at Sycamore Terrace.

London Traffic Board.—It was stated at the meeting of the London County Council yesterday that the Prime Minister has expressed his willingness to receive a deputation from the Council on the subject of London Traffic after the reassembling of Parliament for the Autumn Session.

Telegraph Traffic.—There are no interruptions of either submarine cables or landlines to report, but there are a few cables still requiring repair. President Castro has placed an embargo on Curaçao, the Dutch island in the West Indies, and this, we take it, is a further obstructive step against the Compagnie Française des Cables Télégraphique, who have been delivering cablegrams from Curaçao by placing them in the post or sending them by boats to their destination. Senders of cablegrams to Venezuela had, of course, to fully address their messages to enable this to be done, and they must be desirous that something should be done to put an end to the quarrel existing between the Venezuelan Government and the French company. In consequence of this quarrel, the company's lines have been closed on Venezuelan territory since Jan. 12th, 1906. This last move will mean that telegrams will have to be despatched from some island further away than Trinidad and Curaçao, and probably the next trial will be from Puerto Rico, the island under control of the United States. It is, indeed, curious that the existing conditions have been so long permitted.

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TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Adelaide Municipal Tramway Trust have accepted the tender of the British Insulated & Helsby Cables, Ltd. (Melbourne), at £25,806, for the supply of overhead equipment telephone system, &c.

The Victoria Public Works Department have accepted the tender of E. Bridger for the installation of electric light at the Sunbury Lunatic Asylum at £379.

BRISTOL.—The following tenders have been accepted:—British Thomson-Houston Co., extra high-tension and low-tension switchgear for Avonmouth sub-station, £2,255; Frank Chown (Bristol), concrete gallery for power distribution board at Avonbank, £112; Messrs. Harrison Colmer, Ltd., extension of switchboard gallery at Avonmouth, £312; Messrs. Geipel & Co., supply of arc lamp carbons during the year 1908-9, £318.

GILLINGHAM.—The tender of Messrs. W. Cory & Sons for Hillhouse washed nuts at 15s. 3d. per ton has been accepted.

GLASGOW.—The Magneta Co. have received an order from his Majesty's Office of Works to install the Magneta electric time system in all Glasgow sub-post offices.

LONDON: *London County Council.*—Tenders were invited from seven selected firms for the supply of switchgear at the central car repair depôt, but only Messrs. Spagnoletti & Co., Ltd. (£636), and Messrs. Johnson & Phillips, Ltd. (£700) sent in offers. The Highways Committee recommend the acceptance of the former.

Mr. S. P. Hutton, whose tender for cast-iron insulator frames and covers was accepted last month at £713 15s., has been allowed to withdraw his offer, and the Highways Committee have accepted the next lowest tender, namely, that of the Falkirk Iron Co., at £910.

Hackney.—After considering tenders for the supply of lubricating oils to the electricity works, the Borough Council has decided that the present arrangement with Messrs. Belliss & Morcom be continued to March 31st, 1909. The oils at present in use are supplied by Belliss & Morcom and Messrs. Willcox & Co., and the Electric Lighting Committee reported at the last meeting of the Council that they had given every satisfaction.

Stoke Newington.—The Electricity Committee have received the following tenders for the supply of an engine and dynamo for the new generating station:—W. H. Allen, Son & Co., Ltd., £794; Belliss & Morcom, Ltd. (provisionally accepted), £770; Browett, Lindley & Co., Ltd., £758 17s. For the erection of the building itself the Committee have provisionally accepted the tender of J. Grover & Son at £418, and for the switching apparatus that of Nalder Bros. & Thompson, Ltd., at £183 10s. For the provision of a booster at the sub-station in Edwards Lane the following tenders were received:—Thomas Parker, Ltd., £427; Lawrence, Scott & Co., Ltd., £390; Siemens Bros.' Dynamo Works, Ltd., £388; Lancashire Dynamo & Motor Co., Ltd. (provisionally accepted), £331; Phœnix Dynamo Manufacturing Co., Ltd., £246.

MALVERN.—The Council have accepted the tender of the Electrical Construction Co. for combined 50 kw. steam alternator with Belliss engine.

MALTON.—The tender of the Northern Counties Electricity Supply Co. for public lighting at £400 per annum, under an agreement for three years, has been accepted. The agreement runs from August 1st until May 31st in each year, and specifies the lighting hours.

RAWTENSTALL.—The following tenders have been accepted in connection with the reconstruction of the tramways for electric traction:—Cables, Messrs. W. T. Glover, £21,920; steam dynamos, Messrs. Browett, Lindley & Co., £4,683; transformers, British Westinghouse Co., £1,008; boilers and condensers, Messrs. Yates & Thom, £5,418; generating station buildings, Messrs. Dryland & Preston, £7,503; reconstruction of permanent way, W. Underwood, £39,040; overhead equipment, British Insulated & Helsby Cables.

RHYL.—The tender of the Bradford Electrical Engineering Co. for electrical wiring has been accepted by the Council.

ST. ANDREWS.—The following tenders have been accepted in connection with the additions to the electrical plant of the Fife and Kinross Lunacy Board:—Ironwork and economiser, Messrs. Green & Co., £104; injector piping and valves, and renewal of boiler covering, Mr. D. Houston (Cupar), £54; generating plant, Messrs. Crompton & Co., £252; brickwork and building economiser, Mr. J. Stark (Cupar), £28.

STRATFORD.—The tender of G. N. Haden & Sons, at £106, has been accepted for the installation of electric lighting in a portion of the West Ham and East London Hospital.

TAUNTON.—The tender of Messrs. Bradford & Son for the supply of 2,500 tons of coal from the Glasbrook Colliery at 14s. 10d. per ton has been accepted.

THAMES DITTON.—The District Council at their last meeting accepted the tender for installing an alarm system in connection with the Esher detachment of the local fire brigade of Messrs. Stuart & Moore at a yearly payment of £13 5s., including maintenance, on a five years' contract.

WILLESDEN.—The District Council on Tuesday accepted the tender of Duncan, Watson & Co. to maintain the internal telephones in the public offices for £6 10s. per annum.

COMPANIES' MEETINGS AND REPORTS

ANGLO-ARGENTINE TRAMWAYS CO.—An extraordinary general meeting was held on Wednesday last week in London to confirm resolutions for the creation of capital for the acquisition of the interests of the Compagnie Générale de Tramways de Buenos Ayres, and to make the necessary consequential alterations in the Articles of Associations. The resolutions were carried.

BERLINER ELEKTROMOBIL-DROSCHKEN-A.-G.—The report of this cab company for the year 1907 stated that the cars owned by the company consist of 188 public cabs, 41 private cars, and 5 special cars. Owing to the three months' strike during 1907, the report showed a loss of 253,080 mk., including the losses in 1906. The results of the first five months of working for the year 1908 show a gross income of 895,000 mk. against 390,000 mk. for the corresponding period of last year. The gross profit amounts to 280,000 mk., from which, however, an amount for renewals, &c., will have to be deducted. If the results for the remaining seven months are equally as good, the losses at least will be redeemed, and better results may be expected in the following year.

BOMBAY ELECTRIC SUPPLY AND TRAMWAYS CO.—The report for 1907 states that the total revenue for the year amounted to £127,920. After deducting all revenue expenses, including £700 the instalment written off the electricity supply suspense account, interest on loans and a proportion of debenture interest amounting to £12,725, there remains the sum of £29,537, in addition to £1,363 brought forward from last account, making an available total of £30,701. The dividend on the 6 per cent. cumulative preference shares to December 31st absorbs £27,764, leaving a balance of £2,936 to be carried forward. The receipts derived from the tramways amounted to £105,503, as compared with £101,051 in 1906. The working expenses in Bombay amounted to £61,112, as compared with £56,955 for the previous year. The increase in receipts is due to the increased route mileage worked, and to the establishment of electric traction on a portion of the system, but the unavoidable mixing of the two services has much hampered both. The increase in the working expenses is partly accounted for by the increased mileage worked, but it is chiefly due to simultaneously carrying on two separate services, horse and electric traction, each to a large extent requiring its own organisation. The first portion of the reconstructed tramways from Colaba Terminus to Crawford Market, 2·58 route miles, was opened for traffic by electric traction in May, 1907, and additional routes, as they were completed, were worked by electric traction. At December 31st last, 13·32 miles of route were being worked by electric traction, including 2·69 miles of the authorised extensions. The remainder of the system, 7·37 miles, including 0·35 mile of extensions, was worked by horses, the horse cars also running over a portion of the electrified route. Since the close of the year the electrification of the remaining routes has been completed, and from May 18th the entire system, comprising 20·69 route miles, has been working by electric traction. With the exception of half a mile the tramways are double track throughout. The company has anticipated by three months the period prescribed under the concession with the Bombay Municipality for the completion of the reconstruction of the tramways. The gross traffic receipts since the close of the year show a continued increase, the comparative figures being:—From January 1st, 1908, to June 4th, £53,351; corresponding period, 1907, £42,830: an increase of £10,501. Gross receipts from electric supply for the year amounted to £21,566, as compared with £8,435 for the previous year. The receipts, exclusive of the amount represented by the current supplied for the tramways, have increased by more than 100 per cent. over those for the previous year. Working expenses amounted to £19,346, as compared with £10,075 for the previous year. There is a credit balance of £2,021, compared with a debit balance of £1,659 for the pre-

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vious year. The total capital expenditure to December 31st last stands at £1,547,060. The balance of £4 per share has been called up on the preference shares. 7,350 ordinary shares have also been issued during the year, leaving a balance of 25,643 ordinary shares unissued at December 31st last. In order to provide the funds required to discharge the company's obligations incurred in connection with the electrification and extention of the tramways and in the development of the electric supply business, the directors, since the close of the year, concluded arrangements with a syndicate in Bombay to take up the balance of the ordinary shares, to which effect has since been given. These shares were offered by the syndicate for subscription in Bombay in February last. The meeting is on Tuesday.

At the annual meeting on Tuesday the report and accounts were adopted.

BRUCE PEEBLES & CO.—Meetings of the debenture-holders and creditors were held in Edinburgh on Saturday, when the scheme of reconstruction, already outlined in our columns, was approved.

CHILI TELEPHONE CO.—The report for the year ended March 31st, 1908, shows that the number of subscribers on the books of the company was 7,666, a gain of 551 for the year. The gross revenue in Chili was $1,469,611, an increase of $300,123, whilst the expenditure was $744,121, an increase of $95,572. The net income shows an increase of $204,551. Converted into sterling there is a balance of revenue, including £2,727 brought forward from last year, of £33,817, of which £13,440 has been carried to reserve. An interim dividend of 3s. per share, free of income tax, was paid in January, and a final dividend of 5s. per share, free of income tax, is now recommended, carrying forward £2,777.

At the meeting on Thursday the report and accounts were adopted.

CITY & SOUTH LONDON RAILWAY CO.—The report for the June half-year states that the receipts from all sources have amounted to £88,501 and the cost of working £40,964, leaving a profit of £47,536. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £48,656. After making provision for the debenture stock interest, rent charge, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £32,999. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896, 1901 and 1903, and that a dividend at the rate of 1½ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £1,868 to be carried forward to the next account. The following number of passengers, exclusive of season ticket holders, carried since the opening of the railway, amounts to 201,801,061, and the total dividends paid amount to £1,606,651. The number of passengers carried during the past half-year was 10,891,535, the most that has yet been carried in any half-year. The receipts for the half-year have been unfavourably affected by various causes. The weather in May and June has been finer and warmer than in 1907; an exhibition at the Agricultural Hall in the summer of 1907 proved far more attractive to the public than that which has been held in the corresponding part of this year; and the London County Council's electrified tramways from Moorgate to King's Cross, and past the Angel to Highbury, were opened for traffic in July, 1907. And since April 10th, 1908, the London County Council tramways on the south side of the Thames have been placed in direct communication, by way of Westminster Bridge, with the Angel and Highbury through the completion of the subway from the Victoria Embankment to Theobalds Road. The lower price of coal has only to a limited extent influenced the working of the half-year. With the exception of a sum of about £2,800, the whole of the charges for the extension to Euston, the new works at Stockwell, and the two new trains of five coaches each, ordered in the month of July, 1907, have now been paid.

CROMPTON & CO.—The annual statement of accounts and balance sheet to March 31st last, shows that the output from the company's works at Chelmsford during the financial year shows a large advance over that of any previous year, and at the same time further economies in the cost of manufacture have been introduced. There is a considerable increase also in the turnover of the sales department, and some important contracts have been carried out during the year. The net profit for the year amounts to £31,220 (as compared with £38,291 for the year ending March 31st, 1907, and £20,060 for the year ending March 31st, 1906), and from this figure has been deducted the sum of £1,211, representing a loss on old type stock, which, owing to the introduction of improved designs, it has been thought advisable to dispose of at less than cost. After providing for debenture interest, and other items shown in the net revenue account, there remains, with the sum brought forward from last year, an available balance of £28,216. In view of the continued keen competition and low prices, and the general depression in trade experienced during the latter part of the year, the directors are of opinion that the results of the year's working are satisfactory. The directors propose to recommend a dividend at the rate of 5 per cent. per annum for the year, to provide £2,000 for doubtful debts and contingencies, to place £8,000 to reserve, bringing that account up to £28,185, and to carry the balance, £6,103, forward. The undertakings of the Electric Supply Corporation continue to make progress. A further sum of £9,687 has been invested during the year in shares of the guaranteeing company referred to in the report for the year ending March 31st, 1905, but the directors anticipate a substantial reduction in the amounts which will be required for the remaining two years, during which the guarantee has to run. Any possible loss on this head is partly covered by insurance, which, with the further amount proposed to be placed to reserve out of the year's profits, will, in the opinion of the directors, afford ample provision for this item. The meeting will be held on Monday.

EAST LONDON RAILWAY CO.—The report for the six months ended April 30th, 1908, states that owing to the cessation of through train service from the Metropolitan Railway, the diminution in receipts from passenger traffic continues. Having regard to the serious losses sustained, the lessee companies have been giving the question of electric traction close attention, and the electrical engineers to the Metropolitan Railway and the Great Eastern Railway Companies respectively, Mr. C. Jones and Mr. H. W. Firth, have prepared a comprehensive report as to the best system of dealing with the railway from the point of view of electric traction. This report has been referred to the general managers of the lessee companies, who will report to the Joint Committee. No definite conclusion has been arrived at yet, but the directors state that they have some confidence that the result of the deliberations will have some effect in the near future.

ELECTRIC CONSTRUCTION CO.—At the annual meeting on Monday, the report and accounts given in our last issue were adopted. Mr. W. S. B. McLaren, who presided, drew attention to the greatly improved position of the company compared with 12 months ago.

ELECTRIC & GENERAL INVESTMENT CO.—For the year ended May 31st, 1908, there was a gross profit of £7,891. After meeting all general charges, the interim dividend already paid on the preference shares, and the final dividend upon the latter, there remains a balance of £568, which has been carried to the contingency fund, raising this to £67,556. Owing to the unfavourable financial conditions which have prevailed in the electrical industry during the past year, the revenue has been mainly derived from investments and fees for acting as trustees. The trustees for the ordinary share reserve fund propose to distribute 6d. per share out of the dividends received on the trust investments, whilst the trustees for the founders' shares reserve fund propose to distribute £10 per share. The scheme of reconstruction outlined in the directors' report last year, and submitted to the shareholders in 1907, failed to meet with the preference and founders' shareholders approval, and the matter therefore remains in abeyance.

ELECTRICAL POWER STORAGE CO.—Mr. F. Green, presided at the annual meeting of this company on Thursday, when the report and accounts given in our last issue were adopted. With regard to the falling off during the past year, the chairman pointed out that this was most noticeable since November, when the money panic took place. Up to date, however, they were ahead of the previous year in output, but the most disturbing influence was the absence of large contracts, which had brought about a keenness of competition which he described as suicidal

ELEKTRICITATS-AKT. GES. VORM. W. LAHMEYER & CO., FRANKFORT A.-M.—At the general meeting held recently, the report for the year was adopted, and a dividend of 7 per cent. declared, which is the same as that of last year.

GENERAL ELECTRIC CO.—The report for the year ended March 30th, 1908, shows a net trading profit, including income from investments, &c., of £59,753. A balance of £34,723 remains after deducting depreciation and debenture interest. The directors recommend appropriation as provision for Managing Director's and employees' bonus of £2,223, and the payment of a dividend of 5 per cent. upon the ordinary shares, carrying forward £1,974 to reserve fund. This latter will then amount to £120,343. The report states that the feature of the year has been the sudden fall in the price of raw materials, which has adversely affected the results of several departments and necessitated a considerable writing down of stocks. Mr. M. Byng has resigned the chairmanship of the company, and Mr. E. G. Byng has been appointed a director. The meeting is to-morrow.

GROSSE BERLINER STRASSENBAHNEN.—The report for the year 1907 contains the following information. The total length of single-track now amounts to 522 km. The rolling-stock consists of 574 four-axle and 917 two-axle motor-cars, 1,001 trailers, and 190 special cars. The number of car-kilometers amounted to 85,718,000, or 3·4 per cent. higher than the figure the previous year. The number of passengers carried during the year exceeded 378 million. The total receipts amounted to 36,000,000 marks, and the total expenses to 20,250,000, leaving a surplus of 16,330,000 marks. The share-capital of the undertaking has increased from 44 million marks in 1898 to 100 million marks in 1907.

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PARLIAMENTARY INTELLIGENCE

CENTRAL IRELAND ELECTRIC POWER BILL.—A House of Commons Committee presided over by Lord Donoughmore had this Bill under consideration last week. We have already reported fully the proceedings before the House of Commons Committee, the Bill being at first rejected mainly on the opposition of the Dublin Corporation and on financial grounds, but was afterwards recommitted with Dublin struck out of the area and a stronger financial case. As a consequence, the original capital of £450,000 with borrowing powers was reduced to £150,000 with borrowing powers. It is made a condition in the Bill that before any powers can be exercised £50,000 must be subscribed. The object of the Bill is to erect an electricity works upon the Grand Canal, Co. Kildare, close to Robertstown, to make use of the peat in the district for working gas producers, the generating plant being driven by gas engines. The Company propose to make use of a process now commonly used in Germany and various other parts of the Continent, by which peat is used whilst it still contains 50 per cent, to 60 per cent. of its moisture. It is estimated that the cost of fuel will be 0.05d. per unit. The area includes 7,000 acres of bog land, of which it is proposed at first to purchase 500 acres, there being a depth of peat of 25 ft. Captain H. Riall Sankey, Mr. A. Lupton, M.P., Mr. Crossley, M.P. (chairman of Messrs. Crossley Bros.), and Mr. J. Sturgeon again gave evidence in favour of the Bill, the only opposition being by the Dublin and Alliance Gas Company, whose case rested on the plea of unfair competition. Mr. Stephen Sellon was called by the Gas Company, and expressed the opinion that the scheme could not be financially sound, but the Committee passed the preamble, and reported the Bill for third reading. Full particulars of the previous proceedings will be found in ELECTRICAL ENGINEERING, Vol. III., pages 503 and 803.

FIRES ON TUBE RAILWAYS.—In answer to a question in the House of Commons on Wednesday last week, the President of the Board of Trade said that special requirements had been made regarding the construction of tube railways with the object of guarding against risk of fire. These, however, related to materials, ventilation, insulation, lighting, and similar matters, but he did not think knowledge of these details by the passengers would add to safety. Hydrants and fire hoses were fixed on every platform, and fire extinguishers were carried in every carriage.

LONDON COUNTY COUNCIL TRAMWAYS AND IMPROVEMENTS BILL.—When this Bill came up for third reading in the House of Commons on Tuesday Mr. Timothy Davies moved that the second reading be deferred for three months. He said his objection was to the clause authorising the construction of overhead tramways in Fulham, a bargain having been come to with the Borough Council that the conduit system should be adopted. Mr. Guinness and Mr. Waterlow opposed the amendment mainly on the ground that the Fulham Borough Council did not oppose the Bill in Committee of either House, and that the third reading stage was not a desirable time to bring such matters forward. The amendment was then withdrawn, and the Bill read a third time.

LONDON ELECTRIC POWER BILLS.—The Barnes and Croydon Corporations have deposited petitions in the House of Commons against the London and District Electricity Supply Bill.

The London (Westminster & Kensington) Electric Supply Bill and the London Electric Supply Bill were read a third time and passed in the House of Lords on Monday.

LONDON UNITED TRAMWAYS BILL.—We report the proceedings on this Bill before the House of Lords Committee on Tuesday on page 153.

METROPOLITAN ELECTRIC TRAMWAYS BILL.—We report the proceedings before the Unopposed Committee of the House of Commons on Thursday on page 153.

PROGRESS OF ELECTRICAL BILLS.—The Macclesfield and District Tramways (Abandonment) Bill was read a second time in the House of Lords on Wednesday last week.

The Telegraph Construction Bill was read a first time in the House of Lords on Wednesday last week.

The Nottinghamshire and Derbyshire Tramways (No. 2) Bill was read a second time in the House of Commons on Tuesday last week, and a first time in the House of Lords on the same day.

The Metropolitan District Railway Bill was read a third time in the House of Commons on Friday.

The South Wales Electrical Power Distribution Bill was read a third time and passed in the House of Commons on Thursday.

The Wishaw Burgh Electricity Bill was read a third time in the House of Lords on Thursday.

TRAWLERS AND TELEGRAPH CABLES.—In the House of Commons on Monday Mr. Beauchamp asked the Postmaster-General whether the Commercial Cable Co. had any authority to issue warnings against trawling on the south-west coast of Ireland. The Postmaster-General replied to the effect that having appointed a Committee to inquire into the whole question, which was now taking evidence, the matter would be referred to them. (We gave the names of the Committee and the terms of reference in our last issue.)

UNOPPOSED BILLS.—Electric Lighting Provisional Order Confirmation Bill, No. 3, and Tramways Provisional Order Confirmation Bill, No. 2, were passed by the Unopposed Committee of the House of Commons on Tuesday.

The Committee also considered the Great Northern Piccadilly & Brompton Railway Bill, which provides for an amendment of the agreement with the Underground Electric Railway Co. of London, dated January 13th, 1905, and for the cancellation of 430,000 cumulative preference shares and their conversion into 4 per cent. preference shares. The Bill was ordered to be reported for third reading.

The Macclesfield & District Tramways (Abandonment) Bill was ordered to be reported for third reading by the Unopposed Committee of the House of Lords on Tuesday.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £59 10s. to £60 per ton (last week £59 to £59 10s. per ton).

GT. CENTRAL RAILWAY.—The Gt. Central Railway Co. have issued a most exhaustive selection of excursions on all parts of their system in the form of an A.B.C. programme.

LONDON PRIVATE FIRE BRIGADE.—At the annual competition of the London Private Fire Brigades at the Crystal Palace, on Saturday, the Robertson Fire Brigade (Robertson Electric Lamps, Ltd., Hammersmith) again won the shield presented by Sir T. R. Dewar for the best drill. In the championship totals, the Robertson Brigade came out second against 23 competing brigades, their aggregate time for all the drills being 348 seconds against 342 by the winning brigade.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—At the London Bankruptcy Court last week, J. T. Murray, of West Kensington, came up for public examination. The statement of affairs showed liabilities of £3,212 and assets £73, but there were bad book debts amounting to £30,250. The debtor attributed his position to losses sustained during the last five years in the formation of a tramway company, and he has also been concerned in the formation of the Blackpool garage and General Electrical Engineering Co., Ltd. The first meeting of creditors has been adjourned to enable the debtor to make arrangements with a view to discharging his liabilities.

A meeting of creditors in the voluntary liquidation, for the purpose of reconstruction, of Messrs. Thomas Parker, Ltd., will be held at the offices of the company, Wednesfield Road, Wolverhampton, on Thursday next, July 30th, at 12.30. This is a formal meeting. Since the circular we gave last week, the chairman of the company, Mr. C. T. Mander, has been appointed receiver and manager for the debenture holders, and is carrying on the business until the necessary formalities are completed, and the new company, the Rees Roturbo Manufacturing Co., is formed.

A petition for the winding up of Messrs. Meldrum Bros. will be heard before Mr. Justice Swinfen Eady at the Royal Courts of Justice, Strand, London, on July 28th. Any person intending to appear must give notice to Mr. A. M. Longhurst, 2 Fenchurch Buildings, London, the agent for Messrs. Stratton and Son, Wolverhampton, solicitors for the petitioners.

Creditors of the Lancashire Electric Supply Company are requested to send in particulars of their claims by August 7th to Mr. J. Collier, 4 Chapel Walks, Manchester, the liquidator.

A general meeting of the South-Western Electrical Company will be held at the offices of Messrs. Alles, Salamon & Co., 1 Oxford Court, Cannon Street, on August 21st, at 12 noon, to hear the liquidator's account of the winding up.

The trustee in the bankruptcy of Mr. A. J. Harris, electrical engineer, of Borough Mills, Bower Street, Bradford, has been released.

The Seville Tramways Co. is to be wound up voluntarily. Mr. A. F. Judd is liquidator. A meeting is to be held on Monday at 23 Talbot Road, Highgate, at 3 p.m., to consider whether an application shall be made to the Courts for the appointment of a liquidator in the place of, or jointly with, Mr. Judd.

OUTINGS.—The annual outing of the Sun Electrical Co., Ltd., took place on Saturday, July 11th, in the form of an up-river trip to Hurley. The electric launch *Rosalind* left Maidenhead Bridge at 10.15 a.m., luncheon being served at the George and Dragon Hotel, Marlow. Mr. A. G. Beaver, the manager, proposed "The Sun Electrical Co., Ltd.," and expressed his satisfaction with the success which had attended the introduction of the "Kalkos" system of tubing during the past year, and predicted a great future for it. Tea was partaken of at "Ye Olde Bell," Hurley, after which the return journey was made, Paddington being reached just before 11 o'clock.

On Saturday, the 18th inst., Messrs. E. P. Allam & Co., Red Lion Street, held their annual works outing at Rye House, the excursion being attended by all the employés, including the office staff, departmental managers, and agents.

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MISCELLANEOUS CITY NOTES

ANGLO-AMERICAN TELEGRAPH CO.—After placing £5,000 to the credit of the renewal fund, an interim dividend for the quarter ending June 30th, 1908, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less income tax, is recommended. After paying the foregoing dividends, there will be a balance of £6,962 to be carried forward to the next account.

ANGLO-ARGENTINE TRAMWAYS CO.—A provisional agreement has been arrived at with the Compagnie Générale de Tramways de Buenos Ayres for the acquisition of all the issued share capital of the Buenos Ayres Electric Tramways (1901), Ltd., and the entire undertaking of the Belga Argentine Tramways Co., the consideration being £1,400,000 in fully-paid new ordinary shares. It is further proposed that the £5,000,000 new ordinary shares already authorised shall be divided into £2,500,000 five per cent. cumulative third preference shares, and £2,500,000 ordinary shares, and that the payment for the properties above mentioned, and also for the Buenos Ayres and Belgrano Tramways Co., shall be made as to one-half in third preference shares and one-half in ordinary shares.

BOURNEMOUTH & POOLE ELECTRICITY SUPPLY CO.—An interim dividend of 5 per cent. per annum, less income tax, is recommended upon the ordinary shares for the June half-year.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—It is announced that the issue of new shares has been largely over applied for, and that consequently some delay was incurred before letters of allotment and regret could be posted.

COUNTY OF LONDON ELECTRIC SUPPLY CO.—An interim dividend at the rate of 4 per cent. per annum, less tax, has been declared upon the ordinary shares for the June half-year.

DIRECT UNITED STATES CABLE CO.—A final dividend of 4s. per share, together with a bonus of a shilling per share, both free of income tax, making, with the three interim dividends already paid, 4½ per cent. for the year ended June 30th, is recommended. The sum of £5,000 is placed to reserve fund, carrying forward £2,812.

EDMUNDSON'S ELECTRICITY CORPORATION.—An issue is announced of £100,000 five per cent. prior lien debenture stock at par redeemable at the option of the company at any time after March 31st, 1912, upon six months' notice in writing, at 105 per cent. until 1920, and thereafter at par, and similarly redeemable in the event of voluntary liquidation of the company. Provision is also made for the redemption of the stock by means of cumulative sinking fund of 1 per cent. commencing July, 1912, to be applied in the purchase of stock, or in redemption by drawings at 105 per cent until 1920, and thereafter at par. The stock, which is offered for subscription on behalf of Edmundson's Electricity Corporation, Ltd., by the Electric and General Investment Co., is secured by a trust deed in favour of the trustees, by which it is constituted a specific first charge on certain debentures and debenture stock of the face value of £92,700 in various electric supply companies, and a first floating charge upon the undertaking and remaining property of the company. Power is reserved, however, to issue further stock ranking *pari passu* with the present issue to a total amount not exceeding £200,000, including the £100,000 now offered.

ELECTROMOBILE HIRING CO.—In consequence of the shares in this company now being held by or on behalf of the Electromobile Co., Ltd., the two companies are to be amalgamated. Mr. George Cockerton, 7 Hertford Street, Mayfair, London, secretary of the Electromobile Hiring Co., has been appointed liquidator in the voluntary winding up of this company.

LONDON STREET TRAMWAYS CO.—An interim dividend of 2s. per share, free of tax, upon the ordinary shares for the past half-year is recommended.

MALTA TRAMWAYS CO.—A prospectus has been issued inviting applications for £125,000 ordinary shares of £1 each at par.

MELBOURNE TRAMWAYS & OMNIBUS CO.—The London secretary has received cable advice of the declaration of a bonus for the year ended June 30th by the rate of 5 per cent.

MONTREAL LIGHT, HEAT & POWER CO.—The holders of 4½ per cent. first mortgage bonds, allotment letters, and scrip are notified that the bonds are now ready for exchange. Allotment letters and scrips must be left at the Bank of Montreal, 47 Threadneedle Street, London, three clear days for examination, and forms for listing may be had on application.

A dividend of 1½ per cent., being at the rate of 6 per cent. per annum for the quarter ending July 31st, has been declared.

ST. JAMES' & PALL MALL ELECTRIC LIGHT CO.—An interim dividend for the June half year at the rate of 10 per cent. per annum on the ordinary shares has been declared.

TORONTO POWER CO.—Applications are invited for an issue of £500,000 4½ per cent. redeemable debenture stock at 98.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—In the Chancery Division on Thursday Mr. Justice Swinfen Eady made an order confirming the scheme already given in our columns which has for its object the reorganisation of the company's financial position. There was opposition from some of the note holders but in giving judgment his Lordship said it was the duty of the Court to consider whether the scheme was a reasonable compromise and one which could be regarded as beneficial to both sides. The creditors had approved of the scheme by an overwhelming majority, but at the same time this did not prevent the minority from having their rights and interests protected, and if it was not a fair and reasonable scheme the Court would be bound to reject it. After careful consideration, however, he was quite satisfied that the opponents of the scheme, as well as those who approved it, were fairly dealt with.

WALSALL ELECTRICAL CO. (and reduced).—A petition has been presented to the High Courts confirming a resolution reducing the capital of the company from £25,000 in £1 shares to £20,620 in £1 shares. The petition will be heard by Mr. Justice Swinfen Eady on July 28th.

APPOINTMENTS AND PERSONAL NOTES

Messrs. Souper & Callaghan, Engineers and Agents, of 46 Grosvenor Chambers, Deansgate, Manchester, have entered into partnership for the purpose of carrying on business as buying and selling agents for all classes of machinery and engineering materials and supplies.

The local staff of the Manchester branch of Siemens Bros.' Dynamo Works, Ltd., has presented Mr. Philip C. Pope with a very handsome gold watch, on the occasion of his resigning his position as manager of the branch office. Mr. Edmund L. Hill, who has been appointed to take Mr. Pope's position, made the presentation before the whole of the staff. We understand Mr. Pope is leaving Siemens Brothers' Dynamo Works, Ltd., to take up a position with Messrs. John Musgrave & Sons, engineers, of Bolton.

The Finchley Urban District Council has agreed that the salary of the Electrical Engineer (Mr. E. Calvert) be increased from £450 to £475 per annum, such increment to take effect from July 1st.

Mr. William Corin, Launceston, Tasmania, has been appointed electrical engineer to the Public Works Department, Sydney (N.S.W.), at a salary of £750 per annum.

THE G.B. SURFACE CONTACT SYSTEM

THE tramcars which have been running during the past few weeks upon the G.B. Surface Contact system from Whitechapel to Bow have been withdrawn, and there is a rumour to the effect that the Highways Committee of the London County Council is in favour of the abandonment of the experiment. At yesterday's meeting of the London County Council, Sir John Benn endeavoured to raise the question, but was ruled out of order. Later in the day Mr. Whittaker Thompson, the chairman of the Highways Committee, is said to have stated that in consequence of reports from the officers of the Council as to the accidents upon the system, the Committee had decided to recommend the Council to cease using the system. We understand that a full report dealing with the matter will be presented to the Council at the next meeting.

In the House of Commons on Tuesday, in answer to Mr. B. S. Straus, Mr. Winston Churchill stated that the Board of Trade had been informed by the London County Council of an accident to a horse through coming in contact with a stud upon the G.B. Surface Contact system in the Mile End Road. This system had been sanctioned as an experiment for six months from June 25rd, and if a renewal of the Board's sanction was desired at the end of that period, the nature and number of any accidents that had occurred would be a factor in the consideration of the question.

Wireless Telegraphy.—The *Western Morning News* states that orders have been received directing that the wireless telegraph offices on board battleships, which are exposed to the blast of heavy guns, are to have their doors made of 10 lb. steel plating, suitably stiffened, without windows in the doors. These alterations are to be carried out in all vessels fitted with wireless telegraph apparatus as they come into the dockyard hands.

Projected Swiss Electric Railway.—According to *The Engineer*, the Bernese Alps Railway Company have granted 1,000,000 francs for the immediate adoption of electric traction on the line Spiez Frutigen. The scheme is to be carried out at once, both as an experiment and with the special object of training the staff. Single-phase currents of 15,000 volts at 15 periods have been adopted on the proposal of Chief Engineer L. Thormann, of Bern, who decided in favour of this system as the most economical. The energy is to be taken from the power-station of the united Kander and Hagnek Works, in which special turbo-generators are to be installed. The rolling-stock will comprise both locomotives and motor-carriages. It is intended that passenger trains of 250 tons should take the maximum gradient of 27 per cent. at 40 kilometres per hour, and goods trains should travel at 30 kilometres; about 1,200 horsepower, and two or three motors will therefore be required for the motor-carriages of the passenger trains.

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ELECTRICAL ENGINEERING

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SUMMARY

The second reading debate upon the London Electric Power Bills takes place in the House of Commons to-night. There are eight motions down for its rejection, but the Government will not officially oppose. The Board of Trade will move that the London County Council be named in the London and District Bill as the purchasing authority. (Page 166.)

An article communicated by "A Civil Engineer" contains a plea for the more extended use of hard woods, such as Karri and Jarrah for constructional purposes. It is argued that for flooring and even for foundations for certain classes of machinery in generating stations they are particularly suitable, and the suggestion is made that on account of their comparatively non-inflammable nature they might in some cases replace slate for switchboards. (Page 167.)

The reports of H.M. Inspector of Mines show that the number of electrical coal-cutters in use in the collieries of this country, although still under the number of compressed air machines, is increasing at a more rapid rate. (Page 168.)

The report of the Tramways Committee of the Corporation of Glasgow for the year ended May 31st, 1908, shows an increase in the average traffic revenue per car mile from 10·465d. for the year 1906/7, to 10·488d. for the year 1907/8. The working expenses, excluding capital charges, show an increase of 0·172d. per car mile over those of the previous year. The extensions during the past year comprised about one mile of double track, the total length of single track owned and leased by the Corporation amounting to 179 miles. The generating costs have increased from 1·056d. to 1·191d. per unit issued to the sub-stations for traction and car lighting purposes. (Page 169.)

The report of the work of the German Physikalisch-Technische Reichsanstalt for 1907 contains particulars of a large amount of electrical testing and experimental work, including the production and investigation of continuous electrical oscillations by the arc method. Researches have also been carried out on the magnetic properties of iron alloys, and extensive tests on metal filament lamps have been conducted. (Page 170.)

A report of the Highways Committee of the London County Council recommends the abandonment of the experiments in the Mile End Road with the G.B. surface contact system, and suggests the use of the overhead trolley system, which, it is estimated, can be adopted at a further expenditure of about £8,000. The G.B. Surface Contact Co. have sent a long communication to the members of the Council, in which they claim that the cause of the failure of the experiments is the disregard of their advice by the officers of the

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Council, and they offer to put the installation in proper working order at a cost of not exceeding £2,500, which shall not be paid to them unless the Council continue to use the system. At Tuesday's meeting it was stated that the company have threatened legal proceedings. (Page 171.)

THE results of the experiments in connection with the proposed electrification of the main lines of the Swedish State Railways have been published. The single-phase system was chosen as being the most suitable under the conditions prevailing in Sweden. The behaviour of the equipment is stated to have been most satisfactory. Experiments were made in connection with the rail return indicated that bonding on high-tension single phase railways is unnecessary. Various forms of overhead equipment were tried, but a simple suspension from side brackets, without either cross wires or suspension wires, was considered to be the most satisfactory. No high-speed tests were made. (Page 172.)

A MEETING of the Tramways and Light Railways Association was held on Friday last for the purpose of further discussing the lecture on "Rail Corrugation," delivered by Prof. C. A. CARUS-WILSON at the last meeting of the Annual Congress on July 10th. The discussion was opened by Mr. H. M. SAYERS, who expressed the opinion that intermittent slipping would have the same effect as the intermittent skidding described by the lecturer. Such intermittent slipping could be caused by the sudden rise of motor torque when two or more notches of the controller were passed over without a pause. Mr. J. R. SALTER suggested that the molecular change in the iron rails due to magnetisation might have some influence. The importance of ensuring uniform flange pressure was emphasised by Mr. J. S. WARNER. Mr. S. SELLON objected to the tyre section shown by the lecturer, and called attention to the wear which must take place on the flange and rail-head before check-cutting can occur. He did not think unequal diameters essential for the production of intermittent skidding. The corrugations on the old Brixton cable tramway lines were put forward by Mr. J. WELLING in support of Prof. Carus-Wilson's theory. Prof. CARUS-WILSON replied very completely to all the questions put, and the proceedings terminated. A written communication has been received from Mr. J. A. PANTON. (Page 185.)

THE following books are reviewed in this issue:—"Lead Refining by Electrolysis," by A. G. Betts, and "Die Revision elektrische Starkstrom Anlagen," by Paul Stern. (Page 174.)

AN electric crane installation has recently been carried out at Southampton, in which batteries are used to equalise the load on the generators. (Page 172.)

THE National Telephone Co.'s repair shops at Nottingham are described in an illustrated article. (Page 175.)

IN our fifth illustrated article on matters of electrical interest at the Franco-British Exhibition some further particulars are given of the generating plant in the Machinery Hall, which comprises a large Parson's continuous-current turbo-generator and a Westinghouse gas-engine set, supplied with gas from a Mond producer plant. Details are also given on some applications of electrical power in the Exhibition, including the driving of the "Flip Flap" and the working of the cascade in the Court of Honour by electrically-driven turbine pumps. Some further exhibits, including some of electrometallurgical interest in the French section, are noticed. (Page 177.)

A FEW particulars as to the scope of the Electrical Exhibition at Marseilles, and the current supply thereto, are given in a short article. (Page 181.)

IN an article in a German contemporary by H. REMANÉ, of the Auer Gesellschaft, the probable candle-power of the metal filament lamp which will take the place of the 16 c.p. carbon lamp for general illumination, is considered. Some interesting figures for the dimensions and energy consumption of Osram lamps of various candle-powers and voltages are also given. (Page 182.)

THE annual report of the Board of Trade with respect to electric lighting provisional order applications during 1907 shows that of the 27 applications, 17 were by local authorities, and 10 by companies. (Page 182.)

THE construction of Mr. L. H. WALTER'S tantalum-mercury wave detector was described in a Paper recently read before the Royal Society. Tests of the apparatus in actual practice appear to show that while possibly not so sensitive for very weak oscillations it enables much louder sounds to be produced in the receiving telephone for moderately strong waves than the electrolytic detector, and that it is particularly well suited to wireless telephony. **(Page 188.)**

THE report of the sub-committee appointed by the Tramway Committee of the Dundee Town Council to consider the practicability of using the trackless trolley system in the suburbs of Dundee contains accounts of several similar undertakings on the Continent, and recommends its adoption where the traffic is not sufficient to warrant the laying of tramway track. (Page 184.)

THE accounts of the London County Council for the year ended March 31st, 1908, show total receipts amounting to £1,663,031, and working expenses amounting to £1,170,115. After meeting capital charges, &c., there is a net balance of £45,406, the whole of which, together with the balance of £5,923 brought forward, has been carried to renewals fund. It is pointed out that had the basis for renewals laid down by the Council been adopted, viz., two-thirds of a penny per car mile, the sum of £71,086 would have had to be set aside. (Page 185.)

THE Highways Committee of the London County Council recommend Parliamentary powers being sought for new tramways next session at an estimated cost of £403,430. (Page 185.)

THE refining of the slimes produced at the Raritan Copper Refinery and the production of pure silver and gold therefrom is noticed under "Electrochemistry and Electrometallurgy." The Aluminium Corporation, Ltd., appear to be making good headway. They have started some of the furnaces at Wallsend. They are also building works for the refining of the bauxite, for which a subsidiary company has been formed, and for the manufacture of electrodes. Reference is also made to the preparation of diaphragms. (Page 187.)

UNDER "Electrical Science," in the British and American Section, is a note on a Paper by O. C. CLIFFORD on the magnetic susceptibility of copper-tin alloys. In the Papers abstracted in the Continental Section, GUYE and BRON announce a rule connecting the sensibility of the alternating arc with the atomic weight of the substance constituting the electrodes; GUILLAUME and PERRIN furnish an explanation of the electric fatigue observed by Bose in wires; and J. BECQUEREL anticipates and meets some criticisms of his alleged discovery of free positive electrons. (Page 187.)

A SWITCH for preventing the improper starting and control of motors is the subject of a patent specification by the BRITISH THOMSON-HOUSTON Co., which was published by the Patent Office on Thursday last. The specification describing the "Jandus" enclosed flame arc lamp has also been published. A process for the manufacture of metal filaments consisting of a mixture of silicon and tungsten, and having a higher specific resistance than pure tungsten filaments, is given in a specification by the BRITISH THOMSON-HOUSTON Co. A protective device for high-tension circuits, depending

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for its operation on the difficulty of maintaining an arc with an electrolyte as a cathode, has been patented by E. L. CREIGHTON. The specification describing the composition used for insulating and impregnating cables and known as "Liconite," the invention of E. S. ALI-COHEN, has also been published. A patent for an electrolytic cell, in which the liquid to be electrolysed flows over a rotating surface consisting of the edges of strips of metal alternately negative and positive, expires during the current week. (Page 189.)

THE accounts of the Bristol electricity undertaking show a net profit of £473 after providing £43,637 capital charges, &c.—There is a gross profit of £6,790 shown by the accounts of the Devonport electricity undertaking for the past year, which is reduced to £7 after meeting capital charges, &c.—The Edinburgh Electric Lighting Committee has decided to transfer £9,794 of the profit of £10,541 upon the electrical undertaking for the past year to the relief of rates.—The accounts of the Manchester Corporation Tramways Department show a gross profit of £269,049, of which capital charges absorb £124,255; reserve, renewals, and depreciation, £87,790; and contribution in aid of rates, £55,000.—The Norwich Corporation electricity accounts show a net profit of £3,104 for the year ended March 31st.—An electrobus is running trials in the streets of York. (Pages 191 to 193.)

THE London County Council Fire Brigade recommend an expenditure of £136 in providing metal filament lamps for a number of fire stations. The Great Western Railway Co. propose to erect a generating station at Fowey, in Cornwall. A generator panel and accessories for 2,000 amperes is required at Finchley. Loans for considerable amounts in connection with electric supply are recommended by the Finance Committee of the London County Council at Battersea, Hammersmith, Shoreditch, and Stepney. A Local Government Board inquiry has been held at Tonbridge in connection with a loan of £4,000 for electrical purposes. The West Ham Corporation is applying for sanction to borrow £51,600 in connection with the electrical undertaking. For the information of wiring contractors we give particulars of a large number of buildings about to be erected in London and the provinces. (Pages 193-194.)

THE annual meeting of the National Telephone Co. was held on Thursday, when it was stated that the number of exchanges is now 1,513, and the number of exchange and private stations 463,869. The present rate of effective calls is 656,755,000 per annum, and the revenue per telephone station works out at £6 3s. 4d. In London the company has 99,068 stations against 49,690 on the Post Office system. Complaint was made at the meetings of Messrs. Crompton & Co. and the General Electric Co. of the continuation of severe competition in the electrical industry. Mr. Byng, at the latter meeting, said he did not think any permanent improvement would be made until our fiscal policy is altered. The report of the British Thomson-Houston Co. for the year ended March 31st, after deducting debenture and other interest, shows a profit of £28,038. The accounts of the Metropolitan Railway Co. for the half year to June 30th show a profit of £157,006, and the balance available for dividends, after meeting debenture interest, &c., is £18,002. (Pages 195 to 197.)

THE second reading in the House of Commons of the London Electric Power Bills is down to take place to-night, and we are pleased to see that at last the Government intends to make a genuine effort to put the whole question on a sound basis, once and for all. No official opposition is to be offered to any of the Bills, but Mr. WINSTON CHURCHILL, on behalf of the Board of Trade has given notice of a motion in regard to the London & District Electricity Supply Bill that it be an instruction to the Committee to insert a provision conferring purchasing powers upon the London County Council. It will be remembered that this matter was discussed at some length before Lord CROMER'S Committee, and that the promoters of the Bill have no objection to these powers being conferred upon the London County Council. Their reason for asking the House of Lords Committee to leave the matter open, and not to mention specifically any purchasing authority, was purely with a tactical object, for it at once raised the question of opposition from other county councils involved in the scheme on this particular point and created the spectacle of one opponent objecting to the proposals of another opponent of the Bill. Mr. FITZGERALD, K.C., the leader for the Bill, foresaw that this might have the effect of hanging up the Bill for the session. It now appears, however, to be the desire of the Board of Trade that the London County Council should be specifically mentioned in the Bill, and there is also a general feeling that in return for being granted the linking up powers contained in their Bills, the London electric supply companies shall be compelled to fall in with a general scheme for ultimately handing over their undertakings to the London County Council. This principle also involves the borough councils, whether such a general scheme of purchase is to be carried out in 1931, the date at which the borough councils can now purchase the companies' undertakings, or in 1951, the date mentioned in the London & District Bill. For the first time in this controversy the question of severance has been given special prominence, for it is laid down in the Electric Lighting Acts that where only part of a company's undertaking is acquired by a local authority, compensation shall be paid to the company for loss incurred by the severance of that portion of the undertaking. Consequently if a general scheme for the acquisition of all the electric supply undertakings in a defined area in and around the metropolis were given effect to, this question would cease to have importance. It was in consequence of these proposals of the Board of Trade becoming known that Mr. MORTON asked that the debate upon the second reading should be adjourned until the autumn session in order to give the borough councils and others interested time to consider the new position. As will be seen from another column, the Government has shown a further indication of their desire to avoid any delay which will have the effect of postponing a decision on this important matter beyond the present session, and has refused to adjourn the second reading. No doubt there will be a clear exposition of the attitude of the Board of Trade during the debate this evening, because any scheme for the acquisition of electrical undertakings in London and district by a central authority goes beyond the transfer of the present powers of purchase of local authorities. Any such scheme must also include the municipal undertakings, and this has really been the crux of the matter hitherto. It will also be interesting to learn how it is proposed to dispose of the difficulties which must at once arise when, as will be the case here, one county council is given purchasing powers over an undertaking in the area of another county council.

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THE most extraordinary amount of popular interest has been taken in the unfortunate troubles which led to the cessation of the service of tramcars equipped on the G. B. surface contact system along the Mile End Road. The report of the Highways Committee on the subject, which is given at some length in another column, is strongly worded, and practically characterises the system as a complete failure. The Committee have not, however, thought fit to give any technical detail whatever as to the actual causes of trouble, such as whether it is mainly due to live studs caused by sticking of the plungers or leakage or other irregularities. In view of the wild remarks of the halfpenny papers, we should have thought an authoritative statement of a more detailed nature would have been very desirable. The first inquiry that everyone interested will make is naturally as to what differences in design are present between the L.C.C. equipment and that giving such excellent results at Lincoln, and a very strong position with regard to this is taken up by Messrs. GRIFFITHS and BEDELL, who state in a circular letter that we are able to publish in full that such modifications as have been made in the designs by the County Council engineers were against their advice and contrary to the results of their experience on the pioneer line. They also point out that the Board of Trade inspection was carried out, and traffic commenced in spite of their representations that the equipment was in an unsatisfactory state. It must be borne in mind that the equipments of the three cars that were run were more or less of a temporary nature, and were hurriedly put into use at a time when a good deal of pressure was being brought to bear as regards an early commencement of the service, and did not represent the final form of the designs of the engineers to the Council. The inventors show their unshaken confidence in the system by offering to make the alterations they consider necessary under heavy guarantees as to the proper working of the system, but the Highways Committee, notwithstanding the faith that Mr. WHITTAKER THOMPSON has always shown in the ultimate success of the system, do not see their way to acceding to the request, and are unwilling to take any further risks in the matter. The only alternative they have to suggest is the conversion of the line to the overhead system, as owing to local conditions the cost of the ordinary conduit would be prohibitive. This solution to the problem is by no means as easy as it looks, and the Stepney Borough Council have again declared their unwillingness to withdraw their veto on the overhead system, and nothing short of special Parliamentary powers can enable the County Council to act against their pronouncement. The situation is one of considerable difficulty, and whether the irregularities of working could have been avoided by differences in the details of design or not, it is much to be regretted that the troubles of the Council's engineers should have been made an excuse for the showing of so much party animosity. In accordance with the procedure of the London County Council, the report of the Highways Committee was not discussed at Tuesday's meeting, but the interesting announcement was made that the G.B. Surface Contact Co. contemplate the institution of legal proceedings in the matter, so that there is every likelihood of the matter being thoroughly investigated apart from party politics.

PARLIAMENTARY INTELLIGENCE

FIRES ON TUBE RAILWAYS.—In the House of Commons, on Wednesday last week, Mr. Weir asked the President of the Board of Trade whether, in view of the risk of suffocation of passengers in the tube railways of London should the wooden sleepers by any accident become ignited, he would communicate with the various companies on the subject. Mr. Churchill replied that the Board of Trade proposed to await the report of the inquiry of Colonel Yorke and Mr. Trotter into the recent fire on the City & South London Railway before considering what action, if any, is necessary with regard to this and kindred matters.

THE "G. B." SURFACE CONTACT SYSTEM.—In the House of Commons, on Wednesday, Sir J. Benn asked the President of the Board of Trade whether his attention had been directed to the accidents in the Mile Road, London, consequent on the installation by the London County Council of a route of electric tramways on the stud system; whether this line was inspected by his Department, and was he aware that the London County Council proposed to extend this system to other parts of London; and whether the Board of Trade could take steps to protect the metropolis from the dangers of such extension. Mr. Churchill replied that he was aware that accidents had occurred on the tramway in question, which was inspected on behalf of the Board of Trade before being opened experimentally for traffic. He had no knowledge, however, of any intention on the part of the London County Council to extend the use of this system to other parts of London, and no such extension could be carried out without the consent of the Board of Trade.

LONDON ELECTRIC POWER BILLS.—In the House of Commons on Monday Mr. A. C. Morton asked whether the Prime Minister would consent to the second reading of the London Electricity Bills being put off till the autumn session, so that the London local authorities might have an opportunity of considering the new proposals of the Board of Trade. Mr. Churchill, the President of the Board of Trade, who replied, said he was advised that it would be fatal to the Bills if the second reading were postponed to the autumn session. The proposal to make the London County Council the purchasing authority was not new, but was considered by the Committee of the other House. Full opportunity would be given for existing purchasing authorities to be heard before the Committee, and ample time would be available for the preparation of their case.

The second reading debate takes place this (Thursday) evening. There are eight motions to reject the London & District Electricity Supply Bill, whilst the President of the Board of Trade will move that it be an instruction to the Committee considering the London and District Supply Bill to insert the name of the London County Council as the purchasing authority. At the same time, it may be pointed out that the Parliamentary Committee of the London County Council does not propose to offer further opposition to any of the Bills. Practically all the opponents to the London and District Electricity Supply Bill in the House of Lords has deposited petitions against the Bill in the House of Commons.

THE NOTTINGHAMSHIRE & DERBYSHIRE TRAMWAYS (No. 2).—This Bill has been reported for third reading by the Unopposed Committee of the House of Lords. The Bill authorises agreements between the Nottinghamshire & Derbyshire Tramway Company and the Nottingham Corporation, under which the latter construct certain tramways (powers for which are in the hands of the company), and also gives the company running powers over some lines in the city of Nottingham.

PROGRESS OF ELECTRICAL BILLS.—Tramway Provisional Order Confirmation Order Bill No. 2 was read a third time and passed in the House of Commons on Thursday.

The Great Northern, Piccadilly & Brompton Railway Bill, the Keighley Corporation Bill, and the Metropolitan Electric Tramways Bill were read a third time in the House of Commons on Monday.

In the House of Lords on Monday the following Bills were read a third time and passed: Central Ireland Electric Power, London United Tramways, and Nottinghamshire & Derbyshire Tramways (No. 2).

The Telegraph Construction Bill was read a second time in the House of Lords on Thursday.

The Macclesfield & District Tramways (Abandonment) Bill was read a third time in the House of Lords on Thursday.

TRAMWAYS TRAFFIC DEPARTMENTS.—In the House of Commons on Thursday, Mr. Steadman asked the President of the Board of Trade if he could state the number of men employed in the traffic departments of the various tramway undertakings in the United Kingdom. Mr. Churchill replied that he had no statistics of the kind referred to.

Radio-telegraphic Convention.—The Governor-General of Monaco, in giving notice of his State's adhesion to the Berlin Wireless Telegraphy Convention, states that there is no wireless installation in the country at present, but that one will be erected as soon as circumstances permit.

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THE USE OF HARD WOODS FOR CONSTRUCTIONAL PURPOSES

By a Civil Engineer

WITH the development of heavy engineering in connection with electrical undertakings, more particularly in such affairs as the construction of tramways and the electrification of railways, problems pertaining more exclusively to civil engineering have become invested with a certain amount of interest for the electrical engineer. One of the most interesting points in the choice of building material—more particularly at the present time, when iron and steel have reached a somewhat inflated price—is the limit of the possibilities of hard wood in connection with the construction of electrical engineering buildings and appliances. The three sections under which this question should be considered may be scheduled as the question of inflammability, that of resistance to crushing or vibration, and that of adaptability for use in constructional work where iron or similar materials are usually employed.

The prime importance of the first point is evident on considering the stringent conditions to which constructional materials are subjected in connection with electrical engineering work, more particularly at the present time, when the increase of the size of generating units produces a tendency to maintain an electric arc due to short circuit. When this occurs materials used in construction must be of a nature calculated to resist excessive heat, if they are in any way to satisfy the conditions determined by experience and enforced by the Board of Trade. For this reason a large number of central stations and sub-stations are now built with concrete and iron floors on the Hennebique or similar system and the use of wood, more especially in the vicinity of switchboards, is studiously avoided. At the same time, this may be carried somewhat to excess, and a test made upon some karri beams by the British Fire Prevention Committee in 1903 shows that hard wood is capable of withstanding destruction due to heat to a considerable extent. A brick hut, 22 ft. long by 10 ft. wide, was arranged with several lengths of karri timber 2½ in. thick placed so as to form a ceiling, and on the top of these was a load of bricks weighing about seven tons. Coal gas was then turned on from a generator, and in a short time the interior of the hut was red hot, the temperature at the end of two hours reaching close upon 2,000° Fah. At the end of this time it was discovered that in no place had the fire burnt through the wood, and the load of bricks remained undisturbed to the finish. The underpart of the planks, which were in actual contact with the fire, were, of course, considerably charred, but otherwise the woodwork was unharmed. These conditions would seem to indicate that hard wood, more particularly if well selected and polished, could be used fairly extensively for the constructional work of low-tension switchboards. The insulating property of karri and jarrah is fairly high, and the polishing would prevent the absorption of moisture. The argument that charring might occur in case of an arc may be met by the observation that if a slate slab were subjected to the same condition it would crack and fly about in the most objectionable manner. Even if hard woods were not adopted in parts quite so near the electrical contacts as above mentioned, there is no reason why it should not be used for the flooring of electricity stations, as its perfect safety in this connection is demonstrated by the fact that the London County Council's Building (Amendments) Act of 1905 specified jarrah, karri, oak, and teak as fire-resisting timbers for use in doors, staircases, beams, posts, and floorings.

An incidental point in favour of the use of hard woods for the flooring of electricity supply stations is the fact that it affords greater ease of attachment than concrete for machinery laid upon it, where such machinery is liable to be moved from time to time. There is much less risk of holding down bolts slacking back, and it has the advantage that no dust will arise from it during the course of running the station, as would occur in the case of a concrete floor. Instances have been known where sharp gritty dust from concrete flooring has got into the electrical and mechanical portions of running machinery and caused serious damage; indeed, it is a common precaution in newly-built stations to keep almost twice as much lubrication on the wearing parts of the engines, should these be of the open type, on account of the chance of any slight wind storm carrying the grit from the newly-made floor into the bearings.

The second point with regard to the use of hard woods in electrical construction work is the question of strength and durability. In this connection a mass of conflicting tests and opinions is available, but there seems to be no reason to doubt the fact that hard woods (providing questions of cost are favourable) might be used to a very much greater extent than at present. Karri and jarrah, for instance, are not only intrinsically strong, both in tension, shear, crushing, and compression, but they are very well adapted to stand shock or vibration; this is evidenced by the fact that these woods are largely employed, together with teak or oak, in the construction of the wooden fenders which are placed along dock walls in order to catch the shock of any ship striking the constructional work. The intense grinding and tearing action that goes on between the wooden fender and the iron plates of the ship are sufficient evidence of the fact that hard woods are capable of withstanding a considerable amount of rough usage. From a number of tests taken by Mr. W. H. Stanger, M.Inst.C.E., upon hard woods, the following averages were obtained:—

Jarrah will stand approximately 6¾ tons tensile stress per square inch, while karri will take 8¾ tons per square inch. Karri will bear nearly 4 tons compression per square inch in the direction of the grain before a permanent set is noticeable, while the ultimate crushing strength of jarrah is about 4¼ tons.

Comparative tests between various samples of wood made by the Chief of the Testing Department of the Belgium Railways shows that karri, besides having almost twice the strength of pitch pine (Karri, average of four tests, ultimate breaking load 39,583 lb.; pitch pine, average of 3 tests, 20,281 lb. on samples 10·6 in. × 11·8 in. × 23 ft. between supports) gives a fairly satisfactory deflection before breaking, and is hence likely to survive very severe conditions with regard to vibration. For this reason it is excellently applicable to forming foundations, flooring, and beams for electrical generating machinery, more particularly of the turbine type, where a great dead-weight of foundation is not necessary, and the cheapening effect upon the cost of construction is distinctly a point in favour of its use. The competing form of construction in this connection is, of course, the use of constructional steel and ironwork, and while it is undoubtedly true that with standard sections it is a very easy matter to construct girder and trestle work of good strength and rigidity, the cost of maintenance of such ironwork must be taken into consideration, whereas hard wood requires little or no attention after the first labour of putting it

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together. Iron and steel work needs periodical repainting and examination in order to keep it in good condition, and it should be remembered that in exposed situations where it is likely that severe changes of climate may be felt, iron girder work is apt to become brittle, and its resistance to sudden shock may, under certain conditions, be considerably less than what is anticipated.

The cost of hard wood would, under normal conditions in England, be higher than that of steel, but in outlying situations, where the cost of transport of steel has to be taken into account, hard woods might be used with considerable advantage.

In 1904 the question of the use of hard wood for building purposes arose in Bombay, and the Port Trust Engineer reported that the cost of beams of karri would be rather less than that of rolled steel beams, while teak would be rather more, and a solid timber beam, 12 in. × 16 in. would, in his opinion, make a more fireproof floor than light rolled beams. The writer is also in receipt of information from Messrs. Millers Karri & Jarrah Co., Ltd., that in New York these woods are being used in preference to oak grown in the country, in spite of double freight (from Australia to England and from England to America), import duty and full sale price, for constructional work in connection with the Hudson Companies' Tunnel Railways, and all the London tube railways, except the original "Twopenny Tube," which uses concrete, employ karri, or preferably jarrah, wood for their sleepers.

This brings us more particularly to the question as to its use in constructional work where iron might otherwise be employed. This has been partly considered above, but there are certain points in connection with track and pole line work for electric railways and similar purposes, which might well be emphasised. In track work concrete and iron sleepers are most objectionable on account of the noise produced when trains run over them, and while longitudinal hard wood sleepers might not be a positive cure for "roaring rail" they would, at any rate, do a considerable amount of good in mitigating the evil. In this connection also hard wood might be used more extensively for the heavy longitudinal members of tram-car bodies and similar purposes. It might be used on double-deck cars for the top rail in order to render these more comfortable to passengers in cold weather and to reduce risk of shock in the event of a slight electrical leakage.

That hard wood blocks are a suitable paving in connection with tramway rails is, of course, well known, and the Borough Engineer of Plymouth drew attention in 1903 to the fact that some of the blocks placed along the side of a tramline were slightly grooved at the edge, due to the fact that the rail after seven years' wear was deeply grooved. The effect of this point alone on the life of a wheel is important. For pole lines hard wood has stood a considerable amount of practical testing. In the Cauvery Falls Railway Power Transmission Line, Indian wood poles were first used for the transmission, but under the stringent atmospheric conditions these rotted rapidly, and the introduction of jarrah wood for the poles and arms satisfactorily removed this difficulty.

In all stations where humidity is liable to be a disturbing factor in pole line construction, hard wood would appear to be more useful than iron on account of the excessive maintenance required in scaling and re-painting. *Engineering*, vol. 83, page 5, quotes the case of wood telegraph poles twenty years old, which had only decreased 5 to 7 per cent. in strength, so that provided the æsthetic objections of local authorities can be overcome, wooden poles appear to be the economical solution to the cost of distribution over large areas; and where climatic conditions are unfavourable to the life of wood, the hard wood pole appears to carry the greatest advantage; in addition to which hard woods are from their oily nature possessed of remarkably good insulating properties. In the above notes karri and jarrah have largely been mentioned, inasmuch as they possess the requisite quality of all materials of construction, of hardness and resilience in a considerably marked degree. There is another western Australian hard wood called "Yate," which, perhaps, gives even greater intrinsic properties, but there appear to be commercial difficulties in using yate, so that the claim of karri and jarrah as the hardest commercial woods appears to be amply justified. The only non-Australian wood which possesses anything like their hardness is lignum vitæ, which is in extensive use for the bushing of propeller shafts and similar work. It would therefore seem that further extension of the use of hard woods in electrical engineering undertakings might be made along the lines indicated, more particularly in places abroad removed from direct communication with iron and steel mines, on account of the durability, insulating properties, and non-inflammability of these woods.

COAL CUTTING MACHINES

THE following table, compiled from material in the annual reports of His Majesty's Inspectors of Mines, and showing the proportions of electrical and compressed air coal cutting machinery in use in various districts, is given in the *Iron and Coal Trades Review* :—

District.	No. of machines at work.		Total machines.	Coal cut, tons.
	Electrical.	Compressed air.		
Cardiff	3	14	17	116,484
Durham	76	76	152	1,142,489
E. Scotland	166	91	257	2,628,969
Liverpool and N. Wales	11	118	129	874,865
Manchester and Ireland	11	67	78	258,950
Midlands	81	73	154	1,643,271
Newcastle	40	97	137	899,824
Southern	4	18	22	67,478
Stafford...	17	32	49	416,732
Swansea	6	5	11	49,076
W. Scotland... ...	114	91	205	1,746,049
Yorks. and Lancs.	114	168	282	3,032,837
Totals	643	850	1,493	12,887,054

The total number of machines shows an increase of 360 over the figure for the previous year, which is a larger increase than has taken place in any year.

Taking individually the dozen mine inspection districts into which the country is divided, we find that Yorkshire and Lincolnshire together preserve the pride of place as regards the number of machines employed and the quantity of coal cut by them, there having been an addition of 30 machines in 1907, as compared with 1906, when only five were introduced. Next come the collieries of East Scotland, where much development work is in progress, with 257 machines, or 81 more than last year, while West Scotland has brought its total up to 205, or an increase of 76. Durham and the Midlands are running a close race with 152 and 154 respectively, while the Newcastle district boasts 137, and Liverpool and North Wales 129. Ireland is credited with one machine, and Cardiff with only 17. Swansea has now 11 as against 4 last year; but the Inspector for the district expresses the opinion that it will be many years before machines make much headway there. As for the motive power employed, compressed air is still first favourite, driving 850 machines, while electricity is employed for 643. It is noteworthy, however, that while in the former case the increase on 1906 is 168, in the latter it is no less than 192, showing how rapidly electricity continues to come to the front.

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GLASGOW CORPORATION TRAMWAYS ACCOUNTS

THE fourteenth annual report of the Tramways Committee of the Corporation of Glasgow for the year ended May 31st, 1908, has just been issued. During the last twelve months, extensions amounting to one mile of double track have been added to the system, which, including leased lines, now comprises over 89 miles of route. The alterations to the Pinkston power-house buildings in connection with the extension of the switchboard have been completed, and one of the two new 3,000 kw turbo-generators is at present under construction.

The total number of cars in stock is 759. The stock of cars at May 31st, 1907, was 780, the old single-deck cars, numbering 21, having been written down to a nominal figure and taken out of this account. The Committee have decided to equip all the cars with side lifeguards. The average number of cars in use for a 14-hour day was 548, the average number of car miles per day 103·5, and the average speed 7·93 miles per hour.

The working expenses per car mile (including power works cost) amounted to 5·893d., or 55·6 per cent. of the total receipts. The following is an analysis of the working expenses and capital charges:—

ANALYSIS OF EXPENSES PER CAR MILE.

	Year ended May 31, 1907.	Year ended May 31, 1908.
Traffic expenses—	d.	d.
Salaries and wages and bonus ...	2·288	2·328
Cleaning cars and depot expenses...	0·328	0·341
Cleaning, salting, and sanding track	0·051	0·047
Ticket check	0·123	0·127
Uniforms	0·064	0·086
Miscellaneous	0·036	0·037
	2·890	2·966
General expenses—		
Salaries and wages	0·083	0·078
Rent, rates, and taxes	0·550	0·562
Insurance, law, and Parliamentary expenses	0·314	0·357
Miscellaneous	0·076	0·058
	1·023	1·055
Repairs and maintenance—		
Permanent way	0·752	0·662
Electrical equipment of line ...	0·090	0·108
Cars	0·280	0·344
Electrical equipment of cars ...	0·210	0·211
Buildings and miscellaneous ...	0·108	0·093
	1·440	1·418
Power expenses—		
Fuel	0·161	0·203
Oil waste, water and stores ...	0·024	0·025
Salaries and wages	0·108	0·117
Repairs and maintenance	0·076	0·086
Energy purchased	—	0·023
	0·369	0·454
Total costs, excluding capital charges	**5·721**	**5·893**
Rental of leased lines	0·117	0·114
Interest	0·752	0·614
Sinking fund	0·587	0·795
Income tax	0·117	0·109
Balance of Parliamentary expenses written off	0·082	0·033
Payment to "common good" fund...	0·413	0·405
Depreciation and permanent way renewals fund	1·986	2·180
Special depreciation fund	0·531	0·047
Total costs, including capital charges	**10·306**	**10·190**

The increase in the traffic as compared with the previous year can be seen from the following figures:—

	Year ended May 31, 1907.	Year ended May 31, 1908.
Miles open for traffic (single track)...	176·25	179
Car miles run	20,350,367	20,766,722
Passengers carried	224,063,098	226,948,290
Receipts per car mile...	10·465	10·488

Although the working expenses, excluding capital charges, are somewhat larger than those for the previous year, the smaller amount appropriated for the special depreciation fund causes the total costs per car-mile (including capital charges) to be less than for the previous year. During the previous year over one and a half million units of electrical energy were sold to the Corporation electricity department, whereas in the year under consideration, 496,700 units were bought from this department at the rate of 1d. per unit. This accounts for the figure of 0·023d. for energy purchased, which appears in the analysis under "Power expenses." The total working expenses amounted to £509,895, and the receipts from all sources reach the figure of £916,565 (including £6,247 for interest on surplus revenue). Of the balance thus given, £9,861 was required for rental of leased lines (Govan and Paisley districts); interest, sinking fund, and income tax absorbed £53,152, £68,804, and £9,436 respectively, and £2,884 was written off as balance of Parliamentary expenses. £35,000 was contributed to the Glasgow Corporation "common good" fund, £188,603 was transferred to depreciation and permanent way renewals fund, and £4,061 was appropriated for a "special" depreciation fund, so that finally a surplus of £34,869 remained, which was carried to reserve.

The following is an analysis of the net capital expenditure on the undertaking, as at May 31st, 1908, after deducting amounts set aside to meet renewals and depreciation:—

Permanent way	£994,570
Electrical equipment of line	656,449
Land	136,222
Buildings and fixtures	445,891
Power stations and sub-stations	390,668
Cars	263,629
Electrical equipment of cars	189,352
Miscellaneous...	68,795
	£3,145,576

The following table shows the amount of electrical energy generated at the power-station during the year, and also the various losses:—

Units generated in power station—	
(*a*) Alternating current (6,500 volts)	27,595,026
(*b*) Direct current (500 and 100 volts)	1,067,595
Total units generated	28,662,621
Purchased from Electricity Department (6,500 volts)	496,770
Total units dealt with	29,159,391
Used at power station	1,219,128
Total issued from power station to sub-stations	27,940,263
Used in sub-stations, depots, &c.	2,007,373
Total issued to sub-stations for traction load...	25,932,890
Lost in conversion and transmission	2,332,517
Total units issued from sub-station direct-current busbars for traction load	23,600,373

The number of units used per car mile were 1·25. The maximum load on the station was 8,528 kw., giving a load factor of 38·3 per cent. The coal consumed

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per kilowatt-hour generated was 2·97 lb. The generating costs per unit supplied are analysed in the table below for the year under consideration and the previous year. These figures are calculated on the number of units issued from the power station to the sub-station, exclusive (for the year 1907-8) of the amount supplied by the Electricity Department, namely, on 27,443,493 units.

	Year ended May 31, 1907.	Year ended May 31, 1908.
	d.	d.
Coal	0·130	0·163
Oil waste, water and stores	0·019	0·020
Salaries and wages	0·088	0·095
Repairs and maintenance—		
Generating station	0·034	0·025
Distributing system...	0·024	0·029
Total works cost	**0·295**	**0·332**
Proportion of rent, rates and taxes ...	0·043	0·044
,, general expenses ...	0·010	0·011
Total costs, excluding capital charges	**0·348**	**0·387**
Interest	0·309	0·206
Sinking fund	0·227	0·182
Depreciation	0 172	0·416
Total costs, including capital charges	**1·056**	**1·191**

ELECTRICAL WORK OF THE PHYSIKALISCH-TECHNISCHE REICHSANSTALT IN 1907

THE following particulars concerning the work of the German Physikalisch-Technische Reichsanstalt during 1907 have been taken from the annual report. In the Standards Department the variations in manganin resistances have been found to be very slight and the "humidity effect" only just perceptible. Resistance coils are now being wound on metallic spools with longitudinal slots to render them somewhat flexible; in this way it is hoped to make any effect due to humidity practically negligible. The size of the grains of mercurous sulphate used in the preparation of standard cells is believed to play an important part in the behaviour of their E.M.F. Further experiments are in progress to discover the cause of the initial variation of the cells. Measurements of the wave-length of electric oscillations can be made with an accuracy within 1 part in 1,000 for long waves (above 1,000 metres), and in the case of shorter wave lengths the accuracy is within 1 per cent. Apparatus is on order by which it is hoped to increase the accuracy of the measurements.

Other experiments have been made with undamped electric oscillations produced after the Poulsen method by means of an arc burning in oxygen, with which arrangement the constancy of the oscillations both in regard to their wave-length and intensity was increased. A lamp was first constructed in which the arc burned between a cooled outer cylinder of copper and the surface of a 20 mm. solid carbon rod. A magnetic field in the direction of the axis of the carbon was produced by a coil through which the lamp current passed. This magnetic field was adjustable in intensity, and as it kept the arc continually rotating it ensured the carbon burning away evenly. With this arrangement it was possible to obtain oscillations of great constancy for a long time. In regard to the analysis of electric vibrations, an A.C. oscillograph was constructed in the previous year on Gehreke's principle; this instrument is based on the property of the cathodic glow-light to cover a surface proportional to the current density. By using a rapidly rotating brilliant concave mirror, it was feasible to analyse electric vibrations down to 500 metres wave-length with the aid of this oscillograph. The damping and form of the vibrations, the vibrations in connected systems, the influence of the spark gap and undamped Poulsen vibrations could be demonstrated photographically or observed direct by the eye.

During the year a number of intermittent tests on dry cells (in these tests the circuit remained closed three minutes in each quarter of an hour, and the cells were discharged to the terminal voltage of 0·8 volt) were made in accordance with the procedure of the Testing Bureau of the Imperial Telegraphs, Berlin, at the desire of manufacturers. Moreover, for the information of the Reichsanstalt itself, five cells were discharged continuously through a resistance of 10 ohms, and five others intermittently through the same resistance, both sets of tests being made at terminal voltages of 0·8, 0·6, and 0·4 downwards. The tests showed that the current yielded by both sets of cells was 40 per cent., 10 per cent., and 5 per cent. greater with intermittent discharge than with continuous discharge, the discharge voltages being 0·8, 0·6, and 0·4 volts respectively. Researches were carried out bearing on the question of the influence of the chemical composition and thermal treatment on the magnetic properties of iron alloys and on the regularity of rolled material used in dynamo construction.

The ordinary routine tests were made on instruments, insulating materials, plant accessories, &c. The electric lamps tests were as follows:—460 carbon filament glow lamps (64 of these for life); 183 metallic filament lamps (Osram, Tungsten, and Osmin lamps), 106 of these being tested for life; 20 Nernst lamp filaments; six arc lamps with carbon electrodes; two mercury arc lamps with glass vessel. Tests were also made on one photometer head for equality and contrast. In regard to the glow lamps tested, a series of five 220-volt carbon filament lamps may be mentioned. These decreased 20 per cent. from their original candle-power value during an average life of 920 hours. The current consumption per one Hefner candle of mean c.p. vertical to the axis of the lamp rose from 3·8 to 4·9 watts.

For the various laboratories of the Reichsanstalt itself, 11 single resistances and four sets were tested, as well as four metal bars of copper and aluminium; silver and nickel wires were also tested for specific resistance and temperature coefficient. A number of Weston cells made by the European Weston Co. were also tested. In the Magnetic Laboratory a total of 129 tests were made on non-magnetic material (nickel-steel), cast-steel, cast-iron, magnet steel in bar form, horse-shoe magnets, dynamo sheets, &c. During the year thirteen systems of meters were tested as to type, and seven systems were submitted for verification. A number of the researches undertaken by the institution were not concluded when the report was compiled, and are being continued this year.

Institution of Mechanical Engineers.—The Summer meeting of the Institution of Mechanical Engineers was held at Bristol on Tuesday and Wednesday. There were no Papers of electrical interest.

£10,000 Telephone Claim.—A counterclaim by Col. Edward Gouraud, of Marine Parade, Brighton, for £10,000 damages against the National Telephone Co., was heard in the Brighton County Court last week. The counterclaim, which was made in an action by the National Telephone Co., against Col. Gouraud for £5 5s., proportion of telephone rentals, Post Office fees, and removal charges, was on the following grounds:—(*a*) neglect of duty; (*b*) breach of contract; (*c*) pecuniary loss; (*d*) injury to health; (*e*) prolonging an already long and critical illness; (*f*) increasing expense of doctors; (*g*) unwarrantable and illegal disconnection of exchange service; and (*h*) making statements prejudicial to the credit and honour of the defendant. The Colonel complained that his telephone service was practically useless, and that the instruments were obsolete. He had given orders for the instruments to be thrown out, but his instructions had not been obeyed. The Judge gave verdict for the company, and struck out the counterclaim.

Tantalum Lamps on Alternating Circuits.—Some sketches showing the peculiar effect of alternating currents on tantalum filaments as viewed in the microscope are published in the *Electrical World* (New York). The tests in question are by Mr. M. D. Abbot, of Nebraska, and include observations on the effect of continuous and intermittent, as well as alternating, currents. The effects are very similar to those shown in the micro-photographs given in ELECTRICAL ENGINEERING, Vol. I., pages 109 and 153. Observations were also made of the alteration of tensile strength with life. The lamps used in these tests were of American make, rated at 20 c.p. and 110 volts. The measured diameter of the filament was 0·0017 in., with a tensile strength as obtained from tests made on two samples of 225,000 lb. per square inch, being thus much stronger than steel. The colour was steel grey, with a metallic lustre. The lamps were suspended from coil springs placed between two supports, and connected, two in series, to 220-volt mains. The tensile strength of one of the filaments tested under direct current was found to be greatly reduced at the end of the run of 148 hours, and varied from 30,000 lb. to 60,000 lb. per square inch. The colour had changed from a silver grey to a dull black, and slight depressions of creases were noticeable. The filament became brittle, but remained strong enough to withstand a moderate jar or shock. The colour after the run was very glossy black. The results of the tests on alternating current show the characteristic breaking up into short lengths. The effects of intermittent currents appear very similar, except that the colour of the filament after the run is described is a dull black instead of a glossy black.

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THE "G.B." SURFACE CONTACT SYSTEM

THE Highways Committee of the London County Council has presented a report dealing with the withdrawal of the cars upon the "G.B." surface contact system from Aldgate to Bow. The report recalls the fact that the Council on July 23rd, 1907, decided to reconstruct the horse tramways between Commercial Street, Aldgate, and Bow Bridge, via Whitechapel High Street, Mile End Road, and Bow Road, on the "G.B." surface contact system of electric traction. On the same date the Council approved an estimate of £72,210 for the execution of the work, including the payment of a sum of £500 a mile single line as royalties, if the Council did not decide to discontinue the use of the system. On July 7th, 1908, the reconstruction of this length of tramway had been completed and the lines inspected on behalf of the Board of Trade, and the Board granted a certificate for the working of the line for a period of six months. Electric car services were instituted on the tramways on June 25th, 1908. At the outset it was only found practicable to place three cars on the tramways. The report continues :—

We now regret to have to report that the results obtained from the working of the lines are such as to show that it will not be practicable to continue the use of the system consistently with the safety of the public using the roads, and the efficient working of the tramways under the circumstances prevailing on this route. Arrangements have been made, therefore, pending our submission of the facts to the Council, for the electric cars to be withdrawn. The agreement which was entered into with the G.B. Surface Contact Co. with reference to the matter provided that, if at any time after the opening of the tramways the Council decided to remove or cease to use the system, or to substitute some other system, the company should not be in a position to claim the royalty which would otherwise be due to it under the agreement. Having given the most anxious consideration to the matter, we have reluctantly arrived at the conclusion that it is our duty to advise the Council in all the circumstances to discontinue the use of the system on these tramways. We informed the G.B. Surface Contact Co. of our decision to withdraw the electric cars, and we have since received from the company a letter making certain suggestions with a view to the running of the electric cars and the working of the tramways being continued on the surface contact system of electric traction. After carefully considering the matter, however, we do not see our way to recommend the Council to take any action with regard to these proposals, and the company will be informed accordingly.

We have very carefully considered what action should be taken by the Council in the event of it adopting our recommendation in the matter. It will be remembered that it was originally intended to construct the portion of the route between the county boundary at Bow Bridge and Cambridge Road (four miles single lines) for overhead traction, and the remainder of the route, from Cambridge Road to Aldgate (one and a half miles single line) on the conduit system. This decision was mainly arrived at because of the engineering difficulties which presented themselves to the adoption of the conduit system throughout, owing to the small amount of cover between the station roofs of the Whitechapel and Bow Railway, which runs underneath the route of the Aldgate to Bow lines, and the surface of the carriageway, the officers having reported that exceptionally heavy expenditure, would have to be incurred if the conduit system were installed at this section. Moreover, such a step would entail a serious hardship upon the residents and tradespeople in the roads traversed by the tramways, owing to the necessity for again taking up the lines, and the consequent dislocation of traffic. We have considered what course can be best adopted both to minimise the loss resulting from the termination of the experiment and to secure with as little delay as possible the extension to this important route of the advantages of electric traction. As the result we have decided to suggest to the Council that steps should be taken to equip the lines for the overhead trolley system of electric traction.

The trackwork and cables will serve, almost without alteration, for the working of the lines for overhead traction, and practically the only additional works necessary will be the provision of the overhead equipment, posts, and trolley wires. This work would only occupy a very short time, and would interfere but little with the use of the carriageway for general traffic; moreover, the tramway service could be maintained in the meantime with horse cars. Through services were originally run on this route from Aldgate to Stratford. After the electrification, however, by the West Ham Corporation, on the overhead system, of its lines up to the county boundary at Bow Bridge, the Council's cars were stopped at that point, and passengers desiring to travel from London to Stratford, and *vice versa*, have now to change cars at the boundary. In addition to the lines of the West Ham Corporation, the tramways of the Leyton Urban District Council are worked on the overhead system. These two undertakings are connected with each other, and together comprise a considerable mileage. Other lines outside London in close association with these systems are also constructed and working for overhead traction. These facts appear to us to furnish an additional reason of considerable weight for adopting the course we recommend, as the running of through cars, if practicable, in close connection with, or over these outside lines, would be of great advantage to the large number of persons who wish to travel between the several districts affected. In this connection we may add that when it was proposed to enter into the arrangements referred to above with the West Ham Corporation for them to work the tramways between Bow Bridge and Coburn Road as part of their system, and for the Council to reconstruct that section for overhead traction, the cars for this route were equipped for running in this manner, and the only work which remains to be done to fit the cars for immediate service, is the fixing of the trolley bases and booms. The approximate cost of the trackwork for G.B. surface contact system has been £62,500, and it is calculated that the additional expenditure necessary to adapt lines for overhead traction would be £6,000 for overhead work, &c. (including car equipment), and £2,000 for reinstatement of road surface, &c.

The committee further remark that it is difficult to state with accuracy the additional expenditure which would be necessary if the conduit system were now installed, but from such information as is available at present, they are informed that this would certainly be not less than from £60,000 to £70,000 for roadwork and platelaying alone, and would probably exceed this amount, while the disturbance of the road surface would be necessitated a second time.

The committee express the hope that on consideration of all the facts the two borough councils concerned will see their way to co-operate with the Council in carrying out the arrangements suggested.

In connection with the above the "G.B." Surface Contact Co. had sent the following communication to the members of the London County Council :—

We see from the reports of the Council's meeting held on Tuesday last, that it was decided to abandon the surface contact system on the above route. You will readily recognise that this decision greatly prejudices us as the owners of the patents of the G.B. system. This system has been working at Lincoln since November 23rd, 1905, at a less cost than most overhead systems in this country, and has given entire satisfaction to the Corporation, its officials, and the public, without a single instance of any man or beast having had a shock. The extraordinary contrast between these results and the deplorable state of affairs in the Bow Road is too great to be explained away, by a casual reference to London traffic and London mud, neither of which is the real cause of failure. We therefore think it right in the interests of everyone to lay before you the facts which have led up to the present situation. When the adoption of the system was first under consideration, we were asked to quote for the supply and complete construction of lines equipped with our system, and we accordingly submitted a tender. We were later told that a monetary guarantee must be given equal to the cost of the electrical equipment of the track. This sum was to be retained by the Council for one year, and was only to be paid to us if they were satisfied with the working of the system, and we accepted this proposal. The Council's officials, however, were unwilling to approve the contractors for the road work nominated by us, and the contractors nominated by the officials refused to carry out the work on the basis of the guarantee above-mentioned as required by the Council. As a result of this deadlock, the Council proposed that we should grant a licence, to which course we agreed, and quoted a sum per mile for patent royalties and technical advice during construction. The Council stated that such technical advice was not required, as their technical staff was fully competent to design and superintend the laying of the system, and we therefore agreed to accept a considerably lower sum per mile for royalty. The terms of the licence granted to the Council expressly stipulated our right to reject all material and workmanship to which we could take reasonable objection. Such reasonable objection has been repeatedly made by us in writing to the Council's officials, and so seriously did we regard the deviations that on May 30th, 1908, we wrote, through our solicitors, to the Council that we strongly objected to the Board of Trade inspection being held until our requirements had been complied with. This warning was disregarded with the results that we knew to be inevitable. We now emphaticaly affirm that there is no condition prevailing in the Bow Road which militates against the perfectly satisfactory and safe working of the system, provided that the equipment both in the road and on the cars is properly made and fixed. Without proper manufacture and fixing, tramway apparatus, whether on the G.B. surface contact system or any other, overhead or otherwise, must inevitably cause trouble and danger. So entire is our confidence in the system when properly laid and equipped that we have written to the Clerk to the Council as follows :—

"We learn to-day that your Council have decided to abandon their experiments on the above tramway route. We do not recognise this as an unfavourable verdict on the "G.B." system

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of electric traction, for the reason that the above tramways are not in accordance with our designs, which fact we have repeatedly pointed out. Our confidence in the ability of our system to deal successfully with London conditions leads us to make you the following offer. We will agree at our own expense to put the electrical equipment of the track in an efficient state and maintain the same in that state for a period of twelve months, provided that the Council will equip the cars in accordance with our designs. The supervision of which equipment we will also agree to undertake at our own cost. If at the end of twelve months the Council continue to use the system, but not otherwise, they shall repay us the sums of money we shall have thereby expended, but in no case to exceed £2,500. This offer is, of course, made without prejudice to our rights should the Council not see their way to accept it, but because we have been very materially injured by the course that events have taken, we hope that the Council will, in common fairness, give it favourable consideration."

In conclusion, we fully recognise that a prevalence of live studs constitutes, occasionally a danger and always an extreme inconvenience which would make the system impossible if such a state of things persisted. There has been no possibility of avoiding live studs with the apparatus in the absolutely unsatisfactory condition which prevailed during the short period during which cars were running. That unsatisfactory conditon is due to the total disregard of the advice and instructions from us, the patentees of the system. We therefore trust you will support the suggestion contained in our letter set out above. If we fail to put the system in order we lose the money we expend in correcting the existing defects. If we succeed the ratepayers of London save a sum which has been variously estimated at sums up to £50,000.

Notice of a motion has been given that when the report comes on for consideration, the Highways Committee should prepare an estimate of the cost of reconstructing the lines upon the conduit system.

An interesting sequel to the above report is a report by the Works Committee of the Stepney Borough Council, in which the Borough Council is recommended to decline to give its consent to the use of the overhead system. It is argued that the conduit system is quite feasible, and that expert evidence can be called to this effect.

THE ELECTRIFICATION OF THE SWEDISH STATE RAILWAYS

Results of Experimental Work

THE experiments in connection with the proposed electrification of the main line railways of Sweden, which have been carried out in the neighbourhood of Stockholm by the State Railway Authorities, were concluded in the early part of the year, and the results of these experiments are embodied in a report by the Chief Engineer, Herr R. Dahlander. The railway authorities have laid the report before the Swedish Parliament, and have expressed their intention of submitting the results of their calculations, with regard to the economy to be obtained by substituting electric traction for steam traction, at the end of this year, together with proposals for commencing the work of electrification on a large scale. The advantages of the single-phase system over the three-phase system with respect to the overhead equipment in particular, were considered sufficient to warrant experiments being carried out with the single-phase system only. Under the conditions prevailing in Sweden the cost of the overhead equipment must play an important part in deciding the system, and it was estimated that a 10,000 or 15,000-volt single-phase system would cost less than a 3,000- or 5,000-volt three-phase system.

Various methods of suspending the contact wire were tried, the most satisfactory being apparently the simple method of fixing the contact wire direct on to a swinging bracket without either suspension or cross wires. It was found necessary, even with catenary suspension, to put the contact wire under a certain amount of tension to ensure satisfactory current collection, and owing to the wide variations in temperature the method adopted on the Hamburg-Altona line of putting the wire under a constant tension by means of a hanging weight was resorted to. A constant tension of about 8 kg. per sq. mm. was employed. The well-known Oerlikon method of suspension was also used on one portion of the line. For section insulation the arrangement of parallel or crossed wires with air insulation was found to be more satisfactory than porcelain section insulators, partly on account of the weight of the latter, but chiefly due to the reduction of the insulating property of the porcelain by smoke and dirt. The brown porcelain insulators were provided with iron pins which were cemented into the insulator with a cement composed of 15 to 17 per cent. water-free glycerine and 83 to 85 per cent. litharge. It was noticed that insulators in contact with the live wires kept themselves free from soot, which was thickly deposited on other insulators. The current collector used in the Oerlikon system was found to wear quickly in spite of the low pressure of 0·7 kg., and this system was considered dangerous for use in stations as the contact wire must be suspended only just above the locomotive in the centre of the track when in stations. As the speed of the trains was limited, on account of the nature of the track, to 70 km. per hour, no experiments at high speeds could be carried out.

Extensive investigations were made in connection with the use of the rails as a return conductor. These showed that a large portion of the current was carried by the earth, this amounting, in some cases when the earth was moist, to as much as 70 to 80 per cent. A difference of phase existed between earth and rail currents, the measured power factor for the rails being in a few cases as low as 0·3. An attempt to increase the earth-current, by means of artificially earthing the rails, failed completely. A number of tests showed that at 25 cycles with a rail weighing 49·5 kg. per m., the rail resistance without copper-bonding, amounted to 0·1 to 0·2 ohm per kilometer of line, the resistance varying with the moisture of the ground. The reactance per kilometer was found to be expressed by the following empirical formula :—

$$\text{Reactance per km.} = 0{\cdot}12 + 4\pi f 10^{-4} \ln\left(\frac{d}{n}\right).$$

where f is the frequency of the current, d the distance between contact wire and rails, and n the distance between the rails. The telegraph and telephone lines adjacent to the track were not seriously affected, chiefly owing to the short length of track. In one case, however, a particularly well insulated telephone line was charged to a potential of 5,000 volts when using a contact-wire pressure of 20,000 volts. This static charge was easily avoided by connecting discharging coils between the lines and earth.

The rolling-stock used for the experiments consisted of a 300 h.p. Westinghouse locomotive, a 300 h.p. Siemens-Schuckertwerke locomotive, two motor-cars each of 230 h.p. supplied by the Allgemeine Elektricitäts Ges., and two trailers. Each locomotive or motor-car has run more than 10,000 km. in the course of the experiments, and the electrical equipment has given every satisfaction. No trouble was experienced with the commutators of the single-phase motors. The forced lubrication of the A.E.G. motors effected a considerable saving in oil. It was conclusively proved that forced ventilation was very effectual in increasing the capacity of the motors and keeping the temperature low. The cable method of leading in the high-tension current was found unsatisfactory at high pressures, and a bare wire passing through the open window or through a porcelain collar was resorted to. The energy consumption varied between 13·9 watt-hours per ton kilometer for a 265 ton train and a speed of 51·4 km. per hour to 19·8 watt-hours per ton kilometer for a 144·5 ton train and a speed of 48·2 km. per hour. These values may be taken as values for a level track, as the short up-gradients on the experimental track were compensated for by corresponding short down-gradients. The momentum gained on the latter served in most cases to overcome the extra resistance due to the former. Experiments were also made in order to determine the relative costs of electric and steam car-heating. The consumption of an electrically-heated passenger car was found to be from 0·2 to 0·3 kw. per degree centigrade difference between inner and outer temperatures. In order to compete with steam heating, the price of electrical energy would have to be at most 0·5 pence per unit. With regard to the most favourable frequency of the single-phase current, the opinion is expressed in the report that a lower frequency than 25 cycles would have more disadvantages than advantages, even considering the possible better working of the motors. The frequency for which the plant was designed, namely, 25 cycles, would seem to be the best.

In conclusion, the report states that the experiments have shown that the single-phase system can be considered as the simplest, cheapest, and most satisfactory system for main line working, and that there is little chance of a better system being devised in the near future. The immediate commencement of the electrical equipment of the main lines and the utilisation of the country's water-power for supplying the energy are recommended. The track on which the experiments were made comprised a 6 km. stretch between Tomteboda and Värtan, and a 7 km. stretch between Stockholm and Järfva. The electric trains have now been temporarily replaced by steam-driven trains, which will continue the service until electrical energy can be obtained from a water-power station. During the experiments current was supplied from a steam-driven power-station. The electrical equipment of the track between Järfva and Värtan is, however, kept ready for use for demonstration purposes. At present the authorities are engaged with the design of the equipment for the main lines.

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TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION

Adjourned Discussion to Prof. Carus-Wilson's Lecture on Rail Corrugation

ON Friday last a meeting of the Tramways and Light Railways Association was held for the purpose of further discussing the lecture on "Rail Corrugation," delivered at the last meeting of the Annual Congress on Friday, July 10th, by Prof. C. A. Carus-Wilson. An abstract of the lecture and of the ensuing discussion was given on page 107 of ELECTRICAL ENGINEERING for July 16th. It will be remembered that the lecturer stated that in his opinion corrugation was due primarily to the wheels running on unequal diameters, this causing skidding of the smaller wheel. This skidding, if grit was present on the rail, became intermittent, the period between the skids depending on the limiting twist of the axle.

At the meeting on Friday last the chair was taken by Mr. STEPHEN SELLON.

MR. H. M. SAYERS, who opened the discussion, referred to the Paper on "Rail Corrugation" read before the Institution of Electrical Engineers in March, 1907, by Mr. J. A. Panton. The author of that Paper had concluded that corrugation was caused by defective rolling-stock, and particularly by flange action as the result of skewed axles. In the discussion to that Paper (see ELECTRICAL ENGINEERING, Vol. I., p. 549), Prof. Carus-Wilson had shown himself rather sceptical of these conclusions, and had pointed out that Mr. Panton had not traced the connection between flange action and corrugation. Now, however, the professor had come to very much the same conclusions himself, but had gone one better in that he had given them a definite cause for rail corrugation. Continuing, Mr. Sayers said that he would like to remind the Association that the influence of the torsional vibration of the axle had previously been considered by Mr. T. W. Arnall, Surveyor to the City of Birmingham, in an article published in the *Tramway and Railway World* in 1906. With regard to the alternate skid and roll, suggested by the lecturer as being the cause of corrugation, he thought that alternate *slip* and roll would have the same effect. This latter would take place when the cars were accelerating, and particularly when the motor connections were being changed from series to parallel. On moving the controller to the next higher speed notch, or, say, two or three notches without pausing, the armature torque might suddenly exceed the adhesion value, and the wheel would slip and the motor speed up until the motor couple fell again below the value of the resistance couple due to the sliding friction. In this way, alternate slipping and rolling would be produced. That there might be such a connection between the characteristics of the series motor and rail corrugation had been pointed out recently by M. Lassalle, of Liége (see ELECTRICAL ENGINEERING, July 23rd, page 132). He hoped that Prof. Carus-Wilson would give his views on this point in his reply to the discussion. Alternate skidding and rolling might also take place during braking. There were two points not quite clear to him, and those were: (1) Why was sand a necessary accomplice, and (2) How was it possible that successive cars could produce a combined action on the rails? Some periodic photographs were being taken in London of certain marked portions of corrugated rail, and these, he hoped, would help to solve the problem. In conclusion, he would like to point out that there was not only a grinding action, as evidenced by the hollows, but there was also a cold rolling effect, as the high parts of the rail were rolled up and out into the groove.

MR. J. R. SALTER (Lancashire United Tramways, Ltd.) thought that the chances were very remote that the four conditions mentioned by the lecturer would exist simultaneously. He suggested that the skidding of the wheels in the case of the car experimented with at Croydon was due to the corrugated rails rather than the corrugations due to the skidding. To the many suggested causes for corrugation, he would like to add another, and that was the possible effect of the magnetism of the iron rails due to the unequal distribution of current in the rails. Magnetisation of iron produced a molecular change and an extension in length, and these might have some influence. Owing to the inconsistency in the pitch and the appearance of corrugations, he thought it was necessary to look somewhat further for the cause of corrugation than had been done at present.

MR. J. S. WARNER emphasised the fact that tramway conditions were different to ordinary railway conditions on account of the absence of the check in the latter case. With regard to the oscillations of the wheels, which, the lecturer had shown occurred under certain conditions, he could understand that such oscillations of the wheel on the "free" side might take place, but thought that the friction against the check would prevent the other wheel from oscillating. In any case, he thought the oscillations would be considerably damped by the action of the weight on the wheels. Of the four conditions given by the lecturer as being necessary for the production of corrugations, he thought that one only might be avoided, namely, the presence of a bad wheel section causing check-cutting. To prevent such excessive and irregular wear of the wheels, it was necessary to ensure a uniform flange pressure on either rail which should not become excessive even on an irregular track. The ordinary parallel-axle track did not allow of such uniform pressure, but if a truck construction, permitting of relative angular movement of the two axles (such as the Warner flexible four-wheel truck described in ELECTRICAL ENGINEERING, Vol. III., page 88) were adopted, it would be quite possible. Indeed, the flange pressure and wear was so much reduced with such an arrangement that only half the standard thickness of flange was really necessary.

MR. STEPHEN SELLON said that the tyre section shown in Fig. 2 of Prof. Carus-Wilson's Paper (see ELECTRICAL ENGINEERING, July 16th, page 107) represented an impossible state of affairs. Although it might be possible for a tyre to get in that condition, it would be scrapped long before it could reach that state on a well-managed line. The lecturer had said that the check-cutting which would occur with such a tyre section would produce the alternate skid and roll and the consequent corrugation on the other rail, but he would like to point out that before such check-cutting could take place, the flange of the outer wheel would be grinding on the head of the other rail, and surely that also would produce corrugation. The tyre and the rail section shown by the lecturer were reproduced in Fig. 2 (see below), and to that he had added a rough drawing of the other rail and the other tyre in order to show that before check-cutting could take place, the flange of the other wheel must have ground away a considerable amount of the head of the other rail. Thus Fig. 1 represented the condition of the rail and tyre of the left-hand wheel if

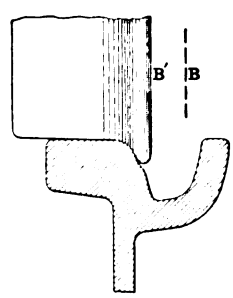

FIG. 1.—LEFT-HAND WHEEL.

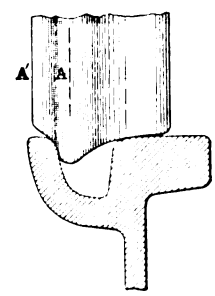

FIG. 2.—RIGHT-HAND WHEEL.

the check-cutting always took place on the right-hand wheel. He, as well as Mr. Sayers, did not quite see why successive cars should act synchronously in producing the corrugations, although running at different speeds. With regard to the ¼-in. clearance between flange and check for a new tyre, he thought it was nearer 1 in. As he had often said, corrugation was due, in his opinion, to the use of rigid road-beds, particularly to the extremely rigid bed laid down by municipal authorities. There had been many examples of steam tramcar lines on which the conditions mentioned by the lecturer existed; the same wear of the check had been noticed, but there had been no corrugation. He had known of curves on which one rail only was a grooved rail, the wheel running on the flat rail on its flange, and yet there was no corrugation. In his opinion it was not essential that the two wheels should be of unequal diameter in order that a torsional effect should be produced. The friction and grinding would produce this effect with equal diameters.

MR. JOHN WELLING (Track Superintendent, L.C.C. Tram-

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ways) announced that Mr. Ireland (Rolling Stock Superintendent, L.C.C. Tramways) had intended to contribute some remarks concerning the coning of wheel-tyres and rails, but as he was unable to be present, he would send in his remarks as a written communication. With respect to the occurrence of corrugations on rails other than electric tramway rails, he (Mr. Welling) had investigated some corrugations which appeared on the Brixton Cable Tramway lines in 1897. The pitch of the corrugations was smaller than that usual on the present lines, but this was well accounted for, according to Prof. Carus-Wilson's theory, by the fact that the speed was only eight miles per hour. The corrugations occurred chiefly on curves.

Prof. C. A. CARUS-WILSON, in reply to Mr. Darymple's remarks (see report of discussion at the Franco-British Exhibition meeting, ELECTRICAL ENGINEERING, July 16th, page 107), said that before a remedy could be found for corrugation, it was necessary that the causes should be made clear. He thought it would be rather rash to adopt Mr. Gibson's proposal and fit all cars with differential drive. It would be advisable to know more about the matter before going to such an expense. With respect to his attitude in the discussion to Mr. Panton's Paper referred to by Mr. Sayers, he then only repudiated the statement that skewed axles were the one and only cause of corrugation. The same cutting of the tyre could take place with an absolutely square truck, and eventually cause corrugation. In answer to Mr. Sayers' question about the necessity of the presence of sand on the rail, he could only repeat his own view that sand became ingrained into the surface of the rail, thus causing a considerable increase in the coefficient of friction between wheel and rail. When this surface was cut through by the wheel, the coefficient dropped suddenly; it was not the drop due to a change from static to rolling friction, but that due to the nature of the surface. Sand lying on the rail had no effect; it was the particles of grit which had been worked into the surface of the rail. With regard to the synchronous action of successive cars, he thought that was accounted for by the fact that an axle in a state of torsional stress would tend to recover itself at the first hollow it came to, and that would tend to cause the wheels to oscillate synchronously with the existing corrugations. To show how the oscillations were governed by irregularities of the rail surface, he had made the following experiment: A portion of corrugated rail was ground smooth, and slanting chisel marks made on the surface at regular intervals. The cuts became filled with grit, and this so increased the friction that the wheels would not slip or skid when in contact with the cuts, but only during the period between the cuts. In this way the pitch of the corrugations was determined by the chisel cuts. In reply to Mr. Salter, Prof. Carus-Wilson pointed out that the conditions mentioned were all normal conditions, and that consequently the chances of their existing simultaneously were by no means so remote. The molecular changes in iron, consequent upon magnetisation, were so infinitesimal that they could, in his opinion, have no influence. The damping effect of the weight on the wheels, mentioned by Mr. Warner, was certainly present. The weight on the wheels determined the rate of skidding, but did not prevent the rhythmic oscillations. A thick flange could not be avoided unless equal wear on both sides of the truck was ensured. In reply to Mr. Sellon, Prof. Carus-Wilson stated that the tyre and rail sections illustrated in Fig. 2 were drawn from an actual case. With regard to Mr. Sellon's suggestion that grinding between the throat of the flange and the head of the one rail would occur before check-cutting on the other rail, he fully agreed that that must be so, but pointed out that when the side pressure is thus taken by the throat of the flange bearing against the head of the rail, the line of contact is only slightly below the tread of the wheel, and under those conditions the skid is small, not exceeding 1 or 1½ per cent. This small skid would be insufficient to produce the intermittent skid caused by the 3 or 4 per cent. or more skidding consequent upon the check-cutting action. In answer to the question as to the effect of speed, he thought that, if the speeds of successive cars were very different, there would be no corrugation. In reply to Mr. Sellon's statement about steam tram-lines, he had known cases in which corrugation had occurred, but it had never been serious. As to the curves with flat rails, he could not explain the absence of corrugation without knowing all the conditions.

In a written communication, Mr. J. A. PANTON stated that on a certain curve he knew of, the head of the outer rail was half cut away, and yet there were no signs of corrugation. He suggested that wheels and axles should be rigidly fixed in their correct positions, so as to prevent askew running. He did not think that the presence of grit was essential, as corrugations were appearing on the rails of the Underground District Railway, which were highly polished.

REVIEWS OF BOOKS

Lead Refining by Electrolysis. By A. G. Betts. 383 pp. 5½ in. by 9 in. 74 illustrations. (London: Chapman & Hall.) 17s. net.

Only a few years ago it would have been out of the question to write a book of 394 pages upon the subject of the electrolytic refining of lead, for the very good reason that there was no such process. It has been known for a great number of years that lead can be deposited from both acid and alkaline solutions in the metallic condition, but the deposits obtained were of a leafy and crystalline structure, and refused to adhere to the cathode in a dense and coherent form. Therefore all processes which had been tried in the laboratory were found to be unsuccessful for the production of lead upon a commercial scale. Among them may be mentioned Keith's process, developed as early as 1878, in which an electrolyte containing sodium acetate and lead sulphate was employed. The anodes were wrapped in muslin in order to hold back the slimes and thus prevent them from falling to the bottom of the bath and contaminating the lead crystals which fell from the cathode.

A plant of sufficient size to deal with three tons of lead was actually fitted up at Rome, New York. Then there was the process of Ashcroft and Borchers, in which a fused electrolyte was employed. The only really satisfactory commercial project which has been successful upon a commercial scale is that of Anson G. Betts, the author of the book, and, as might be expected, the bulk of the work is devoted to this process. There is not the least doubt but that this work will be of the greatest value to all who wish to read up about electrolytic lead refining or wish to experiment commercially; though, of course, one has to bear in mind that all the methods are covered by patents.

Betts, in his original experiments, studied the known methods of deposition, and found, as others had done, that it was not practicable upon a large scale to produce deposits of any thickness. He then tried various salts of lead and inorganic acids and lead and organic acids. But except in the case of certain organic complexes, the results were not satisfactory. On further experimenting, he found that the addition of one part of gelatine to 5,000 parts of a solution of lead fluosilicate yielded surprisingly fine adherent and compact deposits of lead, which had practically the same specific gravity as ordinary fine lead. Gelatine, however, is not of value with all acids; for example, in acetate solutions it appears to have no effective working.

To go right through the book and pick out all its important facts would exceed the space at our disposal; we will, therefore, only draw attention to a few points picked out haphazard. Thus an interesting section is devoted to refinery construction, operation, and refining costs. Useful blocks are given showing the anodes as cast in the anode mould, the arrangement of the baths, and of the electrodes in the baths. The first appendix includes some interesting photographic blocks of the plant at Trail, British Columbia, and the third appendix deals with the treatment of lead refining slime with ferric fluosilicate and hydrofluoric acid.

The book is to be most heartily recommended to all who are interested in electrochemical progress, particularly, of course, any who are interested in lead refining.

Die Revision elektrischer Starkstromanlagen. By Paul Stern 251 pp. 4½ in. by 6½ in. Eight illustrations. (Hanover: Dr. Max Jänecke.) 3.60 marks.

THIS book is intended for the use of insurance, police, factory, and other inspectors, whose work includes the examination of electrical plant and installations with respect to safety, economy, and reliability of working. A general review of the various kinds of inspection, and a list of the most important public and private institutions, followed by a general description of the method to be employed in making an inspection and drawing up a report, are given in the first part of the book. The second part deals with accidents due to electrical causes, and particularly the effect of electric shock on the human body. Statistics of accidents in Germany and Switzerland are given, as well as instructions for first aid. Part three gives particulars of the various sorts of disturbances or damage which can be caused by electrical installations, and fires traceable to the effect of the electric current are dealt with very thoroughly. The remaining section of the book contains a list of the various laws and regulations holding in Germany, and finally a very complete collection of abstracts and extracts from the more important of these. This section occupies over half the number of pages of the book, and should be of great use to inspectors practising in Germany, although, of course, of less value to the English reader.

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THE NATIONAL TELEPHONE CO.'S REPAIR FACTORY

ON the occasion of a recent visit to Nottingham we were courteously invited to inspect the repair factory of the National Telephone Co. in that city, and

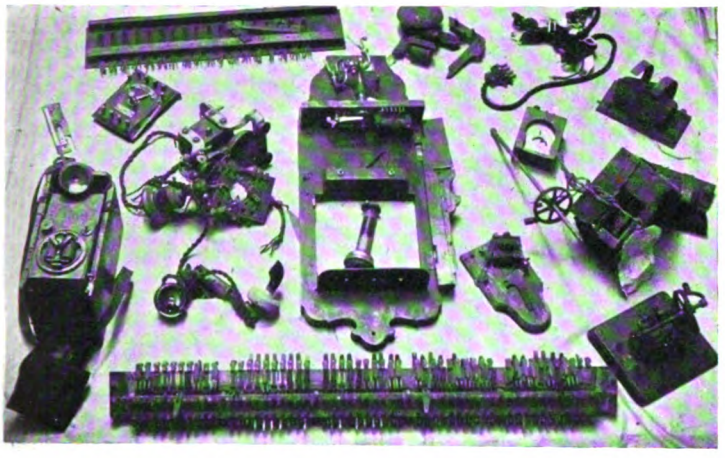

FIG. 1.—SOME "CONDEMNED" INSTRUMENTS.

by the courtesy of Mr. S. J. Goddard we are enabled to publish a brief description of the factory and of the work which is being carried out there. We must also express our indebtedness to Mr. C. E. Fenton, the Factory Manager, for supplying us with all the information contained in this article, and to the Editor of the *National Telephone Journal* for the loan of the blocks used as illustrations, and permission to make extracts from an article by Mr. Fenton in the *Journal*.

Repair work that necessitates the instruments being removed from the subscribers' premises and being overhauled is carried out at the factory, and an average of over 70 tons weight is dealt with every month. Some of those received are in the condition indicated in Fig. 1, and are "condemned," but even these are carefully broken up, and all useful parts are systematically recovered, while the scrap is sorted out so that it may be disposed of to best advantage. The greater part, however, including practically all the instruments of standard type, are renovated in the manner which will be described.

FIG. 2.—A CORNER OF THE POLISHING SHOP.

The instruments after inspection are sorted out into the various patterns, and placed upon racks in warehouses on the ground floor, which occupy a space of about 12,000 sq. ft. They are then taken in hand in large batches as required; a usual number to be dealt with at a time is 100. No attempt is made to examine individual instruments for faults and to repair them in the customary acceptance of the term; the apparatus is taken to pieces absolutely, each part is cleaned and polished, worn out parts are discarded, and the whole instrument is made up afresh. In fact, the instruments which leave the factory are to all intents and purposes new. There is no doubt that this system is the most satisfactory one for dealing with repairs "in bulk." The constituent parts of the instrument are distributed to the various departments, and only come together again in the assembling shop. The backs and other wooden parts of the sets are dealt with in the cabinet department, a considerable portion of which is devoted to French polishing. In another shop, a couple of men will be seen engaged on examining and straightening the cradles of switchhooks. The re-winding of coils occupies another shop, and so on.

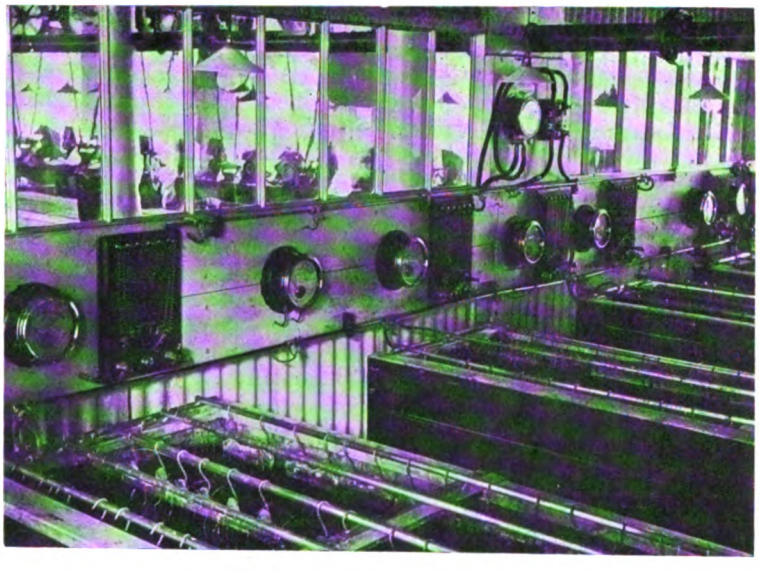

FIG. 3.—NICKELLING VATS.

One of the busiest departments is that devoted to metal polishing. The aluminium parts, such as cases of hand-sets, are scratch-brushed (which produces a matt finish) and afterwards lacquered. The nickel-plated parts have first to be stripped of the old nickel by dipping in *aqua fortis*; they are then polished before nickelling, and again after nickelling (this second polishing is called "colouring off"). It is thus seen that the proportion of polishing work on each instrument is large; some 42,000 parts and 250 gross screws are dealt with each week. Fig. 2 is a view of one corner of the polishing shop. It consists of rows of belt-driven spindles, seventeen double spindles in all, to which mops are attached, and these revolve at a high speed in front of hoods connected by galvanised iron pipes to exhaust fans, which convey the dust to a settling tank outside the building. An interesting feature of this shop is the headgear of the operatives. The cap shown in the illustration fulfils

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two functions: it keeps the wearer's hair more or less free from dust, but its most important use is to prevent the hair from straggling out, being caught in the air draught, and catching in the revolving brushes. A mixture of beeswax and tallow known as "Tripoli" composition is used on the mops. After the first polishing, the brass parts are wired up and suspended for a few minutes in an electro cleaning bath, which removes the grease. They are then placed in a plating vat until they have received a sufficient deposit of nickel. A view of the four nickelling vats is seen in Fig. 3, and in this shop are also a coppering vat, the cyanide bath, hot potash tanks, hot and cold water tanks, also an electro cleaning bath.

Lacquering is done in a separate shop, together with enamelling. The aluminium cases are coated with a transparent lacquer after they have been matt finished.

The coil-winding department is equipped with 16 winding heads, 13 of which are power driven, and the remaining three, reserved for delicate work, are hand-driven. The activity of this shop is largely dependent on the frequency of thunderstorms.

Switchboards, wall-sets, table-sets, and "sundry" instruments are all repaired and assembled in separate shops, and another large shop (Fig. 4), 110 ft. long, is set aside for the making up of switchboard cable. Separate benches are provided for measuring off, lacing, soldering, and examination. Girls are employed chiefly in this department, but the compression of the cable butts in a machine vice of special construction is done by men.

In dealing with the woodwork, the old polish is completely stripped off, and bruises are taken out by means of sandpaper discs running at a high speed, after which the work is French polished just as new wood would be. Fig. 5 is the shop in which the latter operation is carried out.

Before concluding this article, reference must be made to the bonus system employed at the factory,

FIG. 4.—CABLE SHOP.

which is calculated to increase considerably the industry of each operative. The workers are paid by time, and not by piece work, but for all output beyond a certain fixed minimum a bonus is distributed in proportion to the increased production. This system is found to work excellently in practice, and as the output of every hand has an effect on the bonus that is to be divided, each worker keeps a jealous eye on his or her fellows to see that there is no waste of time.

The whole work and organisation of the factory is of extreme interest, and it well repays a visit, forming as it does an example of a highly specialised factory working under conditions which enable repair work to be treated practically as manufacture.

FIG. 5.—FRENCH POLISHING.

Electric Train Lighting in India.—*The Bombay Gazette* states that the Railway Board has recently addressed a letter to the Secretary of the Indian Railway Conference Association advocating the general adoption of electric lighting in carriages on Indian railways. They call the attention of the railway administrations to the additional injuries and deaths inflicted on the occasion of the late regrettable accidents arising from the gas catching fire and burning the carriages, and they point to the terrible results of fire arising from gas on American railways and occasional similar accidents on English railways. The Board recognise that it is not possible to substitute electric light for gas at once, but consider that steps should be taken in that direction as early as possible. They have therefore been considering what system can best be used on the three State-worked railways—the North-Western, the East Bengal and the Oudh and Rohilkhand—and are favourably disposed towards Stone's system. But this they consider to be a matter for consideration, the essential point being that, whatever system be adopted, it should be used on all lines interchanging stock with each other, so that the staff of each railway can effect the necessary repairs on running trains. The Board, therefore, invite the assistance of the Conference in the solution of the question of the most satisfactory system, and ask that the various Railway administrations may be consulted, and hope that views may be available at the next meeting of the Conference at Simla. This timely notice is given as the Board consider it necessary to issue actual instructions to State-worked railways before the end of the present year, so as to, in future, provide all new carriages with electric light and fit a portion of existing stock with this light.

A Proposed Electrical League.—We are informed that a Provisional Committee has been formed in connection with the proposed formation of an Electrical League to discuss commercial and legislative questions affecting the industry, with a view to finding solutions of the present difficulties. This committee, of which Mr. R. Borlase Matthews is chairman, is composed of the following gentlemen:—Mr. A. K. Baylor, Lieut.-Colonel H. R. Beddoes, Mr. A. N. Connett, Mr. B. M. Drake, Mr. E. Garcke, Mr. H. Hirst, Mr. M. B. Mountain, Mr. S. Rentell, Mr. Mark Robinson, Mr. A. A. C. Swinton, and Mr. A. G Whyte. It is proposed to extend the invitation to join the League to everyone who is in any way interested in electricity, whether shareholder, consulting engineer, town councillor, municipal station engineer, manufacturer, contractor, or trader, whether employer or employee, and every endeavour will be made to work in co-operation with all established electrical societies.

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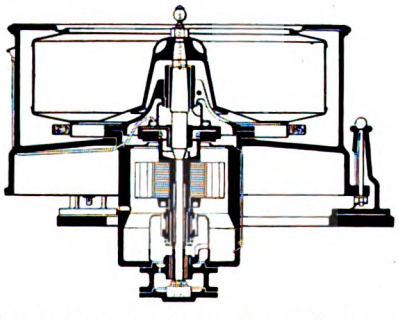
ELECTRICAL ENGINEERING AT THE FRANCO-BRITISH EXHIBITION

IN our previous articles on matters of electrical interest at the Franco-British Exhibition (ELECTRICAL ENGINEERING, May 7th, page 687, Vol. III.; June 18th, page 930, Vol. III.; July 2nd, page 23 and page 143 of our last issue) we outlined the arrangements for the supply of electrical energy to the exhibition, and called attention to some of the principal exhibits of electrical engineering interest, including the collective display organised by the electric supply companies of London; and we propose now to give some further particulars of the power plant working in the exhibition, some examples of the utilisation of electric power, and exhibits of electrical interest to which we have not already referred at any length, including some of the electro-metallurgical exhibits in the French section.

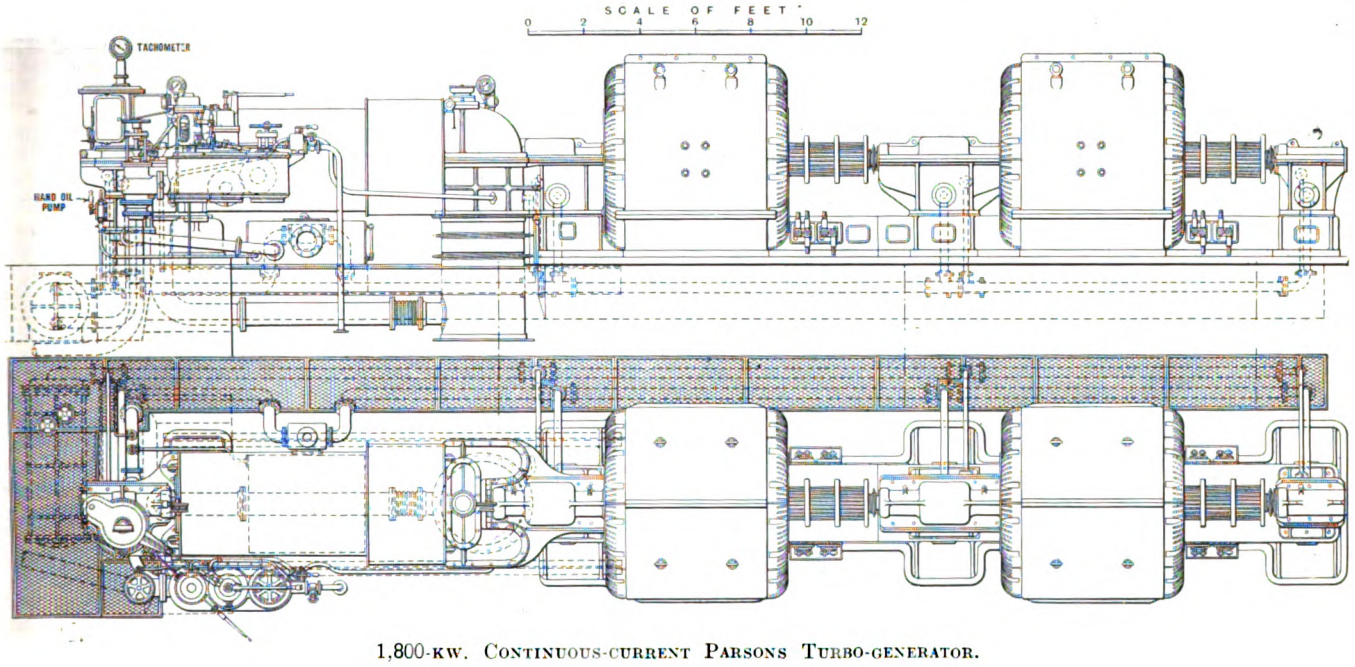
Among the exhibits to which we have only referred briefly on a previous occasion is a hydro-extractor, 48 in. in diameter, of the self-contained electrically driven pattern, on the stand of Messrs. THOMAS BROADBENT & SONS, LTD., of Huddersfield. A section of this machine is given in the accompanying illustration, from which it will be seen that the electric motor is an inherent part of the machine. The armature revolves upon the centre spindle which carries the basket; and the field magnets



48″-ELECTRICALLY-DRIVEN HYDRO-EXTRACTOR.
(MESSRS. THOMAS BROADBENT & SONS.)

are built into the framework of the machine. All the windings of the motor are completely enclosed in an iron casing, so that there is absolutely no possibility of their being damaged by damp or oil. Perhaps the most important feature of this design of electrically-driven hydro-extractor is an ingenious device rendering quite unnecessary any complicated starter and resistance. This arrangement consists in mounting the armature upon a sleeve which is independent of and can revolve round the centre spindle of the machine. To the upper part of this sleeve are attached friction shoes, which are thrown out by centrifugal force when the armature commences to rotate. The weight of these shoes is regulated so that when the motor attains its normal speed the friction developed is equivalent to the power of the motor. The hydro-extractor is then gradually brought up to its proper running speed, although the armature is, of course, running at its full speed the whole of the time. The advantages of this arrangement are that the starting up of the machine is quite automatic; that the attendant cannot damage the motor by switching on the current too suddenly; and that the starting current never exceeds a maximum figure, which can be definitely fixed in designing the machine. The machine shown is driven by a continuous-current motor, but the same system is applied to squirrel-cage induction motors, in which case the method of starting the motor light is even more advantageous.

The power plant in the Machinery Hall actually used for assisting in the supply to the exhibits, as we have already stated, includes a turbo-generator set supplied by Messrs. C. A. PARSONS & Co., of Newcastle, rated at 1,800 kw. at 500 volts continuous current, and capable of 25 per cent. overload for a considerable period. This set, the overall length of which is about 46 ft., consists of a standard Parsons steam turbine running at 1,800 r.p.m., coupled to two generators in tandem. The generators are of Messrs. C. A. Parsons & Co.'s standard pattern, the main features of which distinguishing it from other designs are the retention of the bipolar form for large sizes such as this, and the use of smooth cores, corrugated commutators and metal brushes, and compensation windings without separate commutating poles. The set exhausts into a Körting ejector condenser, and takes steam from the battery of Babcock & Wilcox boilers already described (ELECTRICAL ENGINEERING, Vol. III., page 432). A detailed drawing showing the general arrangement of the set is given in the accompanying figure.



1,800-KW. CONTINUOUS-CURRENT PARSONS TURBO-GENERATOR.

In parallel with this set runs the 500-kw. Westinghouse set, driven by a six-cylinder tandem gas engine of the latest type, to which reference has been made in our previous articles on the Exhibition. The engine is rated at 750 h.p., and is direct connected to a d.c. Westinghouse generator. The cylinders, in pairs, are placed over the three cranks, by which arrangement the makers claim that they can give the most even turning moment of any gas engine on the market. No water-cooling is used for the pistons, valves, or other moving parts, thus avoiding any danger of breakage of pistons, which is sometimes a source of trouble in connection with large horizontal engines. Forced lubrication is used throughout, the oil pumps being in duplicate, and these can be examined and the oil sieves changed whilst

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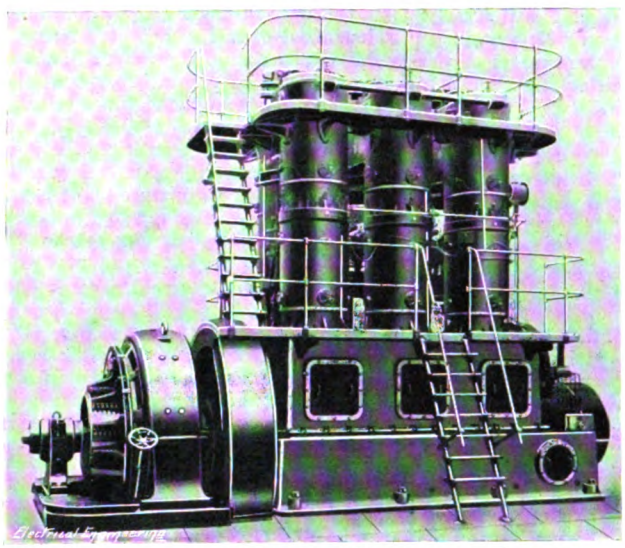
the engine is in operation. All valves are positively operated by means of straight push rods actuated directly from the camshaft. These are also arranged with adjustable screws, so



Generating Set Driven by Six-cylinder Tandem Westinghouse Gas Engine.

that any play or wear can be taken up on these valves whilst the engine is in operation. The set is shown in the accompanying illustration.

The gas-producer, from which the Westinghouse gas engine is supplied, is situated just outside the Machinery Hall, and forms the exhibit of the Power Gas Corporation. It is of a size considerably larger than actually required by this engine, and is really designed for 2,000 B.H.P. The plant consists of two of the well-known Mond Producers, each of seven-foot internal diameter, one patent mechanical washer, one gas cooling-tower, two centrifugal cleaners, two scrubbers, and a governor.

The fuel to be gasified is delivered by means of an elevator into the bunker above each producer, which in turn delivers the fuel into a cast-iron charging hopper at the top of the producer. The fuel, on entering the producer from the charging hopper, goes into a cylindrical bell, which has for its chief object the maintaining of a constant level of fuel. The gas-producer consists of two cylindrical steel shells, one within the other, the inner shell being lined with firebrick, the annular space between them forming an air-jacket in which the air and steam blast is superheated on its way to the space beneath the grate, which consists of specially designed fire-bars set radially in the form of an inverted cone. The producer is of the water-luted type, with lutes all round, and is so constructed that ashes may be removed at all times without interruption of the operation of the producer. In other words, the producer is absolutely continuous in operation. The air-blast is supplied by an electrically-driven Roots blower. The gas leaving the producer passes into a rectangular steel washer, in which it is brought into intimate contact with water sprayed up into the form of rain by quickly-revolving dashers or paddles. By this means the gas is here freed from dust and partially from tar, and is at the same time considerably cooled down. On leaving the washer, the gas enters at the bottom of a gas cooling-tower packed with short earthenware tubes, which effectually distributes over the whole area of the tower the water which is supplied at the top. The gas passes upwards, and on its way comes into intimate contact with the water trickling down. In this tower the gas is much cooled, and a large amount of tar is removed. The gas then passes into a pair of specially designed centrifugal cleaners, into which a small amount of water is introduced. Herein the gas is still further cooled down and freed from tar, and when it leaves this apparatus only contains a small trace of tarry matter, which is removed as the gas passes through the scrubbers, which are rectangular steel boxes fitted with a number of trays, on which are placed simple wood planings or shavings and sawdust. The gas then passes in a thoroughly clean state to the engine. One of the chief points of advantage claimed for this type of plant is that a very cheap fuel can be used, whereas in many other types of plant it is necessary to either use anthracite or a special grade of nut fuel.

These plants are very simple in operation, and are so designed and constructed that a minimum amount of labour is required for their operation, the production being automatically controlled to give only the amount required by the gas engine even under variable load, thus preventing all waste of gas. The standby losses are extremely small, and, after remaining idle for a fortnight or more, the producer may be brought into proper working condition in about 20 minutes, while after ordinary night stoppages it is only necessary to turn on the blast for about five minutes previous to the gas being actually required at the gas engines.

Mond Gas Plant, exhibited by the Power Gas Corporation.

The circuits from the generating plant described above are taken to two switchboards which have been supplied by Messrs. Crompton & Co., Ltd. Each consists of 2 in. marble panels, with a massive teak framework surrounding each board. These two boards are placed side by side, so that they form practically one complete switchboard. No. 1 board is designed for the control of the Westinghouse shunt-wound generator, and also contains duplicate 500 kw. 500-volt feeder panels. No. 2 board is designed to control the two Parsons compound-wound generators, each 750 kw., 500 volts, and two feeders each for

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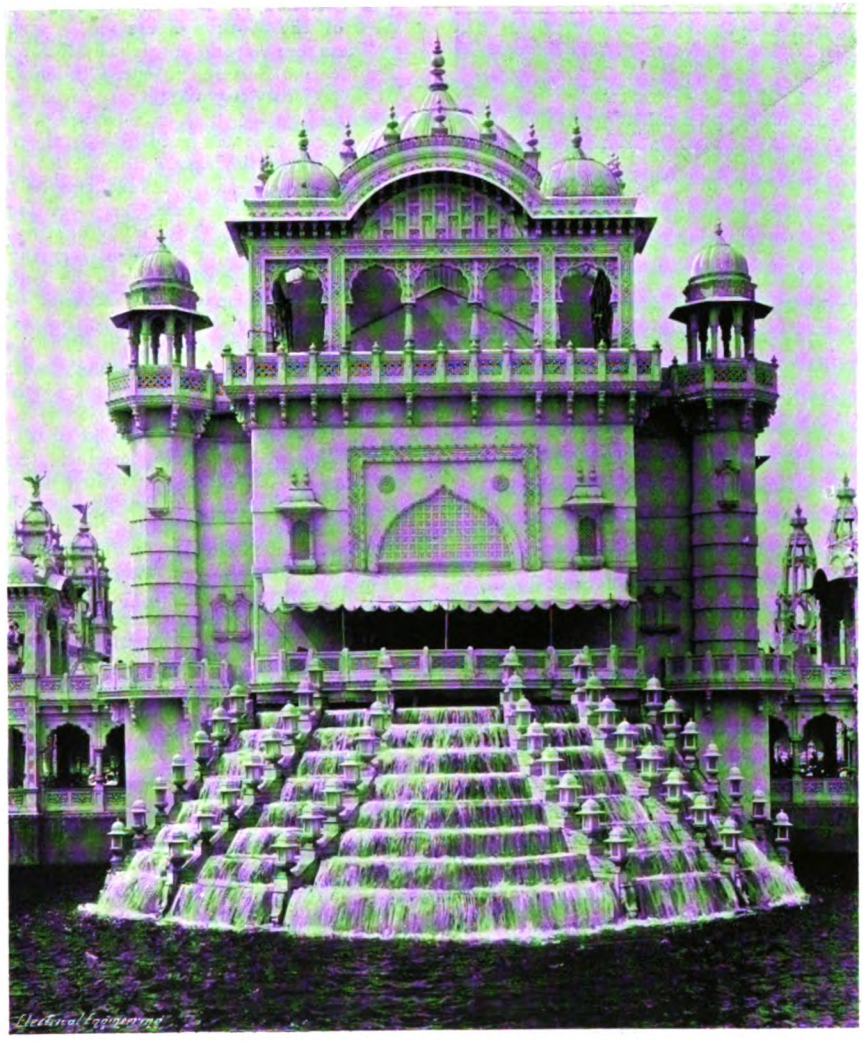
750 kw. The compound windings of these machines have, however, been cut out, and we understand they are now being run as two shunt-wound dynamos. The generator circuits are controlled by two S.P. Crompton circuit-breakers, designed to operate with an overload and reverse current on one pole, and with an overload only on the other pole. The breakers are provided with a magnetic blow-out for final breaking, in addition to the auxiliary carbon brushes and main brushes. The breakers are "fool" proof, inasmuch as the rate of switching on and off is out of the control of the operator. Moving coil amperemeters of Messrs. Crompton's latest pattern are coupled to each dynamo circuit, and the pressure is indicated by three sector type moving coil voltmeters, one fixed at the side, and the others at the top of the switchboards. One of these meters reads the bus-bar pressure, and the others are for reading the voltage of the incoming machines when paralleling. Each circuit is controlled by two overload "C.B.H." pattern circuit breakers of a similar type to those fitted on the generators, excepting that they will only operate with a forward current. An ampere-meter is also coupled in each feeder circuit indicating the feeder current. Equalising switches are fitted on the larger board for coupling to the series windings of the machines, but these are not now in use as the series windings have been cut out for the present. The back part of the board contains the two main bus-bars, the cross section being such that the current density in any part does not exceed 800 amperes per square inch at full load. The main connections are made up of copper bars rigidly bolted to the bus-bars, and the smaller connections to the voltmeters are made by insulated cable. The front of the board is efficiently lighted by means of lamps supported by polished brass brackets fixed to the upper part of the framework. As stated above, these two boards form one complete switchboard, and although it is not done at present it is possible to couple the two bus-bars together by means of links.



CASCADE IN THE "COURT OF HONOUR."

An interesting example of the application of electric power in the exhibition is the electric driving of the pumping plant for supplying the Cascade in the Court of Honour. The pump-room is situated at the side of the building which contains the Congress Hall, where the annual Congress of the Tramways and Light Railways Association was held. The accompanying photograph shows the Cascade, which is built on to that side of the building which faces the Court of Honour. The work of delivering the water to the head of the cascade is performed by two electrically-driven centrifugal pumps of the "Rees-Roturbo" pattern, supplied by MESSRS. THOMAS PARKER, LTD., of Wolverhampton. One of these pumps is in the pump-room, at the side, where it can be seen through a window, and is illustrated herewith, and the other is situated on a platform under the cascade. Both pumps are direct-coupled to 500-volt continuous-current motors of about 30 B.H.P., and are controlled from a double panel switchboard in the pump-room. Each panel contains an ammeter, voltmeter, double-pole switch, fuses, and an overload circuit-breaker. A starter and a shunt-field regulator for each machine are also provided. The latter enable the speed of the motors, which run at 530 r.p.m., to be increased 30 per cent. if necessary. Each pump normally delivers about 3,000 gallons of water per minute, or 180,000 gallons per hour, against a head of about 25 feet. The total amount of water delivered by the two pumps to the Cascade is some 16,000 tons during a working day of 10 hours. The length of the suction-pipes to the pumps are 14 ft. and 15 ft., and the suction-heads are 7 ft. and 10 ft. respectively. Both suction and delivery pipes have a diameter of 14 in. Each motor was really designed for a capacity of 2,500 gallons per minute against a head of about 45 ft., but the particular characteristic of the "Rees Roturbo" pump is that it will adjust itself to any conditions of working without it being necessary to alter the speed, and without any chance of overloading the motor. Thus these same pumps could have been used for working a fountain with a head of over 70 ft., the volume of water only being automatically reduced in inverse proportion to the head, so as to keep the load on the motor constant. In fact, the construction of this type of pump is such that the power goes down with excessive head, and with a very small head the volume only increases to such an amount that the load remains constant. It was hoped that there would be an opportunity of demonstrating this property of the pump at the exhibition by working fountains with variable heads in the Court of Honour and other Courts, but this was found impracticable, owing to the boat traffic on the lagoons. A point worthy of mention is that in each section and on each step of the Cascade, extra feed-pipes with adjustable valves are placed, so as to give an equally heavy flow of water on the wide lower steps as at the top of the cascade. There are in all 96 such feed-pipes. The delivery pipes from both pumps feed in a common perforated main at the head of the Cascade. In the "Rees Roturbo" pump the water first enters a rotating impeller which is always full of water at a high pressure so long as the pump is working. From the periphery of this impeller, the water escapes tangentially out of "Venturi-shaped" nozzles in a direction opposite to that in which the impeller is rotating. The pressure of the water in the impeller is converted into velocity in the first part of the impeller nozzles, and then leaves the impeller with a velocity about equal and opposite to the impeller velocity. It then enters external fixed expanding channels at a high pressure, but with practically no velocity, having produced a propelling or turbine effect on the impeller due to the reaction of the issuing jets. It is due to this turbine effect that the power absorbed when running at a constant speed remains practically constant for all heads of discharge, and never appreciably exceeds that required for the head for which the pump is designed. The efficiency of this

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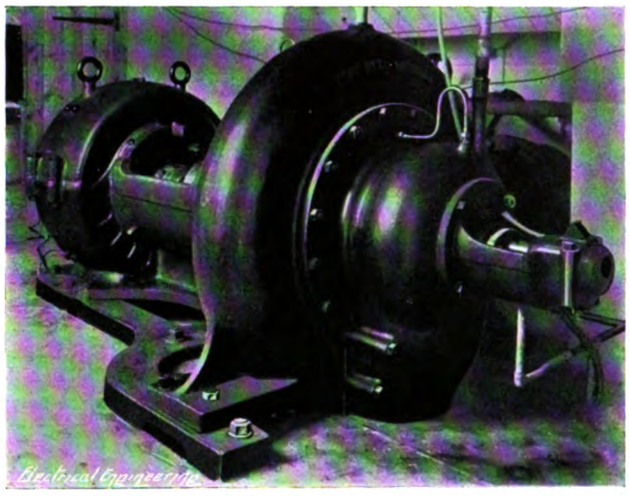
type of pump is very high; one example, designed for an output of 45,000 gallons per hour against a head of 65 ft., had a full load efficiency of 70 per cent.

Another notable example of electric power in the exhibition applied to what may be termed amusement engineering is the driving of the "Flip-flap." The appearance of this remarkable structure, with its two lattice steel counter-weighted arms, each moving through an angle of a little over 180° in opposite directions, and carrying at their extremities cages containing passengers, is too well known to need description, but the method by which these are driven by a single electric motor, and the precautions taken to ensure safety of control, are of some interest. It should be said, first of all, that the main counterweights are equivalent to the arms plus the fully-loaded cars, so that the least power is required when the cars are full, and the tendency in case of accident is rather for the arms to rise than fall. The driving gear for the live arms is connected together by a pair of central bevels driven by the motor, so that



ELECTRICALLY-DRIVEN REES-ROTURBO PUMP SUPPLYING THE CASCADE IN THE COURT OF HONOUR.

the wind pressure is balanced in such a way that the motor only has to overcome the load due to the difference in the wind pressure on the two arms. The motor is rated at 100 b.h.p. at 500 r.p.m.; it is shunt wound, and is supplied by a special 500-volt continuous power feeder from the sub-station adjoining the Machinery Hall. It drives the vertical bevel shaft through worm gear. Each driven shaft carries a pair of sprockets, from which the power is transmitted by chains to the triple reduction spur gearing on each side of each arm, and differential gears are provided to ensure equality of drive on both sides of each arm. There are thus four sets of gearing, all driven by the one motor. Jockeys are fitted by which the slack of the chains can be taken up, as these are rather long. An important feature of the gear is the set of brake drums, 34 in. in diameter and 4½ in. wide, on the first pinion shaft of the spur gear, upon which wooden brake shoes are applied by the four solenoid brakes whenever the current is cut off or fails, after the manner of the usual electric crane brake. These solenoid brakes are fitted with dashpots, so that they can be taken off instantly but only applied gradually. Hydraulic buffers are placed to receive the ends of the arms in case the stopping is not accurate, and a most ingeniously designed locking gear is fitted to lock the arms when passengers are entering or leaving the cages. The locking bolts are connected to contacts which control the circuits of green and red signal lamps in the driver's cabin, and there are also similar signal lamps on the platforms, which operate in the way described below. Further safety devices consist in limit switches preventing the driver overrunning the platforms, and emergency switches on both platforms by which the motor can be stopped and the brakes applied at any time independently of the driver. The apparatus in the driver's cabin comprises, besides the actual drum type controller with its resistances, a solenoid operated main switch, which plays an important part in the system of control. Suppose now the arms are both locked and passengers are going on board, the red signal light circuit is closed at all points. The attendant at one end draws his locking bolt when he is ready; this puts out the red lights and warns the driver, and also closes contacts at that end in the green lamp and solenoid circuits, but these two circuits are not completed until the attendant on the second platform also withdraws his bolt. When this is done the green lamps light up, and the solenoid switch in the main motor circuit is closed ready for the driver to use his controller. He then starts up the motor and runs the trip, being able to stop accurately by a system of sighting arrangements. During the trip the motor can be stopped independently of the driver in the following ways: By a temporary failure of current, by an emergency switch, by an improper closing of one of the locking bolts, or by the working of the limit switches; but it is important to notice that in none of these cases can the machinery be restarted except by bringing the controller back to the zero position and making a fresh start. The way this is ensured is by arranging that the solenoid switch only has its full current through its coil when the controller is in the off position; in all other positions a resistance is in the solenoid circuit, which brings down the current to a value sufficient to hold the armature on but not to pick it up. The main solenoid switch is provided with carbon contacts and magnetic blow out, suitable for 200 amperes at 500 volts. It should be said that the contract for the flip-flap was given to the Cleveland Bridge and Engineering Co., of Darlington, and the electrical and mechanical equipment was designed by Mr. C. W. Hill, under whose direction this part of the work was erected.

There are several electrometallurgical exhibits in the French Engineering Section. Mons. Gin shows a very interesting model of his circulating induction furnace, which is used for the manufacture of high-class steels. By taking off the top of the model one sees readily how the circulating canals operate. The steel in the canals forms the secondary of the furnace, and when sufficiently refined can be tapped out of the furnace by tilting it, there being an electro-motor placed underneath it for this purpose. This style of furnace is installed and used in Krupp's works at Essen in Germany. On the same stand are also shown photographs of the electrode furnace, in which ferro-alloys are made, and samples of ferro-silicon, ferro-tungsten, ferro-molybdenium, ferro-chrome and ferro-vanadium, and manganese silicon are exhibited. One photograph is especially interesting, in which the carbon electrodes are shown after they have been in use, and one can see how they have been eaten away at the one end, that in contact with the molten slag.

The Société d'Electro Chimie of Paris show some magnificent specimens of electrolytic products, such as potassium, sodium and barium chlorates, ammonium perchlorate, a block of metallic calcium and also calcium hydride, besides which they show pure aluminium, chromium, manganese, and ferro-titanium.

The Société Metallurgie Française have an interesting exhibit in which they show a model of the Héroult electrode furnace for the manufacture of special tool steels. A sample of pig iron made in this furnace is also shown, and various pieces of high-speed tool steel. In the same stand there is an exhibit of aluminium in the form of ingots and bars shown by the Ste. Ane. Des Alliages Cothias (Paris).

Near this is the exhibit of the Procédés Company in connection with Mons. Paul Girod, showing ferro-chrome, ferro-tungsten, ferro-molybdenum, ferro-tantalum, and ferro-silicon, all made in Girod's special electric furnace, which, however, they do not exhibit.

Electric Railways in the Alps.—According to the *Elektrotechnischer Anzeiger*, the Bavarian Government proposes to construct a system of narrow-gauge electric railways in the Bavarian alpine district, in order to encourage the tourist traffic. The district would include the fourteen highest peaks of the Bavarian Alps.

Wireless Telegraphy.—A station is now being erected in the grounds of the Vatican at Rome. The transmitting and receiving instruments will have a range of about 350 miles. A large wireless station has also been opened recently at Emden, in East Friesland, Germany, and operators desirous of entering the service on the large ocean liners will be examined there in future.

Speed Indicators on Tramcars.—The Board of Trade is inquiring into a suggestion that speed indicators should be fitted to tramway cars. The Board has asked all tramway and automobile organisations for any information which they may possess regarding the trustworthiness and the cost of any speed indicators now on the market. They add that for the purposes of tramcars it is desirable that the indicator should be reliable for speeds as low as four miles an hour, as well as for maximum speeds.

Liverpool and District Electrical Association.—The following have been elected as President and Council for the ensuing year:—President, Mr. H. E. O'Brien; vice-presidents, Messrs. J. A. Crowther and C. W. Mallins; Members of Council, Messrs. H. W. Brooks, J. Greenhalgh, W. H. Hamilton, R. A. Lambert, C. I. Moore, J. Maxwell, and J. J. Richardson; hon. secretary and treasurer, Mr. S. Frith; assistant hon. secretary and treasurer, Mr. J. T. Stanbury.

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THE MARSEILLES ELECTRICAL EXHIBITION

ALTHOUGH officially the Marseilles Electrical Exhibition has been open for more than two months, it is only comparatively recently that the exhibits of electrical interest have been completed, and it was only on June 6th that the main buildings were even opened. By this time, however, the display is more complete, and a few weeks ago members of the French technical Press were invited to view the exhibition, the main features of which were explained by Prof. Fabry, of Marseilles. It is to articles in some of our French technical contemporaries that we are indebted for the information given here.

The site of the exhibition, the Parc du Rond Point du Prado, is nearly two miles from the centre of the town. It was formerly a military parade ground, about 62 acres in extent, but was transformed into a park two years ago, when a Colonial exhibition was held there. The supply of electricity for the purposes of the exhibition, for which some 2,500 kw. is required, is taken entirely from external sources, as it was decided not to erect any steam-driven generating plant within the exhibition. The supply is divided up in the following way.

The Compagnie d'Electricité de Marseille has arranged to supply 1,000 to 1,200 kw. in the form of three-phase current at 5,000 volts and 50 cycles, and a further three-phase supply at 5,500 volts, and the same frequency, amounting to 600 kw., is taken from the system of the Société du Gaz et de l'Electricité de Marseille. The remainder, another 500 or 600 kw., is supplied by the tramway company at 5,500 volts, 25 cycles. Special cables from the feeding points or stations of these undertakings take the high pressure supply to the main distributing switchboard in the exhibition.

The main switchboard, which is placed in the Palais de l'Energie, was constructed by the Société Industrielle des Téléphones. In addition to the incoming and outgoing feeder panels, provision is made for the control of two converting sets, which supply continuous current to a three-wire network with 220 volts between the outers. One of these sets, manufactured by the Société Alsacienne de Constructions Mécaniques, of Belfort, is of 500-kw. capacity, and will eventually be placed in the station of the Compagnie d'Electricité de Marseille, where four sets of similar size are already in operation. The other set, which is for 300 kw., is made by the same firm, and is destined for one of the sub-stations of the Société du Gaz et de l'Electricité. The equipment further comprises a small balancer set consisting of two 50-kw. machines by the Société l'Eclairage Electrique, coupled together. From the main board are taken feeders, through which the distributing network in the exhibition is supplied through sub-stations containing transformers stepping down to 190 and 100 volts, and aggregating about 500 kw. on each of the two sections of the network supplied by the two companies already mentioned. The distribution system for the 5,500-volt, 25-cycle supply is taken to another sub-station. In this has been installed a Thury motor-generator of about 225-kw. capacity, which supplies the 2×110-volt continuous-current networks, with the assistance of a small balancer set of the firm of Fabius Henrion, of Nancy. There are also three 100-kw. transformers, which supply some of the illuminations, and also current to exhibitors, and in the same building is the Rateau-Brown Boveri electrically-driven pump, which absorbs about 600 h.p., and supplies the cascades and fountains. The general lighting of the exhibition is by 450 arc lamps, and the illuminations include more than 40,000 incandescent lamps, requiring about 1,200 kw. An excellent effect is produced by the inclusion of a number of mercury vapour lamps in the scheme of the illuminations.

The exhibits are contained in four palaces, named respectively, Le Palais de l'Energie, Le Grand Palais, Le Palais de la Traction et des Mines, and the Palais de l'Agriculture. The first of these, which comprises on one façade a *château d'eau*, with illuminated cascades and symbolic groups of figures, and is decorated internally with a series of paintings, representing allegorically the progress of electricity, is about 500 ft. long. In it are to be found exhibits relating more particularly to the distribution of electrical power and its applications to military purposes, navigation and the chemical metallurgical and other industries. Here the principal power supply authorities in the south of France and elsewhere have stands where the development of their systems is demonstrated by plans, photographs, &c., and a large relief model illustrates the scheme for the supply of power from the Rhone to Paris, at 120,000 volts, three-phase, proposed by Messrs. Blondel, Harlé, and Mahl. The principal French manufacturers have stands whereon are exhibited dynamo motors, switchgear, and other apparatus; the leading Continental cable-makers are also represented, and cables are shown under test with voltages of 100,000 volts alternating, and 300,000 volts continuous (or, rather, rectified). There is also a good display of line material, insulators, &c., for 50,000 volts, the pressure used in the neighbourhood of Marseilles by the Société l'Energie Electrique du Littoral Méditerranéen for transmission lines up to 62 miles in length. In the electrochemical section are to be found samples of electrolytically-refined copper and the various commercial products of the electric furnace, including aluminium, calcium carbide, and various metals and alloys. There are also models and drawings of various electrometallurgical works and furnaces. The Société de l'Azote has plans and diagrams demonstrating the Birkeland nitrogen furnace, and there are a number of exhibits relating to the uses of electricity in the chemical laboratory. The exhibits relating to the purification of water by ozone, although properly belonging to this section, are contained in the Grand Palais. Several accumulator manufacturers show cells and plates, and a lorry driven by Edison accumulators is shown by the Bergmann firm. A fine model of a lighthouse lamp is exhibited by the Ministry of Public Works.

The Grand Palais is a permanent building about 300×150 ft., which has been erected by the Municipality of Marseilles with a view to future use for exhibition purposes, and is decorated with symbolic sculpture. The electrical exhibits therein relate chiefly to branches of electrical activity which do not involve heavy machinery, including lamps and lighting, telephones, telegraphs, medical apparatus, measuring instruments, and educational appliances. Prominent among the exhibits are samples of various patterns of metal filament lamps, artistic electric light fittings, and a very complete display of meters by well-known Continental firms. The department of posts and telegraphs have a large display of telegraph apparatus. In this building there is also an interesting historical collection comprising, amongst other things, the original ring armature of Paccinotti, rotary field motors made by Ferraris, and one of the alternators of the famous Frankfurt-Lauffen transmission.

The Palais de la Traction et des Mines contains a good deal of electric tramway material, but none of the electric railway exhibits have yet been completed; it is stated, however, that they will include a motor truck for the Chamonix railway, together with a snow plough and apparatus illustrating Messrs. Auvert & Ferrand's single-phase rectifier system, shown by the P.L.M. Railway Co. In the mining section is a mining locomotive of the French Thomson-Houston Co. for a mine near Marseilles, together with electric rock drills and coal cutters There is, however, a certain amount of traction apparatus in the Palais de l'Energie, including a Brown Boveri single-phase commutator motor, and a train-lighting equipment.

In the agricultural section the possibilities of electrical power as applied to agriculture are demonstrated on a model farm by the Société le Sud Electrique, and in this section are shown cooking appliances, pumps, ozone water purification apparatus, sewing machines, electric flat irons, kneading machines, lixiviation apparatus, crushers, churns, cream separators, ice-making machinery, sheep-shearing machines, chaff-cutters, oil-presses, &c.

A wireless telegraph installation has been established by the Société C.G.R., which is provided with a fan-shaped aërial supported by two masts each about 100 ft. high. Communication is maintained with the Eiffel Tower, and experiments have been made with wireless telephony on the de Forest system. Another feature of the exhibition is a complete furnished villa in the grounds, equipped by the Société du Gas et Electricité de Marseille, to demonstrate the various applications of electricity to domestic purposes, in a similar manner to the flat in the collective electrical exhibit at the Franco-British Exhibition. The equipment comprises lighting and power applications, electric lifts, vacuum cleaners, and heating and cooking apparatus of every kind, including even electrically-heated rugs and eiderdowns.

Electricity from Peat in Germany.—On page 139 of last week's issue we gave some particulars of a scheme for erecting a power station in the East Friesland peat district. Preparations are now being made for the building of another large power station in Holstein. The work has been undertaken by the firm of Gebr. Körting Akt. Ges. The large gas engines will be supplied from gas producers generating the gas from air-dried peat. The generating costs are estimated at 0·1d. per horsepower-hour. Electrical energy for light and power will be distributed to various local authorities and manufacturing concerns within the district.

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THE MANUFACTURE OF METAL FILAMENT LAMPS

AN article by H. Remané, of the Deutschen Gasglühlicht A.-G. (Auer-Gesellschaft), in a recent issue of the *Elektrotechnische Zeitschrift*, deals with the possible future development of the metal filament lamp from the point of view of the lamp manufacturer. The Auer-Gesellschaft are the manufacturers of the Osram lamp, and some interesting information, relating to the difficulties encountered in the manufacture of high-voltage, low-candle-power Osram lamps, is given in the article. One of the first questions to be considered, writes Mr. Remané, is, what will be the candle-power of the normal metal filament lamp, corresponding to the present 16 c.p. carbon filament lamp? The latter has become the standard, not on account of its convenient intensity as an illuminant, but because the cost of the energy consumed by such a lamp was already high enough, and a larger unit would consume more. The normal incandescent gas unit is nominally 60 c.p., and now that the working costs for electric incandescent lighting have been so much reduced, there is every reason to expect that the normal lamp of the future will be at least a 32-c.p. lamp. In places where the cost of energy is high, as, for example, in Paris, 25-c.p. lamps are at present preferred, while in Berlin, Leipzig, and other cities where energy is comparatively cheap, 50-c.p. lamps are more generally employed.

With regard to the best pressure for lighting circuits, the higher voltages will always be unfavourable to the metal filament lamp, as has been the case with the carbon filament lamp. Taking the consumption of a 110-volt lamp at 1 watt per hefner candle, experience has shown that the consumption of 220-volt lamps of from 40 to 100 candle-power, with the same light constants and the same life, will be 1·25 watts per hefner candle. It is quite possible that this figure will be reduced a few per cent. in the future, but the low-voltage lamp will always have the advantage. There is at present little prospect of a 32-c.p. 220-volt lamp consuming less than 1·4 watts per hefner candle appearing on the market, and still less prospect of a 25-c.p. 220-volt. for less than 1·6 watts per candle appearing. Under such conditions, in order that a consumer on a 220-volt circuit may obtain his light at the same cost as another on a 110-volt circuit, both using 32-c.p. metal filament lamps, the price of energy per kilowatt-hour would have to be 30 per cent. cheaper in the former case. The saving in generation and distribution obtained by the adoption of the higher pressure would not, in most cases, amount to as much as 30 per cent., and, consequently, the author concludes, it will be more to the advantage of the consumers if distribution is effected at 110 volts.

The chief difficulty encountered in the manufacture of the high-voltage lamp is the extreme fineness and excessive length of the filament. A comparison between the diameters and lengths of carbon and Osram (tungsten) filaments for equal pressures and candle-powers is shown in the table below. The consumption in watts per hefner candle is also given in each case. These figures for consumption, with the exception of that for the 16-c.p. 220-volt lamp, were experimentally obtained.

Diameters and Lengths of Carbon and Tungsten Filaments for Various Voltages and Candle-powers.

	Candle-power and voltage.	Average diameter in mm.	Average length in mm.	Watts per hefner candle.
Carbon filament...	50/220	0·13	400	3·0
	32/220	0·12	380	3·5
	25/220	0·085	350	3·5
	16/220	0·07	275	3·5
	10/220	0·06	265	4·0
	50/110	0·23	240	3·0
	32/110	0·18	230	3·1
	25/110	0·16	220	3·1
	16/110	0·12	200	3·1
	10/110	0·075	175	3·5
Osram filament ...	50/220	0·0342	1040	1·25
	40/220	—	—	1·25
	32/220	0·0254	910	1·25
	25/220	0·0216	826	1·25
	16/220	0·0154	723	1·10*
	50/110	0·0530	605	1·10
	32/110	0·0395	524	1·10
	25/110	0·0328	490	1·10
	16/110	0·0244	410	1·10

* These figures are calculated, as this type of lamp has not even been constructed on an experimental scale.

The Auer-Gesellschaft manufactures short lengths of tungsten filament with a diameter of 0·020 mm. for low-voltage lamps with a consumption of 1·0 watt per candle, but the difficulties in the way of producing in large quantities long homogeneous threads of that diameter seem insurmountable. High-voltage lamps of this type are also very fragile, and have short lives.

ELECTRIC LIGHTING ORDERS, 1907

THE annual report respecting application to, and proceedings of, the Board of Trade under the Electric Lighting Acts, 1882 to 1902, during 1907 shows that of the 27 applications, 17 were by local authorities, and ten by companies or persons. The Orders granted have been submitted to Parliament as follows:—

Electric Lighting Provisional Order Confirmation Bill, Nos. 1 and 2.—Bispham-with-Norbreck, Caldy Manor, Carmarthen, Fleetwood, Halesowen, Heswall, Lowestoft (Amendment), and Woking (Extension); Barrhead, Clydebank (Amendment), Dundee (Extension), and Rutherglen (Amendment).

Electrical Lighting Provisional Order Confirmation Bill, No. 3.—Bridgend (Extension), Hendon (Amendment), Llandaff and Dinas Powis (Amendment), Llansamlet, Oulton Broad, Sowerby Bridge (Amendment), and Tewkesbury.

The application for the Smethwick Electric Lighting Order, which at the date of the last report was still under the consideration of the Board of Trade, was subsequently withdrawn by the promoters.

The Rural District Council of Barton-upon-Irwell applied for an Order to enable them to transfer their powers obtained in 1906. The Board of Trade were not satisfied as to the financial position of the company, who were proposed as transferees, or that the company wished to take a transfer, and the Order was refused. The Rural District Council of Bath promoted an Order but did not proceed with the application. Broadstone, Ltd., applied for an order for the Fleetwood district, but did not proceed with the application. In the case of the Johnstone (N.B.) Electric Lighting Order promoted by the Strathclyde Electricity Supply Company, the promoters failed to produce the consent of the Local Authority or to satisfy the Board of Trade that the consent should be dispensed with, and the Board refused to grant the Order. In the case of the Lowestoft (Extension) Order, this confers further powers upon the Corporation in respect of their existing undertaking in Lowestoft, but the application included in it, for the Urban District of Oulton Broad, was refused, a separate Order being granted to that Urban District Council. In the case of the Macclesfield Electric Lighting (Amendment) Order, this was promoted by the Corporation to transfer their powers under an Order obtained in 1901 to a company. The Board of Trade, however, was not satisfied as to the financial position of the company who were proposed as transferees, and the Order was not granted. In the case of the Woking Electric Supply (Extension) Order the promoters, the Woking Electric Supply Co., Ltd., withdrew the application in so far as it related to the Urban District of Staines and Egham, and the Order was granted in respect of the remainder of the area included in the application.

Since the date of the last report the under-mentioned Orders have been transferred:—Annfield Plain, 1901 (Cleveland & Durham County Electric Co.); Arbroath, 1907 (Arbroath Electric Light & Power Co.); Benfieldside, 1901 (Cleveland Durham County Electric Power Co.); Bude, 1906 (Bude Electric Supply Co.); Calverley, 1903 (Electrical Distribution of Yorkshire, Ltd.); Chesham, 1901 (Chesham Electric Light & Power Co.); Chichester, 1898 (Chichester Electric Light & Power Co.); Consett, 1901 (Cleveland & Durham County Electric Power Co.); Farsley, 1906 (Electrical Distribution of Yorkshire, Ltd.); Hartlepool, 1899 (Cleveland & Durham County Electric Power Co.); Hoddeston, 1901 (North Metropolitan Electric Power Supply Co.); Leadgate, 1902 (Cleveland & Durham County Electric Power Co.); Ossett, 1898 (Electrical Distribution of Yorkshire, Ltd.); St. Albans, 1898 (North Metropolitan Electric Power Distribution Co.); Smethwick, 1898 (Birmingham & Midland Tramways, Ltd.); South Bank-in-Normandy, 1902 (Cleveland & Durham County Electric Power Co.); Stanley, 1902 (Durham) (Cleveland & Durham County Electric Power Co.); Uxbridge and District, 1903 (Metropolitan Electric Supply Co.); Wisbech, 1901 (Wisbech Electric Light & Power Co.).

The Fire on the City and South London Railway.—Colonel Yorke and Mr. A. P. Trotter resumed their inquiry on Saturday last into the fire which occurred on the City and South London Railway on the 16th inst. No further evidence was called, however, the Board of Trade officer spending a considerable time in the tunnels where the fire took place, and further questioning the witnesses who gave evidence on the 20th inst., reported in our last issue.

The Fire Brigade Committee of the London County Council have considered a report of the Chief Officer of the Fire Brigade on this fire, and state that this raises several questions of importance in connection with tube railways generally, and the City & South London Railway in particular, upon which they think it will be advisable for the Council to make representations to the Board of Trade. They state that they have called for further reports on the subject, and in view of the approaching recess they ask to be authorised to make any representations to the Board of Trade as soon as these reports shall have been considered.

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THE TANTALUM WAVE-DETECTOR

A PAPER was read by Mr. L. H. Walter before the Royal Society on May 7th last, in which the author's Tantalum Wave-Detector and its Application in Wireless Telegraphy and Telephony was described. It has been known for some years that the metal mercury lends itself well to the purpose of constructing a detector of electric oscillations which is capable of spontaneously returning to its initial or sensitive condition, or, in other words, is spontaneously decohering. Iron, carbon, and platinum have all been tried for this purpose in conjunction with mercury, but possess several disadvantages.

The advent of the tantalum lamp, which appeared to promise that this hitherto unobtainable metal would soon be commercially available, seemed to hold out some possibility of successfully overcoming the previous difficulties in the way of finding a suitable noble metal. For the fact that tantalum is a noble metal in so far as its chemical behaviour is concerned, that it is indifferent to atmospheric influences, that it has great strength and ductility, and, finally, that it is absolutely indifferent to mercury, seemed to bear out the above view.

A first experimental detector was made by passing two tantalum wires, taken from an ordinary tantalum lamp, down two fine glass capillary tubes, and allowing the wires to project about 1/20 inch, and their points to just touch the surface of a small pool of mercury. Trials of this detector gave good results, and it was found that both the liquid dielectric and the insulating sheathing could be dispensed with. The general construction and actual size of the detector as now used is shown in section in Fig. 1, the whole arrangement being hermetically sealed in a glass bulb.

Here P is a sealed-in platinum wire, forming one terminal, dipping into a small pool of mercury M, in the glass vessel G; the other terminal is also a platinum wire P_1, having a clip at its end, holding a short length (3/16 inch about) of tantalum wire T of 0·05 mm. diameter. The sealed-in platinum loops form a handy means of connecting up, with the aid of a lamp-holder of the Swan type. Before sealing up, mercury is poured into the bulb, through a small side neck N, to such a level that the tantalum point is just immersed, which is best ascertained experimentally by the sound in the telephone receiver. The bulb can then be sealed, having previously been exhausted, if so desired. When properly constructed, such detectors appear to be permanent, and not to deteriorate, nor have they been found fragile in transport.

Detectors of this form have been tested at actual wireless telegraph stations, and it has been found that, while possibly not so sensitive for very weak oscillations (signals) as the electrolytic or magnetic detector, for slightly stronger oscillations the sound is several times louder than that obtained with the elecrolytic, which is itself much more sensitive than the magnetic detector. With the second detector made, very loud signals were obtained at a distance of 70 miles over sea, without any attempt at tuning, louder than those obtained with the electrolytic detector with the aid of a step-up oscillation transformer and careful tuning. Using one of the less satisfactory of the later models of the tantalum detector, loud commercial signals have also been obtained at a distance of 450 miles from an ordinary 2-kilowatt ship installation.

An examination of the tantalum detector by the resistance substitution method shows that in the receptive condition these have a fairly low resistance, 1,200 to 1,800 ohms (as compared with the filings coherer, 100,000 ohms or so, and the electrolytic detector, 30,000 to 50,000 ohms). This low resistance should prove beneficial to the tuning in certain cases. When oscillations are acting, the resistance drops to anything from 250 ohms for strong, to 70 ohms, say, for very strong signals. The great loudness of the signals obtainable with the tantalum detector is due to the large change in the current through the telephones. For this detector the ratio of the current when oscillations are acting to that in the normal condition ranges from 3 : 1 to 8 : 1, and can amount to 30 : 1 without reaching the maximum sound obtainable; the normal current, using 580-ohm telephones, is about 1/20 to 1/10 milliampere.

The tantalum detector is, in the author's opinion, specially suited for wireless telephony. For this application of electric wave propagation the use of microscopically weak signals is out of the question, and here it is that the superiority in loudness of the tantalum detector for moderately strong oscillations comes in.

The form of detector just described, while serving very well for use in fixed stations where a firm support can be obtained, is not so satisfactory when the detector is liable to be subjected to shaking or mechanical shocks during the reception of messages. It was, therefore, thought desirable to find some method of immobilising the mercury, and a satisfactory arrangement was arrived at by constructing the detector in the following manner: The tantalum wire is fastened in a platinum clip, and at the end of the tantalum encased in glass by a special method, necessitated by the impossibility of sealing-in tantalum in the ordinary way as is done with platinum. The platinum wire is sealed into a minute glass bulb B (see Fig. 2) blown on one end of a glass tube; the other end of the tube is connected to an air pump and the interior exhausted. The glass tube is next heated, when the vacuum causes it to collapse on to the tantalum wire. The end of the glass-sheathed wire can then be ground down so that the tantalum surface is just flush with the glass (simply breaking off the glass end usually suffices). The mercury is contained in a glass tube G, having a bore of 5/32 in. A larger tube would be better, but the sensitiveness to shaking then reappears; a smaller tube gives a less sensitive and more variable detector. An ivory plug, *I*, through which a platinum or nickel wire passes and projects, is placed at one end of a length of a few inches of such glass tube with thick walls. A few drops of mercury—enough to form a pellet (*M*) about 5/16 in. long—are then put in, and a second ivory plug, I_1, this one with the sheathed

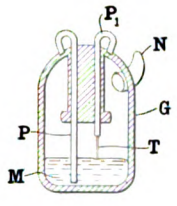

FIG. 1.

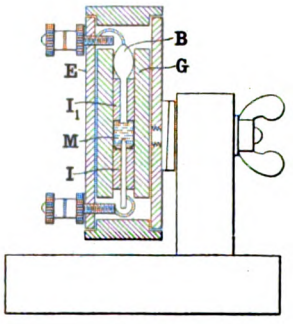

FIG. 2.

tantalum wire passing through it and projecting about 1/20 in., inserted so that the tantalum glass surface just dips into or under the mercury surface. The best (most sensitive) position is that shown in Fig. 2, with the glass tube vertical, and the tantalum electrode at the top, and this gives a detector which may be roughly shaken or tapped during the reception of signals, without affecting their sound in any way. For sealing up, the whole arrangement is encased in an ebonite tube, *E*, and the ends filled in with insulating compound.

As it seemed somewhat remarkable that such exceedingly good results should be obtainable with tantalum, the first metal tried, a series of experiments was carried out, using mercury in conjunction with other metals hitherto untried by the author, especially those which are most resistant to the action of mercury.

In the case of the metals, iron, steel, nickel, and tungsten, and "Eureka" resistance alloy, it was found quite impossible to obtain anything but a "perfect" contact, and no effect at all was obtained with vanadium, molybdenum, cobalt, manganese, tellurium, zirconium, ferro-silicon, ferro-manganese, ferro-nickel, nor with antimony or bismuth. Trying pure tantalum with different solid metals, it was found that a sensitive and moderately loud spontaneously restoring detector can be made by placing a tantalum point so that it bears on an iron surface (best oxidised). An equally sensitive but not quite so loud detector is obtained with a similar arrangement, but using tantalum and tellurium. A very weak effect was observed with cobalt, antimony, manganese, and bismuth in this order of decreasing loudness, while with molybdenum and vanadium there was no effect whatever. But with all these coherers one has only to compare them with the tantalum point dipping into mercury to realise that they are hopeless as practical competitors.

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ELECTRIC TROLLEY OMNIBUSES

THE following is an abstract of the report of a sub-committee appointed by the Tramways Committee of the Dundee Town Council to investigate the practicability of a system of railless electric trolley omnibuses for public service in the outlying parts of Dundee.

For some years there has been a strong local demand for some form of vehicular transit in the Clepington Road. Various reports have been prepared, all going to show that, from a financial standpoint, it was impossible to lay down an ordinary tramway in this district. In the 1907 Provisional Order, powers were taken to run motor omnibuses within the city. At a meeting of the committee on March 9th last, it was resolved to instruct the manager to report as to the propriety of running motor omnibuses between Maryfield and Fairmuir via Clepington Road, and to ascertain whether the Board of Trade would permit overhead wires in connection with the installation of the trackless car system. Subsequently the manager submitted his report, which went to show that the trackless trolley system was the most practical and cheapest form of locomotion for a district where the traffic would not warrant the laying of rails, and a sub-committee, consisting of Convener A. Speed, Councillor G. A. Johnstone, Mr. P. Fisher (Tramways Manager), and Mr. H. Richardson (Electrical Engineer), was appointed to visit places on the Continent where such a system was in operation, as no town in Britain had yet adopted it. The deputation left Dundee on June 12th, and proceeded in the direction of Düsseldorf to a town named Monheim, where a trackless system for passengers and goods was owned and worked by the community of Monheim. This system has been in operation here for a number of years, and a traffic has been developed between the railway station of Langenfeld and the town of Monheim, a distance of about two and a half miles, sufficient to warrant the laying of rails. This is an illustration of the value of the railless system in testing and developing a district before the enormous expense of laying an ordinary tramway is undertaken. The overhead poles, wires, &c., for this new system are available when an ordinary tramway is constructed along the same route on which the railless system has been operating. The system might be described as a motor-car or motor-bus obtaining its energy from an overhead wire instead of carrying a prime mover on each individual vehicle. The power is obtained from overhead wires just as is the case on an ordinary electric tramway, with this difference, that two wires are required overhead instead of one, as no earth return is available. On some systems two separate trolley poles are used, but on the more up-to-date systems only one trolley pole is required; this pole is forked near the top with a spread sufficient to allow of the two trolley heads fitting exactly on the two wires. When the deputation visited Monheim they had an illustration of what was possible in the way of distributing produce where small towns were linked up by a system such as they were inspecting. The overhead wires were carried into the goods depôt at the railway station of Langenfeld, the passenger car had a trailer waggon for goods and parcels, the parcels were transferred to the latter and the passengers taken on board the car. The run to Monheim was smartly made, the parcels were transferred to a hand cart, and the deputationists saw several large parcels delivered to different houses in the town one hour and five minutes after the train on which the parcels were brought to Langenfeld left Cologne, altogether a railway journey of something like 20 miles, 2½ miles on the trolley car, and, lastly, the transference to and delivery from the hand cart. The installation at Monheim is one of the oldest of this system, the carriages are very clumsy, with rubber tyres on only the front wheels, the rear wheels having steel tyres.

The next system to be inspected was that connecting the towns of Ahrweiler, Neuenahr, and Walporzheim. For dealing with traffic in this district many schemes have been considered. An ordinary tramway could not be laid down on account of the initial cost. Motor-buses were considered and rejected on account of the cost of working and maintenance. In 1905 it was decided to adopt the trackless trolley system, and a limited company was formed to carry out the scheme. The capital is £7,000, of which the greater portion was subscribed by the town of Ahrweiler and the rest by private persons. The line was opened in May, 1906, for both passengers and goods. In the town of Ahrweiler the streets are very narrow; the paving of the streets is of a sort of rubble, and not so smooth as most of the streets in Dundee. Between the towns the roads are macadamised and have a surface somewhat similar, certainly no better than we are accustomed to. The macadamised roads are about 23 ft. wide. Trailer cars are also used on this system for passengers. Rubber tyres are fitted to all four wheels of the trailers and the riding is comparatively smooth and comfortable. The cars are seated for 20 passengers, and are well and comfortably finished inside. The public authorities sanction a speed of 14 miles per hour on this system along the open roads. From actual figures the amount of electric energy is 0·67 of a unit per mile run, which at the price charged for current in Dundee would amount to about ¾d. per mile. The other items of expenditure are all correspondingly low. The deputationists were very favourably impressed with the serviceable character of this installation, and were thoroughly satisfied that it could be adapted for the requirements of Clepington Road and such districts.

The sub-committee next visited Mulhausen, where the very latest example of this system of traction can be seen. This town has an ordinary tramway system which was constructed and is worked by a company holding a concession for a number of years. The Zoological Gardens of the town lie at the top of a hill, access to which is obtained by a good road with steep gradients for the greater part of the distance. Large crowds of people are attracted to the Gardens, and the want of travelling facilities was very much felt by the inhabitants. The tramway company was approached with a view of getting them to lay a tramway to the Gardens. The company agreed that, as the gradients were too steep for safe working, and that the traffic would only be intermittent, they did not feel justified in constructing a line to this district. Other means were considered, and a deputation of the Council were sent to the valley of the Ahr to study the trackless trolley system in operation there. The deputation returned with a favourable account of the working of this system, and recommended that the authorities themselves erect overhead work, reconstruct some of the streets, and procure vehicles to give a service between the centre of the town of Mulhausen and the Zoological Gardens. The work was carried out on the Max Schieman system with the latest improvements. The work was completed and experimental running was carried on between May 4th and 17th of this year with satisfactory results. After this period of trial the State officials from Strassburg came to inspect the line and carriages with their equipments. During this inspection the car got beyond control of the driver on the steep hill, and but for the excellent steering arrangements on the car, and the coolness of the driver, serious consequences must have resulted. Carriages and other obstructions were on the street, a dangerous curve with a bridge was at the bottom of the hill, and while the driver was unable to retard the progress of the car he was able to steer it clear of all danger. After this experience the State authorities demanded that the vehicles be fitted with more powerful and effective brakes; this has now been done, but another difficulty has arisen between the State authorities and the municipality. The State authorities claim that the system is a railway, and liable to all statutory obligations as such. The local authorities argue that it is only an ordinary road vehicle, deriving its power from an electric circuit instead of being drawn by a horse. Till this question is settled the cars will not be allowed to run. The sub-committee went over the route and found that the gradients were steeper than the steepest part of Albert Street, Dundee, and certainly should not be operated on without very efficient safety appliances.

While the cars here are lighter and more up-to-date than any that had previously been seen, still there are features in them which would unsuit them for British requirements.

The report continues:—During our visit of inspection we corresponded with the manufacturers of the chassis and equipments for this form of traction. They informed us that it was their desire to do business with us through a syndicate in London which had been formed to push this system in Great Britain, we also communicated with the London people from various places on the Continent, and we arranged that one of our number should have an interview with them on our return to London. The results are that draft specifications and approximate estimates of cars have been submitted to us, and we are now in a position to give the committee some idea what it would cost to install such a system on the Clepington Road and provide three cars for the purpose of giving a service thereon if the committee resolve on such a course.

The following are the conclusions appended to the report:—

(*a*) The trackless trolley system of traction is undoubtedly practicable and well suited for routes where the traffic would not warrant the construction of an ordinary tramway, and the sub-committee are satisfied that there is more likelihood of success with this system than any other. (*b*) That the Clepington Road (from Forfar Road to Strathmartine Road) should without delay be equipped with this form of traction. And, further, if the Town Council adopt this recommendation for the limited area already mentioned, the councillor members of the sub-committee are of opinion that the railless system should, as early as possible, be extended from Strathmartine Road via Loons Road to Lochee, thus forming a splendid circular tour by car via Maryfield, Clepington Road, and Lochee, or *vice versa*, and at the same time providing a much-needed connection between Lochee and the north end of the city. (*c*) In the event of the committee and the Council resolving to install the railless system on any route, instructions should be given for submitting all details of the proposals to the Board of Trade.

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LONDON COUNTY COUNCIL TRAMWAYS

Accounts for year ended March 31st, 1908

THE accounts for the year ended March 31st, 1908, in connection with the London County Council's tramway undertaking have now been made up, and are reported upon by the Highways Committee. The tramways system on March 31st, 1908, extended over a total length of 119¾ street miles, being 68⅜ miles of electric lines and 51⅜ miles of horse lines, the whole of which is worked by the Council with the exception of a short length of ⅜ mile (double line) in Archway Road, Highgate, which is worked by the Metropolitan Electric Tramways, Ltd. The capital expenditure on the undertaking up to March 31st, 1908, amounted to £8,414,590 15s. 11d., of which £1,468,280 4s. 11d. represents expenditure during the year 1907-8. The total debt repaid up to the same date amounted to £819,376 18s. 11d. out of revenue, and £264,515 18s. 2d. from the proceeds of sales of horses and old materials, &c. The debt outstanding on March 31st, 1908, was £7,330,697 18s. 10d., or, dededucting £68,558 for the value of surplus land, £7,262,139 10s. 10d.. The Council decided on June 23rd, 1908, subject to the approval of his Majesty's Treasury, to repay the debt (estimated at £961,954) on the capital which will have become obsolete at March 31st, 1914, owing to the electrification of horse-tramways, within fifteen years from that date. The present position with regard to this obsolete capital expenditure has accordingly been shown in the accounts for 1907-8. The amount of obsolete capital on March 31st, 1908, was £978,843 14s. 11d. Deducting the debt in respect of such capital repaid out of revenue, viz., £203,243 3s. 4d., the outstanding debt is £775,600 12s. 7d.

The total receipts from the undertaking during the year were £1,663,031 16s. 3d., and the working expenses £1,170,115 12s. 2d., leaving a surplus on working of £492,916 4s. 1d. There was a deficit on the horse tramways of £57,362. After deducting debt charges, &c., there remains a net balance of £45,406 3s. 8d., the whole of which, together with the balance brought forward from the year 1906-7 of £5,923 1s. 11d., a total of £51,329 5s. 7d., has been carried to the renewals fund as on March 31st, 1908.

The Council decided on June 23rd, 1908, that provision should be made for renewals at the rate of two-thirds of a penny for each car-mile on the total car-mileage run on the electric tramways each year; and that the question of the adequacy or otherwise of this provision should be again considered at the expiration of five years. Provision for the year 1907-8 on this basis would necessitate the setting aside of £71,086, and similar provision in each year of electrical working would, with accumulations, have amounted at March 31st, 1908, to £196,741 (£200,733, less expenditure £3,992).

The Council also decided, on June 23rd, 1908, on the recommendation of the Finance Committee, that a "General Reserve Fund" to provide for general contingencies, should be established, and that to form the nucleus of this fund, the sum of £34,634, being the amount of £30,772, the total of the renewals reserve fund on April 1st, 1904, in respect of the horse system, together with interest accumulated to March 31st, 1908, should be transferred to the fund. The accounts give effect to these decisions of the Council.

The total standing to the credit of the renewals reserve fund at March 31st, 1908, was £193,256. Deducting the amount now transferred to general reserve, £34,634, the balance of the renewals fund, as now constituted, is £158,622.

The total operating expenses for electric traction were £724,381 10s., including £6,736 6s. for special charges, or 6·79d. a car-mile run, as compared with 7·06d. a car-mile in 1906-7. The toal working expenses in connection with horse traction amounted to £445,734 2s. 2d., or 10·73d. a car-mile run. Considerable loss was sustained during the reconstruction of horse lines for electric traction, as not only were some of the routes entirely closed, but sections of other routes had to be closed, and this disorganised the whole traffic on important through routes.

The following further facts may be of interest to the Council. The system on April 1st, 1907, included about 58 miles of electric tramways, and during the year a further length of about 10 miles was opened, making a total of about 68 miles. The lines opened during the year are the new tramways from the Obelisk, Lewisham to Lee, from Defoe Road, Tooting, to Tooting Junction and to Merton, and from Goose Green to Peckham Rye, and the reconstructed tramway routes from Great Eastern Street to Norton Folgate, along Hackney Road, along City Road (from Old Street) and Pentonville Road, along Goswell Road, along Gray's Inn Road, and from Highgate to Highbury. The average fare per passenger was 1·05d., the same as in 1906-7.

The total number of units generated during the year at the Greenwich generating station was 51,805,633, and the cost amounted to 0·570d. a unit, including interest and sinking fund charges, as compared with a cost during 1906-7 of 0·676d. per unit. These figures relate to generation only.

The toal number of passengers carried during the year was 372,515,754, of which 279,166,461 were carried on the electric cars. The total number of car-miles run was 35,561,189, electric traction being represented by 25,591,028.

The Finance Committee, in reporting upon the accounts, states that there are certain features to which they think it desirable to direct the attention of the Council. The accounts follow the same general lines as adopted last year, but as the result of the recent decisions of the Council on Messrs. Peat and Pixley's report, the balance sheet shows separately the proportion of the capital expenditure on horse traction which had been rendered obsolete up to March 31st, 1908, by the conversion of the lines to electric traction, and *per contra* the amount of debt thereon repaid out of revenue. This shows that the outstanding debt in respect of obsolete capital up to March 31st, 1908, was £775,601. Moreover, the details of expenditure have been relegated to the supplemental statements; the "renewals reserve fund" has been altered to "renewals fund"; and a "general reserve fund" has been formed.

The surplus for the year is £14,529 less than the original estimate, and £25,174 less than the revised estimate of the year based on nine months' working prepared in connection with the estimates for the current financial year. The interest and sinking fund charges met out of the surplus of £492,916 amounted to £450,024 (£17,604 less than the original estimate, which made too large a provision for charges on estimated further expenditure), and other charges against the surplus reduce the balance for the year to £45,406. This shows a slight improvement over the original estimated surplus balance for the year (£41,788), but is £21,141 less than the revised estimate.

The renewals fund has been increased by the net surplus of £45,406 and by the balance on the appropriation account on April 1st, 1907, of £5,923 and dividends on stock and interest on the cash balance during the year. Expenditure on renewal of special work amounting to £3,993 and expenses of investment £192 were defrayed out of the fund.

In accordance with the resolution of June 23rd, 1908, a sum of £34,634 in respect of the balance on March 31st, 1904, of the renewals reserve fund of the horse system (£30,772), together with accumulations to March 31st, 1908, at 3 per cent., was transferred to a special fund to be called the "general reserve fund," leaving the balance on the renewals reserve fund on March 31st, 1908, of £158,622. Provision for renewals at two-thirds of a penny per car-mile, the basis recently adopted by the Council, would require £71,086 in 1907-8, as compared with £45,406, the actual surplus of the year, but the results of the year were adversely affected by the reconstruction works which were in progress. If provision for renewals at two-thirds of a penny per car-mile had been made from the beginning of the working of the electric lines, the total amount with accumulations would bring the total in the fund to March 31st, 1908, up to £196,741, as compared with the present amount of £158,622, so there is a shortage of £38,119. Allowing, however, for the amount of £34,634 transferred to the general reserve fund, the shortage is reduced to £3,485. £142,000 of the fund has been invested—£122,900 in L.C.C. stock and £20,000 in National War Loan. The market value of these investments on March 31st, 1908, was £140,482.

Tramway Proposals for 1909.

The Highways Committee have presented their annual report with regard to new tramways for which powers should be sought in the next session of Parliament. This deals with the matter under two heads :—(1) Schemes designed to facilitate the electrification of certain routes which still continue to be worked by horse traction owing to the width of the thoroughfares which they traverse being in parts insufficient for a double line of electric tramways; and (2) proposals for the construction of new tramways in extension of the existing system or for the purpose of connecting up detached portions of the tramways. The total estimated cost of constructing and equipping the proposed new lines is £403,430. The estimates are based on the use of conduit traction in each case, except as regards the proposed lines from Harrow Road to Edgware Road, *via* Sutherland Avenue, and from Wandsworth to Putney Bridge. This first-mentioned line, it is suggested, should be constructed for overhead traction, so that it may be worked in conjunction with the existing lines in Harrow Road which are already running on the same system, while the Wandsworth to Putney tramways will connect with the Hammersmith to Putney lines which it is proposed to construct on the overhead system The other tramways would, for the most part, be worked in close relationship with existing conduit routes, and for this reason it has been thought advisable to give the cost as for that system, as it would probably be economical from the point of view of working expenses and the convenience of the traffic not to introduce a fresh system. This, however, will not preclude the Council, should the schemes be authorised, from arranging, subject to the terms of the Act of Parliament, for the adoption of any other system if special circumstances make that course desirable.

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(i.) *From Harrow Road*, via *Sutherland Avenue, to Maida Vale.*—Length of tramway, about 5 furlongs 5·5 chains. Estimated cost of construction and equipment for the overhead system of electric traction, £20,240. This tramway will connect the existing lines in Harrow Road, which are about to be purchased by the Council, with Edgware Road, and represents an instalment of other lines for which legislation will be promoted in a subsequent session.

(ii.) *From the existing tramways in Farringdon Road*, via *that thoroughfare, to a point opposite the north side of Charterhouse Street.*—Length of tramway, about 2 furlongs 4 chains of double line. Estimated cost of construction and equipment, for the conduit system of electric traction, £21,470. This is an extension beyond the present terminus of the horse tramways now running between King's Cross and a point near Farringdon Road station. It will take the tramways to a point adjoining the City boundary, and will be a considerable convenience to those desiring to reach the portion of the City adjacent to Holborn Viaduct and Snow Hill, and also to persons working in the meat market. A proposal for the electrification of lines as far as the terminus is under consideration.

(iii.) *From Mare Street* via *Victoria Park Road to Wick Road.*—Length of tramway, 1 mile 1 furlong 9 chains of double line, 3 chains of single line; total, 1 mile 2 furlongs 2 chains (route miles). Estimated cost of construction and equipment for the conduit system of electric traction, £54,890. This proposal will provide direct electric tramway communication between the densely-populated residential districts adjoining Victoria Park and the various City and West End termini of the Council's tramways *via* Hackney Road, Clerkenwell Road, &c.

(iv.) *From Essex Road*, via *Englefield Road and Stamford Road, to Kingsland Road.*—Length of tramway, about 5 furlongs 5 chains of single line. Estimated cost of construction and equipment for the conduit system of electric traction, £19,380. (iv*a*.) *Junction line between Kingsland Road and Dalston Lane*—Length of tramway, 1·6 chains of single line. Estimated cost of construction on the conduit system of electric traction, £650. (iv*b*.) *From Kingsland High Street*, via *Ridley Road and Dalston Lane to Amhurst Road*—Length of tramway, about 6 furlongs 3 chains of single line. Estimated cost of construction and equipment for the conduit system of electric traction, £23,800. These schemes together provide an alternative single line route of tramways to the existing lines in Essex Road, north of Englefield Road, Ball's Pond Road, Dalston Lane, and Graham Road to Mare Street. This route is at present worked by horse traction. The same proposals were included in the schemes for Parliamentary powers adopted by the Council in the years 1906 and 1907, but the Council was unsuccessful in obtaining the consent of the Hackney Metropolitan Borough Council to the introduction of a Bill to authorise them. It is hoped on the present occasion that the Council may be able to present the facts in such a way to the borough council as to obtain its consent to the scheme.

(v) *From New North Road* via *Shaftesbury Street and Shepherdess Walk, to City Road.*—Length of tramway 4 furlongs 2 chains of single line. Estimated cost of construction and equipment, on the underground conduit system of traction, £13,960. This tramway is intended to provide an alternative route to the portion of the existing tramways in East Road and New North Road, which lies between Shaftesbury Street and City Road. Between these two points the thoroughfares traversed by the lines are very narrow, and a considerable portion of the tramways consists of single line. To electrify this portion of the tramway as a double line would involve a very considerable outlay for street widenings.

(vi.) *From Battersea Park Road*, via *Battersea Bridge Road, Battersea Bridge and Beaufort Street, to King's Road.*—Length of tramways, 7 furlongs, 9 chains of double line. Estimated cost of construction, on the conduit system of electric traction, £59,850.

(vii.) *From Battersea Bridge* via *Cheyne Walk, Cremorne Road, Ashburnham Road, Tadema Road, Gunter Grove, Finborough Road, Warwick Road, and Holland Road to Uxbridge Road, with single line diversion* via *Edith Grove, Redcliffe Gardens and Richmond Road.*—Length of tramway, about 1 mile 7 furlongs 3 chains of double line, and 1 mile 5 furlongs, 7·5 chains of single line. Estimated cost of construction and equipment for the conduit system of electric traction, £135,470. The route suggested provides for single lines being constructed as alternative routes to each other, (1) from Cremorne Road *via* Edith Grove, Redcliffe Gardens, and Richmond Road, and (2) *via* Cremorne Road, Ashburnham Road, Tadema Road, Gunter Road, and Finborough Road, to the south end of Warwick Road. Throughout the remainder of the route a double line will be constructed along the main road. This route would connect up the Council's southern tramway system with the London United Tramways, which at present come to a dead end at Shepherd's Bush, and the portions of which within the county are purchasable by the Council in 1909.

(vii*a*.) *From Battersea Bridge* via *Cheyne Walk, Cremorne Road, Ashburnham Road, Tadema Road, Gunter Grove, Finborough Road, Warwick Road, and Holland Road to Uxbridge Road, with single line diversion* via *Ifield Road and Adrian Terrace.*—Alternative scheme to No. vii. above outlined, and provides for a double line throughout the main route, with the exception of a short distance in Ashburnham Road, where a single line will be laid. It is, however, suggested that a single line only should be laid in Finborough Road, between Fulham Road and Ifield Road, for dealing with the traffic in one direction, a single line being constructed along Ifield Road and Adrian Terrace for the traffic in the other direction. The cost of the construction and equipment of the tramways for the conduit system of electric traction will be about the same whichever route is adopted, although the cost of street widenings along the latter route will, we understand, be greater. Reference to this will no doubt be made in the report of the Improvements Committee.

The road authorities affected by the proposal, viz., Chelsea, Hammersmith, and Kensington Borough Councils, have not yet been consulted.

(viii.) *From York Road, Wandsworth*, via *High Street, Wandsworth, West Hill, Upper Richmond Road and High Street, Putney, to Putney Bridge, with single line diversions* (*a*) via *Buckhold Road, a new street between Buckhold Road and Broomhill Road, and Broomhill Road and* (*b*) via *Oxford Road and Putney Bridge Road.*—Length of tramway about 6 furlongs 5 chains of double line and 1 mile 4 furlongs of single line. Estimated cost of construction and equipment for the overhead system of electric traction, £53,740. This scheme provides for alternative single lines to portions of High Street, Wandsworth, and High Street, Putney, where the construction of a double line throughout would involve very expensive street widenings. The total length of line involved is 17 miles 1 furlong 3·1 chains, single line, and the total cost, £403,450.

Dealing with existing lines, the report recommends the reconstruction of portions of the London, Deptford, and Greenwich horse tramways from Tooley Street to Deptford, and proposes an extension to near London Bridge, and from Deptford to Greenwich; also with the reconstruction of the Highgate Hill cable tramways and a portion of the Woolwich and South East London tramways. These will all be dealt with upon the conduit system at a total cost of £297,850, the total length being 12 miles 1 furlong 8 chains single line.

A CRANE INSTALLATION WITH BATTERIES

WE have received from the D.P. Battery Co. some particulars of an installation at Southampton, where one of their storage batteries is used to equalise the load in connection with a series of electric cranes. These cranes take an average current of 250 amperes, at a line voltage of 500-525. The current fluctuations are necessarily severe with this type of work, and vary from 0 to 800 amperes. With the aid, however, of a battery and reversible booster, this load is very successfully dealt with by one 150 h.p. producer gas engine—another similar engine being in reserve. The engines are direct coupled to generators capable of an output of 192 amperes at 520 volts, with a 15 per cent. overload for half an hour. The coal consumption with the engines working at full load is 1·5 lb. per kw.-hour. The battery consists of 245 cells of the standard "L.S." 15-plate type, in wood lead-lined boxes, capable of discharging at 500 amperes for one hour, or at 1,000 amperes for short periods. The positive plates are about half an inch thick, and very solidly constructed to stand the heavy rates of charge and discharge. The formation of the plates is the "D.P." Battery Co.'s special Planté process, and consists of a thin hard skin, which is practically proof against disintegration—a very necessary qualification with a load such as the one in question. The cells are burnt up throughout, and the inter-row and terminal connections consist of 1 in. diameter copper rod. The battery is erected on single-tier stands, mounted on concrete blocks. The booster, made by the Lancashire Dynamo & Motor Co., is so adjusted that the engines can be set at any desired load, and all variations above or below this load are taken care of by the battery and booster. From the records taken at this station the value will be appreciated of the services rendered by the battery and reversible booster, as, with the line load fluctuating from zero to 800 amperes, the variation in the generator load is only about 15 amperes above and below the mean. The connections of the switchboard are so arranged that (1) the battery can be put into line by itself; (2) the battery and booster can take the load without the generators, the booster being adjusted so as to give an over-compounding effect; (3) the battery and booster can be put on the line in parallel with one or both engines, one engine being the normal running condition of things. In the unlikely event of both sets being temporarily disabled, the battery could keep all the cranes going for over three hours; thus the station is amply safeguarded against an interruption of supply. Besides the advantages in installing storage batteries, briefly alluded to above, a very considerable economy is effected in the size and first cost of the whole generating plant, in addition to the saving in daily working expenses and wear and tear of plant. The consulting engineers were Messrs. Lacey, Sillar, & Leigh.

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ELECTROCHEMISTRY AND ELECTROMETALLURGY

IN the issue of the ELECTRICAL ENGINEERING of July 9th, we referred to an article by Frank B. Easterbrooks upon the Rartan Copper Works, which is, we believe, the largest electrolytic refining works in the world. Mr. Easterbrooks published the final part of this article in the July number of *Electrochemical and Metallurgical Industry*, this part of the article being devoted chiefly to the working up of the slimes and refining of bullion. The slimes are first screened through copper plates with one inch perforations, and then through a slotted copper screen equivalent to 40 mesh; by this means the bulk of the loose copper particles are removed. The slimes after this treatment are pumped from the tank-house to receiving tanks on the top of the slime room, centrifugal pumps lined with antimonial lead being employed. All overflow water and washing water which has been used for the washing of slimes in the filter press is returned to the tank-house. The slimes themselves are run from the receiving tanks into circular lead-lined tanks and boiled with sulphuric acid, sodium nitrate being added to hasten solution. Hard lead paddles containing 10 to 12 per cent. of antimony are rotated in the tanks, thus preventing the slimes from settling to the bottom in a solid mass. When the copper in the slimes is reduced to a very small quantity the mixture is transferred to an "egg," this being a lead-lined cast-iron vessel. From there they are forced by compressed air into a Bushnell filtering press where they are washed free from copper sulphate. Lead antimony alloy is used for the rings and plates of the press as it is found that copper or copper alloys become greatly attacked. The pressed slimes which are now in the form of cakes, are dropped from the press directly into trucks which run beneath it. They are then sampled, the amount of gold and silver being determined, weighed, and transferred to the furnace department. It should be mentioned that after the slimes have been screened, still from 8 to 18 per cent. of copper remains in them, and the boiling process with acid just referred to is to remove this copper. This gives an idea of the extremely fine state of division which is caused to the anode by electrolytic corrosion. Unfortunately the copper extraction by this method, although it occurs in the slimes in very minute particles, is very slow, and it is remarked that there is room for much research in order to devise an improved process to remove the copper. At present 10 to 15 days is required to ship the finished slimes as fine gold and silver calculating from the date they are received from the tank-house. In the furnace room the slimes are smelted, air being at the same time blown over the molten surface until they reach 98-99 gold+silver. Oil fuel is used in the furnace. Tellurium is one of the last impurities to be removed from the silver bullion, considerable loss of silver at the same time taking place. The refined bullion is cast by hand into thin plates, these forming the anodes for the electric parting plant. The cells used in the parting plant are constructed of white acid-proof stone ware, and the bottoms are lined with flat slabs of carbon carefully jointed together; these form the cathodes. The anodes are set slightly inclined from the horizontal, thus allowing solutions of heavy sp. gr. which are formed during electrolysis to more readily mix with the electrolyte below. The cathode contact pieces are made of fine silver, and last indefinitely. The anode contacts of bullion are made in specially constructed moulds, a threaded end being cast directly from the hot metal. The plant is so arranged that one aisle is used entirely for the removal of the deposited silver, and the adjoining one for the removal of the gold mud which remains upon the canvas tray placed beneath the anodes and over the cathodes. After drying and washing, the silver is melted down in a tilting crucible furnace; from this it is cast into bars weighing about one thousand troy ounces; the final product being 1,990 parts per thousand fine silver. The gold is melted down and refined as usual.

We understand that the Aluminium Corporation, Ltd., have every reason to be satisfied with their furnaces which were started some little time ago at Wallsend-on-Tyne, the quality of the metal produced never having fallen below 99 per cent. of the pure metal. Visitors to the Machinery Hall at the Franco-British Exhibition may see sample ingots in the exhibit of the Aluminium Corporation, Ltd. In connection with the furnaces, works for producing carbon electrodes have been erected which will be sufficient to supply the whole of the company's requirements, both at Wallsend and Dolgarrog. One of the three carbon electrode furnaces to be installed has already commenced operation. The company have also valuable bauxite properties in France in the Var district, and they are now mining the bauxite for the production of alumina. They have entered into arrangement with the United Alkali Co., of Newcastle-on-Tyne, who have works at Hebburn, close to Wallsend, to work up the crude material. To refine the bauxite a subsidiary company has been registered entitled the Bauxite Refining Company, three-quarters of the capital being held by the Aluminium Corporation, and the rest by the United Alkali Company. This subsidiary company will purchase bauxite at a fixed price from the Corporation, and will in return supply them with pure alumina. These bauxite refining works are very favourably situated from the point of view of cheap fuel, cheap power, and good transport facilities. In fact, it is claimed that alumina can be more cheaply produced here than at any other place in Great Britain. It is hoped that the alumina works will be ready to commence operations in January next, when it is expected employment for about 200 working people will be afforded. Owing to the great demand for aluminium sheets we understand that the Aluminium Corporation have lately included an agreement with an important firm on Teesside, in the neighbourhood of Middlesbrough, who will equip rolling mills in order to produce aluminium sheets, and also mills for the drawing of aluminium wires. The Welsh undertaking is stated to be progressing rapidly, and hopes are held out that operations may commence there in the autumn.

In *Electrochemical and Metallurgical Industry* of July, Mr. A. R. Betts, in the Correspondence Column, supplements the article by Mr. F. B. Croker, which appeared recently (ELECTRICAL ENGINEERING, Vol. III., page 635), upon diaphragms. Mr. Betts says that asbestos is the best all-round material available for diaphragms, the chief difficulty being to support the asbestos in the position it is required to occupy. He has successfully made diaphragms by forcing with moderate pressure, wads of moist asbestos into $\frac{5}{8}$ inch to 1 inch round holes bored in $\frac{5}{8}$ inch to $\frac{3}{4}$ inch boards. Another and probably better method is to place several thicknesses of asbestos paper between two perforated lead sheets, or perforated wood or rubber sheets, depending upon the nature of the solution with which the diaphragm is to be employed. The resistance of such a diaphragm made, *e.g.*, of 4 lb. lead perforated with $\frac{3}{8}$ holes, is practically negligible, and the lead does not ordinarily act as a metallic conductor. He says, however, that the best diaphragm for ordinary weak acid solutions, is made as follows. Powdered sulphur is evenly sifted over a $\frac{1}{4}$ inch asbestos mill-board, and heat is evenly applied an hour or so to the board at a temperature slightly higher than the melting point of sulphur. The operation is then repeated with the reverse side. Such diaphragms have a very good life.

ELECTRICAL SCIENCE

British and American

Susceptibility of Copper and Tin Alloys.—In the June *Physical Review* O. C. Clifford gives the results of a long series of measurements which had as their object the determination of the law connecting the magnetic susceptibility of copper-tin alloys with percentage composition. The apparatus used consisted of an electromagnet with the north pole vertically over the south pole, and with both poles bored by a central vertical hole. Through the hole in the upper pole the phosphor-bronze ribbon of a torsion pendulum passed and supported a disc of celluloid, which floated horizontally between the pole faces. The disc carried two small equal pieces of bismuth placed symmetrically. Four small iron pegs, two in each pole face, concentrated the magnetic field at the two symmetrically-placed points, where the bismuth rested when no field was on and when there was no torsion in the phosphor-bronze suspension, and, therefore, when the field was thrown on the bismuth was repelled from its zero position through an angle which was measured by mirror, scale, and telescope. The specimens of copper-zinc alloys to be tested were all the same size and shape, and were laid on the bismuth pieces on the suspended celluloid ring. There was an increase or a decrease of deflection, according as the added specimen was diamagnetic or paramagnetic. The tin used in the making of the alloy was specially purified for these experiments. Its susceptibility was found to be $+0{\cdot}31\times10^{-6}$; that is, it was very slightly paramagnetic and not diamagnetic, as Faraday found it in 1845. Probably there was still a slight iron contamination. The copper was native, and gave a susceptibility of $-1{\cdot}88\times10^{-6}$. Seven alloys were made and examined. As the proportion of tin increases from zero the negative susceptibility increases till a maximum is reached, when the tin is by volume one-third of the volume of the alloy. This is the alloy known as speculum metal; the susceptibility is

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about $-2{\cdot}1\times10^{-6}$. The author gives his full results in the form of tables. These tables include the determinations made with magnetic fields varying from 250 to 700 C.G.S. units.

Continental

Electric Fatigue of Metals.—Some six years ago Dr. Jagadis Chunder Bose, of Calcutta, described an effect which closely resembles the fatigue observed in animal and vegetable tissues. When a wire, immersed in an electrolyte, is suddenly twisted, it sends an instantaneous current through a galvanometer. Repeated twistings show a gradual diminution of the current, but after a period of rest it recovers. A good deal of light is thrown on this curious phenomena by the Papers which appear in the *Comptes Rendus* for July 6th. One of them is by E. Guillaume, and the other by Jean Perrin, both well-known experimenters. The former finds that the effect is not observed when the wire is perfectly clean. An oxidisable wire shows it as soon as a thin layer of oxide is formed. A silver or platinum wire may also be made to show it by covering it with a thin porous coating of non-conducting material, such as silver, oxide, kaolin, or gelatine. The amount and sign of the effect may be predicted from the rules of electric osmosis. Perrin supposes that a thick electric double layer forms inside the porous film, and that ions of one sign are squeezed out by the torsion, thus giving rise to a p.d. and a momentary current. The process cannot be compared to the process of vital fatigue.

Stability of the Arc.—C. E. Guye and A. Bron have investigated the connection between the period of extinction of the metallic arc and the kind of metal employed for the electrodes. In the *Comptes Rendus* for July 6th, they announce an interesting relation which appears to exist betwen the p.d. and the atomic weight of the metals. The effective p.d. required to keep an alternating arc steadily burning is the higher the greater the atomic weight of the metal. With a current of 0·04 effective amperes, it ranges from 640 for carbon (atomic weight 12), 700 for magnesium (24), 850 for iron and nickel (56, 59) to 1,000 volts for platinum (194), and 1,070 for gold (197), the length of arc being 5 mm. In cadmium, which gives off thick vapours, the p.d. is exceptionally small, being only 725 effective volts with an atomic weight of 111. This is the only exception however. Two explanations suggest themselves. According to Dulong and Petit, the specific heat varies inversely as the atomic weight. Hence the heavier metals are cooled down more rapidly and have longer periods of extinction. Re-lighting is, therefore, more difficult. Also, if the vapour to be ionised is heavier, the ionising velocities of the electrons projected from the cathode must be greater, *i.e.*, its temperature must be higher.

More about Positive Electrons.—In the *Comptes Rendus* for July 13th. Jean Besquerel anticipates some criticisms likely to be passed on his alleged discovery of positive electrons in the free state. The easily deflected positive beam which he has observed is not identical with the beam of canal rays from which they emerge. If the willemite screen is connected with the cathode a new patch appears on it, which is only slightly deflected by a magnet. This is the original canal ray beam which the rearrangement of the field enables to travel the whole length of the three tubes. The easily deflected beam is not affected in any manner by the charge of the willemite screen. Its latter end appears to be totally unelectrified. The author appears to consider this as evidence that positive and negative electrons re-combine to form some new species of matters, perhaps identical with Righi's "magnetic rays" or even with hydrogen. But at first sight the facts seem to be covered by supposing that the undeflected beam simply consists of X-rays generated at the second cathode, which acts as an "anti-cathode." The author successfully meets the argument that the deviation of the positive beam is produced by a strong electrostatic field. The principal and secondary cathode beams may be independently deflected by two different magnets.

Lighting of Victoria Embankment.—The Highways Committee recommend that the gas-driven electric generating station upon the Victoria Embankment, which is used for the lighting of that thoroughfare, shall be abandoned in favour of a supply from the Charing Cross, West End & City Electricity Supply Co. at 1d. per unit, which will be reduced to 0·95d. per unit at the end of four years, provided the Council agrees to enter into agreement to take a supply for eight years. The difficulty arising from the fact that the Embankment is in the area of several electric lighting companies is got over by the circumstance that the distributing mains now laid for the lighting are the property of the Council, and the electric lighting company will give a supply to the Council's sub-station, from whence it will be distributed by the Council. It is stated that a saving will be made in the cost of lighting the Embankment, whilst the building now occupied by the generating station will be partly utilised as a sub-station for distributing the current, and partly for offices and accommodation for the staff of the electrical branch of the chief engineer's department, now housed in Cranbourne Street.

CATALOGUES AND PAMPHLETS RECEIVED

TESTING INSTRUMENTS & ACCESSORIES.—Messrs. Siemens Brothers & Co., of 12 Queen Anne's Gate, have just issued a very complete and profusely illustrated catalogue of testing instruments and apparatus for use with the same. The apparatus listed includes laboratory and portable moving coil instruments, dynamometer instruments, measuring transformers, Ferraris and electro-magnetic instruments, galvanometers, ohmmeters, resistance boxes, standards, testing sets, condensers, apparatus for testing iron losses, photometers, and other instruments and accessories. The following deserve special mention :—A direct-reading wattmeter, provided with two current ranges up to 200 amperes, and three pressure ranges up to 750 volts, for three-phase circuits, with unequally loaded branches.—A portable current transformer for enabling the current flowing in a single a.c. conductor, to be measured without the necessity of breaking the circuit. This consists of an iron core, the two halves of which can be unscrewed and clamped over the bare or insulated conductor. The secondary coil must be connected to an electro-magnetic ammeter, which should be calibrated with the transformer.—An apparatus for measuring the resistance of rail joints of electric railways by comparing the pressure drop across the joint against that in a given length of rail.—A portable induction bridge for measuring induction constants and the losses in inductive circuits. Large coefficients of self-induction down to about 10^{-3} Henry can be measured with this instrument.—A portable testing set for street use, consisting of a battery of 105 dry cells, and the necessary apparatus for measuring insulation, resistance, and capacity. The case is provided with shoulder-straps and collapsible legs, and weighs only 70 lb. complete, so that it can be carried by one man.—A collapsible photometer with self-contained ammeter and voltmeter, for continuous- or alternating-currents, and a Siemens-Bunsen silver-spot screen. Candle-power current, pressure, and energy consumption can be measured with this apparatus, which can be fitted with standard lamps of all powers.

CONDUIT FITTINGS.—The latest "progress sheet" from Simplex Conduits, Ltd., describes a new porcelain interior for conduit joint boxes, &c. This may be used either for making a tee or branch connection for flexible cord or fittings wire to light. The diameter permits of its being used with the standard Simplex switch ceiling rose or plug box, or circular junction boxes. The two brass contacts, which are separated by a stout porcelain fillet, have vertical saw cuts and an external thread; the insulation of the main wire is bared back sufficiently to allow it to be inserted in the vertical cut, and is then clamped down by means of a brass ring, having a female thread. The flexible cord or branch wire is treated in the same way and clamped down by a further ring. Connection can be made without cutting the main wire, ensuring good electrical contact. Some new cheap brass brackets are also illustrated on the same sheet.

VOLTMETERS.—A leaflet is to hand from the Hart Accumulator Co., of Stratford, describing their cell testing voltmeters. The scale is divided into tenths of a volt, and reads 3 volts either way, with zero in the centre. The resistance is high, enabling accurate testing. The pointer is made to point towards the positive terminal, so that the polarity may be easily determined.

SMALL TRANSFORMERS FOR METAL FILAMENT LAMPS.—The Foster Arc Lamp & Engineering Co., of Wimbledon, have issued a new list of auto-transformers for metal filament lamps. These are standardised in a very large number of sizes for secondary voltages of 25, 50, 60, 75, 80, 100, 110, 115 volts, and frequencies of 25, 40, 50, 60, 70, 75, 80, 83, 90, and 100 cycles per secondary current, varying from 4 to 100 amperes. The company claim to be the largest manufacturers of this class of apparatus. An example is worked out and given in the list showing the enormous saving that can be obtained with this system of lighting which, in the particular case taken, amounts to 71½ per cent.

NEW PUBLICATIONS

Electrical Engineering for Electric Light and Power Artisans and Students. By W. Slingo and A. Brooker. Fifth edition, revised by W. Slingo, assisted by T. F. Wall. (London: Longmans Green & Co.) 12s. 6d.

The Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages. By Kurt Deinhardt and Alfred Schlomann. Vol. III.: Steam Boilers, Steam Engines, Steam Turbines. Edited by Wilhelm Wagner. (London: Archibald Constable & Co.) 16s.

"Laboratory and Factory Tests in Electrical Engineering." By George F. Sever and Fitzhigh Townsend. Second edition. (London: Archibald Constable & Co.) 10s. 6d.

"English Prices with Russian Equivalents." By A. Adiassewich. (London: E. & F. N. Spon.) Price 1s. net.

Telephones in the Alps.—The *Globe* Rome correspondent states that the work of connecting up the various Alpine shelters by telephone with neighbouring towns, will shortly be completed.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published July 23rd, 1908

A full list of these was published in our last issue. The following are abstracts of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

15,262. **Motor Starting and Controlling Switch.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). A motor switch, with the starting and speed varying arms so interlocked that the motor cannot be started up unless the field resistance is short-circuited. The field resistance also cannot be inserted until all the armature resistance is cut out. A no-voltage release is provided. Three claims, four figures.

24,138. **"Jandus" Enclosed Flame Arc Lamp.** A. D. JONES. This specification describes the particular arrangement of inner and outer globes, and the air-tight fixtures adopted in the construction of the "Jandus" enclosed flame arc lamp described in ELECTRICAL ENGINEERING, Vol. III., p. 299. An abstract of the specification, giving the composition of the salts carried by the positive electrode in this lamp, was given on page 365 of ELECTRICAL ENGINEERING, Vol. III. The arrangement described in the present specification permits of the withdrawal of the inner cylinder and lower (positive) carbon without the removal of the outer globe. Three claims, one figure.

24,707. **Manufacture of Metal Filaments.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). One method of increasing the specific resistance of a metal is to add to it a small quantity of another metal. The increase in resistance is generally accompanied by a lowering of the melting point, and this is particularly the case with tungsten and other difficultly fusible metals. The addition of a small amount of silicon to tungsten, however, raises the specific resistance to three or four times the original value without seriously lowering the melting point. According to this invention, silicon, produced by the reduction of silica in the electric furnace, is powdered and mixed with powdered tungsten in the proportion of 5 per cent. of silicon to 95 per cent. of tungsten. The mixture is bound with an alloy of equal parts of cadmium and mercury, and squirted through a diamond die at a temperature of about 150° C. The resulting filaments are baked and then sintered, so that the final filament consists of tungsten and silicon only, possibly in some chemical combination. Such filaments are said to have a specific resistance three or four times as high as pure tungsten filaments, and yet a fusing temperature and an operating efficiency substantially the same as that of the pure tungsten filament. Three claims, no figures.

26,642. **Protective Device for High-tension Systems.** E. L. CREIGHTON. The usual spark-gap connected between a line conductor and ground will relieve the line of any charge producing a potential higher than that necessary to overcome the resistance of the gap. Once the gap resistance is broken down, however, an arc is established, and there is practically no resistance to the flow of line current. This invention consists in employing a spark-gap, in which at least one of the terminals is an electrolyte. The difficulty of maintaining an arc with an electrolyte as a cathode is so great, that so long as the line voltage is less than about 1,500 volts, the arc is extinguished directly the lightning or other high-potential charge has gone to earth. For line pressures higher than 1,500 volts, a number of such gaps in series must be used. The gap is constructed as a cell containing a solution of potassium and sodium carbonates. The two copper electrodes, which project downwards to within a short distance from the surface of the electrolyte, are separated by a partition extending below the surface of the electrolyte. An ordinary spark gap in series with a battery of such cells, prevents any continuous leakage to earth over the surfaces of the cells. Experiments have shown that the discharge through such cells, due to a rise of potential, never lasts for more than a fraction of a half-cycle. A modified form of cell has no metal electrodes, the discharge taking place between two electrolytes. Four claims, thirteen figures.

1908 Patent

5,279. **"Liconite" Insulating and Impregnating Compositions.** E. S. ALI-COHEN. An insulating material described in specification No. 8,071 of 1902, consists of a mixture of purified asphalte and petroleum in proportions varying between 70 : 30 and 40 : 60 per cent. respectively, according to the consistency required. The asphalte is previously heated for a long period at a temperature of about 160° C.; and then the petroleum, a solution of aluminium aceticum, some colophony, and an alkali are added. According to this specification the hard jet-black product, produced as above, is mixed with a vegetable oil such as castor oil, linseed oil, colza oil, or wood oil. The oil is first dried, and then oxidised by boiling with from one to three per cent. of peroxide of manganese. The mixture of oil and petroleum-asphalte compound is heated, cooled down, and a vulcanising agent, such as sulphur, added; it is then reheated to effect vulcanisation. The product is passed through heated rollers and then resembles vulcanised india-rubber, being strong, elastic, and impervious to water. In this state it is suitable for the insulation of high-tension cables. To produce an impregnating liquid, the above mixture, of the previously patented composition and a vegetable oil, is not vulcanised, but is mixed with benzine or some other solvent. Five claims, no figures. (Some high voltage tests, on some cables insulated with the elastic material and also tests on paper-cables impregnated with the impregnating liquid, were described in ELECTRICAL ENGINEERING, Vol. III., p. 803.)

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Summaries of the more important of these patents will appear in our next issue.

1907 Patents

8,079, LEONARD. Control of electric motors.
12,967, RORKE & RORKE. Switch.
13,206, ARTHUR. Controlling system for electric railways.
15,634, EBERT. Control of electrical devices.
15,789, EDGAR. Telegraphic receiving instruments.
15,798, KUZEL. Metal filament lamp.
15,830, FENNELL & PERRY. Mould for casting accumulator grids.
16,034, THOMSON. Pocket electric lamp.
16,067, RAMSAY. Manufacture of nitric acid.
16,068, RAMSAY. Manufacture of oxides of nitrogen.
16,073, WILLIS (*Waring*). Electrically-operated cloth-cutting machines.
16,137, ALLGEMEINE ELEKTRICITÄTS GES. Signalling systems.
16,175, MORGAN CRUCIBLE CO., & MCCOURT. Means for attaching flexible conductors to commutator brushes.
16,431, STEARN & TOPHAM. Electric incandescent lamps.
17,817, HYDE. Joints in metal filament lamps.
18,661, GILFILLAN. Brake for tram cars.
20,919, BELL. Magneto ignition machines.
21,127, OLDFIELD & OLDFIELD. Anti-vibration device for the electric lamps of automobiles.
21,363, RAWORTH & RAWORTH. Motor control.
23,116, RAILING, SOLOMON, & CROCKER. Metal-cored flame arc-lamp carbons.
23,318, HARTMANN & BRAUN AKT.-GES. Magneto machines.
23,768, SIEMENS BROS. & CO. & GRIMSTON. Electrically-controlled compasses.
28,530, MATHER & PLATT, LTD. (*Rosenberg*). Motor generators.
28,738, EBNER. Electrical ignition devices.

1908 Patents

3,507, PASSBURG. Vacuum drying and impregnating apparatus for electric cables.
5,107, SCOTT. Regulation of electrically-driven fluid compressors.
6,737, FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. Non-inductive resistances.
6,895, SIEMENS & HALSKE AKT.-GES. Electric meters.
7,480, SIEMENS & HALSKE AKT.-GES. Method of testing electrolytic valve cells.
8,065, CROMPTON & CO., MACFARLANE, & BURGE. Rotary transformers or motor generators.
9,849, BOULT (*Union Switch and Signal Co.*). Electric signalling systems for railroads.
10,121, ALLGEMEINE ELEKTRICITÄTS GES. Dynamo commutator machines.
11,524, SIEMENS & HALSKE AKT.-GES. Manufacture of metal filaments free from carbon.
12,097, RORKE & RORKE. Make and break devices.

Complete Specifications open to Public Inspection before Acceptance.

1908 Patents

11,221, SCHERL. Single track vehicles.
12,656, TIMAR & VON DREGER. Arc lamps.
14,048, SIEMENS-SCHUCKERTWERKE-GES. Overhead electric traction systems.
14,093, BARADUC-MULLER. Metallurgical process.
14,483, MARETTI. Process for rapidly mounting metal filaments in electric lamps.

Expiring Patent

The following patent expires during the current week after a life of fourteen years :—

14,988, of August 4th, 1894. **Electrolytic Cell.** E. SOLWAY. The liquid to be electrolysed flows over a rotating surface which is composed of the edges of a number of strips of platinum alternately positive and negative and insulated from each other. The roughened surface diminishes surface or capillary adhesion. A construction of cell which also enables the evolved gases to be collected separately is described.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	—	10½—11	
Do. 4½% Cum. Pref.	10	4½	4½%*	9⅝—10⅜	
Do. 6% Cum. Second Pref.	10	6	6%*	10⅛—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½%*	100—103	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	—	4⅛—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%*	94—97	
Brompton & Kensington E. S. Co.,Ld.	5	10	—	7—8	
Do. 7% Cum. Pref.	5	7	7%*	6⅞—7⅞	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%*	3½—4	−¼
Ch. Cross, W. E. & City E. S. Co.	5	5	—	3⅜—4⅛	
Do. 4½% Cum. Pref.	5	4½	4½%*	4—4½	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%*	3⅝—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	—	3—3⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	5/-*	9½—10½	
Do. 6% Cum. Pref.	10	6	6%*	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%*	3¾—4¼	
County of London Elect. Sup. Co. Ltd.	10	5	—	7½—8½	
Do. 6% Cum. Pref.	10	6	6%*	10½—11	
Do. 4½% Deb. Red	Stock	4½	4½%*	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%*	98—101	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%*	61—71	
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5½	
Do. 5% Cum. Pref.	5	5	5%*	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%*	98—101	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%*	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	—	8—9	
Do. 4% Deb. Red	Stock	4	4%*	96—99	
Kens. & N'Tng Hill E.L. Cos. Db.Rd.	Stock	4	4%*	97—101	
London Electric Supply Corporation	3	2½	—	⅞—1⅛	
Do. 6% Pref.	5	6	6%*	4½—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	8[illegible]—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅝—5½	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅝—4⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E.Corp.for P.Dist.1stMt.Db.	100 & 500	4½	4½%*	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%*	94—97	
Newcastle-upon-Tyne Elec. Supply..	5	5	2/6*	5⅝—5⅞ xd	
Do. £2 Paid	5	8	4·85d.*	2¼—2⅜ xd	
Do. 5% Pref. (fully paid)	5	5	2/6*	5⅛—5⅜ xd	
Do. £2 Paid	5	5	4·85d.*	2⅛—2⅛ xd	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	12—13	
Oxford Electric Co., Ltd.	5	7	—	5⅜—6½	
Do. 4% Deb. Red	Stock	4	4%*	95—98 xd	
St. James and Pall Mall E. L. Co. Ld.	5	10	—	7½—8½	
Do. 7% Non-Cum. Pref.	5	7	7%*	6½—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%*	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%*	70—74	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	—	⅞—⅞	
Do. 7% Cum. Pref.	1	7	—	1—1¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½%*	99—102	
Urban Elec. Supply Co., Ltd.	5	5	—	½—1½	
Do. 5% Cum. Pref.	5	5	5%*	1⅞—2⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%*	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	—	7¾—8¾	
Do. 4½% Cum. Pref.	5	4½	4½%*	5—5½	+⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%*	90—92 xd	
Central London	Stock	3	3%*	68—71	
Do. 4% Preferred	Stock	4	4%*	8[illegible]—89	−1
Do. Deferred	Stock	2	—	53—56	
Do. 4% Debentures	Stock	4	4%*	101—104 xd	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%*	81—84	
City and South London Cons.	Stock	4¼	—	33½—34½	
Do. 4% Perp. Deb.	Stock	4	4%*	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	113—116	
Do. 5% Perp. Pref. 1895	Stock	5	—	112—115	
Do. 5% Perp. Pref. 1901	Stock	5	—	110—113	
Great Northern & City Pref. "A"	10	11½d.	—	¾—1¼	
Gt. Northern, Piccadilly & Brompton	10	4	—	7¼—7⅜	+¼
Do. 4% Perp. Deb.	Stock	4	4%*	90—92	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	¼	—	3[illegible]—36	+½
Do. 3½% Preference	Stock	3½	—	86—89	
Do. 3½% "A" Pref.	Stock	3½	—	76—79	
Do. 3½% Convertible Pref.	Stock	3½	—	73—76	
Metropolitan District	Stock	—	—	11—12	
Do. 6% Perp. Deb.	Stock	6	6%*	115—120	
Do. 4% Deb.	Stock	4	4%*	71—76	
Do. Perp. Extension Pref. (5%)	Stock	—	—	21—26	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	46—50	+2
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	—	40—44	
Whitechapel and Bow 4% Deb.	Stock	4	4%*	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	—	⅝—⅞	
Do. 4½% Deb. Red.	Stock	4½	—	85—90	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅜—1½	
Do. 6% Cum. Pref.	10	6	—	4¼—4⅜	
Do. 5% Perp. Deb.	Stock	5	5%*	95—98	
Do. 4½% 2nd Deb.	Stock	4½	4½%*	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%*	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	—	12½—13½	
Do. 6% Pref.	10	6	—	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%*	3½—3¾	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%*	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%*	91—93	
London Street Tramways Co.	4	4/6	2/-*	⅝—⅞	
London United Trs., Ld., Cm. Pf.	10	5	—	6½—7½	−½
Do. 4% 1st Mort. Deb. Red	Stock	4	4%*	79—84	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%*	1⅛—1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%*	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	½—⅝	
Do. 5% Cum. Pref.	1	5	—	⅝—¾	
Do. 4½% Deb. Red	Stock	4½	4½%*	93—96	
Provincial Tramways Co. Ltd.	10	4	3/-*	4⅝—5⅝	
Do. 6% Cum. Pref.	10	6	6%*	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	—	¾—1	
Do. 4% Deb. Red.	Stock	4	4%*	76—80	
Sunderland Dst. E.Trs.1st Mt.Db.Rd.	100	5	5%*	75—80	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	3¼—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%*	83—86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	15/-*	57—60	
Do. 6% Pref. Crd.	Stock	6	30/-*	103—104	
Do. Def. Ord.	Stock	1	—	15½—15⅞	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%*	83—86	
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3½	
Do. 10% Cum. Pref.	5	10	10%*	8—9	
Do. 4½% Debs.	50	4½	4½%*	100—103	
Direct United States Cable Co. Ltd.	20	4¼	4/-*	13⅜—13⅞	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%*	98—100	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	—	100—102	
Do. do. (Mauritius Sub.)	25	4	—	100—102	
Eastern Ext. Australasia & China	10	7	2/6*	12⅜—13½ xd	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%*	101—103	
Eastern Telegraph Co.	Stock	7	1½%*	132—135 xd	
Do. 3½% Pref.	Stock	3½	3½%*	83½—85½ xd	
Do. 4% Mort. Deb.	Stock	4	4%*	101—103	
G. N. Tel. Co. (Copenhagen)	10	20	5/-*	27—29	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	+1/16
National Telephone Co., Ltd., Pref.	Stock	6	6%*	109—111	−1
Do. Deferred	Stock	6	6%*	117½—119½	−2½
Do. 6% Cum. 1st Pref.	10	6	6%*	10½—12½	
Do. 6% Cum. 2nd Pref.	10	6	6%*	10—12	
Do. 5% 3rd Pref.	5	5	—	5⅜—5⅞	
Do. 3½% Deb. Red	Stock	3½	3½%*	97½—99½	
Do. 4% Deb. Red.	Stock	4	4%*	100½—102½	
Western Telegraph Co., Ltd.	10	7	3/-*	13⅜—14½	
Do. 4% Deb.	Stock	4	4%*	99½—101½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	1⅛—1⅜	+1/16
Do. 6% Cum. Pref.	1	1/2⅝d.	1/4½d.	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	—	3½—3⅝	
Do. 6% Pref.	1	6	—	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	—	6½—6⅝	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%*	102—105	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%*	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅞—1⅛	
Do. 4% Mort. Deb. Red.	Stock	4	4%*	43—48	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%*	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%*	53—58	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10½	
Do. 5% Cum. Pref.	5	5	5%*	5⅛—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%*	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½ xd	
Crompton & Co., Ltd.	3	5	—	1⅜—1⅝	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%*	90—93	
Dick, Kerr & Co., Ltd.	1	10	—	1½—1⅝	
Do. 6% Cum. Pref.	1	6	6%*	1—1½	
Do. 4½% Deb. Red	Stock	4½	4½%*	99—102	
Edison & Swan United "A." £3 paid	5	2/6	—	⅜—⅝	
Do. do. (fully paid)	5	4/2	—	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%*	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%*	85—87	
Electric Construction Co., Ltd.	2	—	—	¼—⅜	
Do. 7% Cum. Pref.	2	—	—	1½—2	
Do. 4% 1st Mort. Deb.	Stock	4	4%*	66—71 xd	+1
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7⅛—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%*	84—87	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	—	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%*	5—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%*	106—108	
I. R. & G. P. Co., Ltd.	10	10	5/-*	15½—16½ xd	
Do. 4% Deb. Red.	100	4	4%*	98—100	
Tel. Const. & Maintenance Co.	12	17½	12/-*	31—33 xd	
Do. 4% Deb. Bds. Red	100	4	4%*	100—102	
Willans & Robinson, Ord. Shres	1	5	—	⅜—1⅛	
Do. 6% Cum. Pref.	5	6	6%*	3½—3¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%*	72—76	

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LOCAL NOTES

ABERDEEN: *Tramways Accounts.*—The total revenue from the Corporation tramway system for the year ended May 31st, 1908, was £71.931, a decrease of £675 compared with the receipts of the previous year. It should be explained, however, that the receipts for 1907 show an abnormal increase of £14,000, due to the visit of the King and Queen. The working expenses were £38,669, a decrease of £1,765, whilst the car mileage run has increased by 36,437 miles, giving a decrease in the working expenses of nearly ½d. per car mile. Capital charges amount to £18,341, a decrease of £406, which is brought about owing to 16 days' interest for the current year having been paid in the last accounts. The balance amounts to £14,920, an increase of £1.497, which has been carried to renewals fund, and is the largest which has yet been available. The quantity of electrical energy used was 1,955,858 units, an increase of 49,640, whilst the car miles run were 1,566,118, an increase of 36,437. The cost of electrical energy has decreased by £389 owing to a rebate in the price charged by the electricity department. During the year six additional cars have been provided with top covers and magnetic slipper brakes. The receipts per car mile were 11·02d., and the working expenses 5·93d. The percentage of working expenses to receipts is 53·75.

ARGENTINE: *Buenos Ayres Tramway Returns.*—A Consular report states that there are now 327 miles of electric tramways in Buenos Ayres and 11 miles of horse tramways. The number of passengers carried in 1907 upon the electric tramways was 21,770,000 and upon the horse tramways 7,388,000. The total receipts from both electric and horse tramways in 1907 amounted to £1,986,100.

Telegraph System.—There are now 15,535 miles of telegraph lines in Buenos Ayres. The total revenue in 1907 from the post and telegraphs amounted to £862,631, whilst the expenditure was £1,015,790.

AUSTRALIA: *Sydney Tramway Strike.*—The employees on the tramway system struck work on Thursday, some 3,000 men being involved. A later telegraphic message states that all the tramway strikers have been officially dismissed. The Premier has stated that the Government will not appoint a proposed special tribunal to hear the men's grievances until they have returned to the work.

BARNES: *London Electric Power Bills.*—The Parliamentary Committee recommend continued opposition to these Bills. It was stated at the last meeting that £150 have been spent in opposition to one Bill and £115 in opposition to the second Bill. When the Council first decided to oppose these Bills the sum of £250 was allowed for expenditure, and complaint was made that the expenditure seemed to be going on much in excess of the estimates before the Council.

BELFAST: *Lighthouse Communication.*—The Belfast Harbour Board has had under consideration the question of telephonic communication with the lighthouse at Blackhead, Copeland Islands and St. John's Point. The matter has been referred to the Irish Lights Board.

Halfpenny Tramway Fares.—The experiments with halfpenny tram fares during the trial fortnight decided upon by the Corporation shows a decrease in receipts compared with the corresponding period of last year of £1,350, or over 15 per cent. A good deal of controversy is taking place as to the system of fares which should be adopted in order to place the undertaking on a sound financial basis. A scheme proposed by Mr. A. Nance, the manager, in 1905, is now to be given a trial. This proposes a 2d. fare for the full journey over any route, with 1d. stages.

BRENTFORD: *Condition of Tramway Track.*—The Brentford District Council has received a copy of the report made to the Board of Trade by Col. Yorke on his inspection of the tramway track, expressing the opinion that the condition of the track was a source of inconvenience to the ordinary traffic, and of possible danger to motor-cars and bicycles. It was, therefore, his duty to report that in his opinion "there has been default in maintaining and keeping in good condition and repair, and so as not to be a danger or annoyance to ordinary traffic the rails of the tramway and the substructure." However, Col. Yorke added that there were evidences that extensive repairs had been, and were being, carried out, and he recommended that the company should take steps to put the whole of the portion of their system in question in proper condition with as little delay as possible. The District Council has decided to ask the company to give an undertaking to take steps to put the whole of their system in the district in order and repair, and at the last meeting of the authority the Clerk said that if the company would not give the undertaking they could be prosecuted for penalties.

BRISTOL: *Electricity Accounts.*—The report and accounts for the electricity department for the year ended March 25th, 1908, show a gross profit of £43,126, to which is added £855 interest and £129 transferred from redemption sinking fund account. Capital charges, reserve, &c., absorb £43,637, leaving a net profit of £473. This latter sum, together with £8,657 brought forward from the last account, has been carried forward, minus £2,150, which has been carried to the credit of capital account, in respect of wages of workmen engaged on capital work, owing to the work being carried out by workmen in the permanent employ of the committee. The number of units sold was 7,650, 074, of which 3,088,055 were for private lighting, 3,718,296 for power purposes, and 843,773 for public lighting. This is an increase of 1,231,928 over the output of the previous year, whilst the units for power purposes had increased to no less than 1,098,466.

BUENOS AYRES: *Electric Supply.*—It is stated that the accounts of the German Transatlantic Electricity Co., for 1907, show a profit of M9,955,000, against M8,278,000 in 1906. A dividend of 9½ per cent. has been declared.

CARDIFF: *Tramway Men's Wages.*—The Electric Lighting and Tramways Committee have had under consideration a request by the tramway employees for increased pay and modified hours. Mr. Arthur Ellis, the tramways manager, reported that if the committee granted the increases asked for he should have to ask the committee that the tramway men be brought into line with those upon other tramway systems as to the conditions of their employment, namely, that 60 hours per week be worked, that ordinary rates be paid on Sundays, and no double time paid for Bank Holidays. He also suggested that it would be necessary to charge higher fares if the tramway men's demands were acceded to. A further special meeting is to be held to consider the position.

COATBRIDGE: *Electrical Inspector.*—The Council has been considering the question of appointing an electrical inspector under the Electric Lighting Acts, to advise them on all matters appertaining to the supply of electricity in the district by the Coatbridge & Airdrie Electricity Supply Co. Several offers have been made by gentlemen willing to act in this capacity, but their fees have averaged from £50 to £100. At a recent meeting of the Council the view was expressed that these gentlemen regard the office as a more important one than the Electric Lighting Committee did, and the matter is left for the moment in the hands of the committee.

DEVONPORT: *Electricity Accounts.*—The gross profit upon the electricity undertaking for the past year amounted to £6,790, against £9.055 for the previous year. This decrease is mainly due to the extra cost of coal (£830), and a decrease in the revenue from sale of electricity (£1,000); this latter has been brought about by decreased prices, the use of metal filament lamps, and the requirements of the tramways companies having been less. The net profit was just under £7, compared with £2,480 in the previous year.

EDINBURGH: *Electric Lighting Estimates.*—The Electric Lighting Committee have estimated that the expenditure for the current financial year will be £65,900, against £60,040 last year. The estimated revenue is put at £131,360, against an estimated revenue last year of £132,585, and an actual revenue of £129,691.

Electric Lighting Surplus.—The Electric Lighting Committee have been considering the question of the best manner in which to dispose of the surplus of £10,541 upon the electric supply undertaking for the past year. It was unanimously agreed to carry £747 to reserve, bringing this up to £97,940. Several suggestions were made with regard to the disposal of the balance of £9,794, and the one to the effect that the whole should be allocated to the relief of rates was carried. This has yet to be confirmed by the Corporation.

EPSOM: *Cost of Cables and Services.*—The Lighting Committee having considered the question of defraying any expenditure incurred, or to be incurred, in respect of cable extensions and services which is properly chargeable to capital account and temporarily paid out of revenue account, the accountant has been directed to place such expenditure to a suspense account pending the raising of a £1,500 loan.

FRANCE: *Calais Electric Tramways.*—A British Consular report states that the system of electric tram lines, of which Calais has so long been in need, being many years behind the much more hilly town of Boulogne in this respect, is being rapidly pushed on, and is expected to be opened for traffic coincidentally with the inauguration of the Calais Exhibition.

Dieppe: Wireless Telegraphy.—A Consular report states that the Artom experimental wireless telegraph station between Havre and Barfleur has given disappointing results, but that experiments with the Bellini & Tosi system have been very encouraging.

GREENOCK: *Admiralty Supply.*—The Electricity Committee have been negotiating with the Admiralty with regard to the supply of electricity to the proposed torpedo factory, which is to be erected at Battery Park. Among the proposals provisionally accepted by both parties is that the Admiralty agree to take the whole of the electrical energy required for power and lighting purposes at the new torpedo factory for a period of 14 years at certain rates, with proportionate allowances in the event of a general reduction of price. It is further stipulated that the Corporation shall supply a maximum of 200 kw., but that the Admiralty shall give six months previous notice of any

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appreciable increase in its maximum demand. It is expected that the supply will be required in about 18 months.

HENDON: *Experimental Street Lighting.*—An offer of the Hendon Electric Supply Co., Ltd., to fix two specimen lamps in positions in the public streets to be selected by the District Council to demonstrate the advantages of electricity for public lighting, has been accepted. The lamps are to be fixed free of cost to the Council.

HINDLEY: *Provision Order Extension.*—The Council have obtained an extension of their Lighting Order for a further twelve months.

LIVERPOOL: *Tramway Fares.*—A report has been submitted by the tramways manager dealing with the question of free conveyance of blind persons upon the tramway system. The Finance and Traffic Sub-Committee, however, report that they cannot recommend charity as a basis of administration of the tramway undertaking, and this decision was confirmed at the fortnightly meeting of the Tramways Committee last week.

LONDON: *London County Council: Norwood Car Shed.*—A site of approximately two acres has been acquired for the purpose of a car shed at Norwood by the Highways Committee at £7,750.

Marylebone: Assessment of Electricity Undertaking.—The Local Government, Records, and Museums Committee of the London County Council, in a report upon the assessment of the electricity undertaking of the Marylebone Borough Council, state that the present assessment of £7,547 is quite inadequate, based upon the accounts for 1906–7, and that an estimate, which had been prepared by taking the revenue from the sale of current on the basis of the average of the prices obtained during 1906–7 by other undertakings in the neighbourhood, showed that the rateable value should be £57,391. In view of these facts they had requested the Assessment Committee to re-value the undertaking at once. They complain, however, that nothing has been done to put this recommendation into effect, although the accounts for the year ended March 31st, 1907, have been available many months. Having regard to the very great importance of this case, the Local Government, Records, and Museums Committee state that they thought it desirable to place the facts before the committee.

Islington: Supply of Electricity Bill.—Messrs. Vorley & Lambert have been appointed delegates to represent Islington upon a deputation from metropolitan local authorities urging the President of the Board of Trade to re-introduce the Supply of Electricity Bill.

Southwark: Electricity Accounts.—In his report on the working of the Borough Council electricity department for the year ended March 31st (the eighth year the works have been in operation), the Borough Electrical Engineer (Mr. D. M. Kinghorn) remarks that the most noticeable feature of the accounts is reduction in the net profit, which is accounted for by the increased cost of coal, but if future profits are to be greater some immediate steps should be taken to reduce the expenditure in this direction, as it is scarcely possible to do so with the plant running non-condensing. Economies have been effected in the other costs, but as coal forms about 40 per cent. of the combined works costs, a variation of one-tenth of a penny will affect the net profit to the extent of £584. Further capital expenditure will be necessary, but considering the possible economies effected any reasonable expenditure will not unduly burden the undertaking. The total working expenses for the year (£9,667) exceeded the amount for the previous twelve months by £1,232, the expenditure for coal having increased in nearly the same proportion as the units generated. The total distributing cost compares very favourably with former years. Public lighting maintenance increased by £73, owing to the flame lamp having superseded the old open arc, excepting on one circuit. The total income for the year amounted to £14,932, showing an increase over that of the preceding year of £1,220, and the number of units sold increased 17 per cent. The units sold for lighting purposes increased by 123,948, which, says the engineer, may be considered a satisfactory increase, in view of the great improvement made during the last two years in the metal filament lamp. The average price was 3·1d. per unit, compared with 3·49d. per unit last year. The units sold for power purposes increased by 30 per cent., the average price obtained being 1·37d. per unit, the same as the previous year. The gross profit carried to net revenue account is practically the same as the previous year, amounting to £5,265, representing a return of 6·6 per cent. on the total capital expenditure. The total capital charges are now equal to 0·877d. per unit sold, comparing very favourably with other metropolitan undertakings, the decrease for the year being approximately 10 per cent. compared with the previous year.

Stoke Newington: Tramways.—The Borough Council has decided to call upon the London County Council to at once put in hand the electrification of the Green Lanes tramway line.

Woolwich: Tramway Extension.—Col. Yorke on Friday inspected the new tramway line which has been built by the London County Council from Plumstead Church to Abbey Wood. This line joins the Erith Urban District Council's Tramway system, thus making it possible to travel by tramway from the Victoria Embankment some 12 or 14 miles into Kent, almost to Gravesend.

MANCHESTER: *Tramway Accounts.*—The annual report and accounts of the Corporation Tramways Department show a traffic revenue of £760,994, parcels revenue of £1,220, and revenue from other sources, £6,858. The working expenses amounted to £500,022, leaving a gross balance of £269,049, to which has to be added £2,105 bank interest. Capital charges, &c., absorb £124,255, and the balance has been appropriated as follows: reserve, renewals and depreciation, £87,790; contribution in aid of rates, £55,000; street improvements, &c., £4,108. The quantity of electrical energy used was 29,955,070 units, representing 1·76d. per car mile. The percentage of working expenses to receipts was 65, and the total revenue per car mile was 10·87d.

MIDDLESEX: *Tramways.*—At the last meeting of the County Council it was reported that the work included in the contract for Edgware Road Tramways extension has been completed by Mr. Clift Ford. The contract price was £5,886, and when the balance of the retention money has been paid to the contractor the contract price will have been exceeded by £1,336 for extras. The County Council agreed to this. Mr. Clift Ford has also completed the work included in the contract for the Harrow Road, Wembley, tramway. When the retention money has been paid the contract price will have been exceeded by £1,896 5s. 3d. This amount is made up of extras, *i.e.*, the substitution of granite setts for wood blocks on the double track. The Council agreed to the excess. After the payment of retention money to Messrs. Dick, Kerr & Co., the estimated cost of the Jubilee Clock to Willesden Junction tramway, which work has been completed under a schedule of prices, will have been exceeded by £2,037. This amount, which the Council agreed to, is made up of extras for the construction of junction line at Jubilee Clock tower and the paving of the haunches of the roads with wood blocks.

NEWCASTLE: *Blaydon Tramways.*—A deputation from the Blaydon Urban District Council waited upon the Newcastle Tramways Committee last week, urging the extension of the Newcastle tramways into Blaydon. A long discussion took place, and at the conclusion the Chairman stated that the matter would be very carefully considered by the Tramways Committee, but at the same time he thought there was at the present no prospect of surmounting the many difficulties that had been mentioned during the discussion.

NORWICH: *Electricity Accounts.*—The accounts of the electricity undertaking for the year ended March 31st, 1908, show an income of £35,613 and an expenditure of £18,868. The charges for interest and sinking fund have increased by £16,080 over those for the previous year, and there remains a net profit of £3,104, to which is added £195 brought forward from the previous year. The sum of £3,200 has been placed to depreciation and the balance carried forward. The depreciation account now stands at £15,905. There has been an increase in the number of units sold of 29 per cent., the figures for the present and past years being 2,839,130 and 2,661,522 respectively. There has also been an increase in the total income of £3,335, equal to 11 per cent., and it may be pointed out that new meters to the extent of £1,193 have been provided out of revenue. There are now 4,253 consumers, of which 291 have been connected during the year. The connections are equivalent to 129,171 8-c.p. lamps, and the aggregate h.p. of the 405 motors connected to the mains is 2,215. There has been a reduction in the total works costs of 0·15d. per unit, despite an increase in the cost of coal amounting to £800. The accounts were submitted at a meeting of the Corporation last week.

PONTYPRIDD: *Electric Lighting and Tramways Accounts.*—The accounts of the Electricity Department for the past year show a gross profit of £2,554, but after providing for capital charges there is a loss of £1,255, against £2,582 last year. Upon the tramway undertaking there is a gross profit of £4,081, but a deficit, after making capital charges, of £3,541.

ROSS: *Extension of Lighting Mains.*—The Ross Electric Light & Power Co. propose to apply for a provisional order to extend their mains in the Rural District. The Council, however, consider the area too large, and the question of consent has been adjourned until further information is received from the company.

RUSSIA: *Moscow: Telephones.*—A Consular report states that the Swedish-Danish-Russian Co., which has the monopoly for telephones in Moscow, some eight years ago had about 500 subscribers. At the present moment there are about 25,000, and the company is enlarging its premises so as to deal with 50,000. The present annual charges are:—Private telephone, 71 r. (£7 10s.); public telephone, 102 r. (£11); these prices apply within the two-verst radius. Outside of that the prices are raised.

SOUTHEND: *Tramway Extension.*—The tramway extension to the Halfway House towards Shoeburyness has now been commenced.

SOUTHPORT: *Electricity Accounts.*—The accounts of the electricity department for the year ended March 31st, 1908, show a revenue of £25,404, and an expenditure amounting to £9,836. Interest on loans, sinking fund, and dividends on redeemable stock absorb £11,734, leaving £3,834 net profit. Of

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this, to which has to be added £311 balance from last year, £2,750 have been transferred in aid of rates, £496 to the renewals fund, and £90 to the motor-wagon account. The number of units sold was 2,104,259, of which 1,317,181 were to private consumers, 687,128 under contract, and 99,950 for public lamps, of which there are now 72. The total maximum demand supply demanded was 1,673 kw.

SWANAGE: *Electric Lighting.*—Messrs. Foote & Milne have notified the Council of their intention to apply to the Board of Trade for an electric lighting provisional order for the district.

SWANSEA: *The Telephone Service.*—Complaints having been made that the telephone service in Swansea since it has been taken over by the National Telephone Co. is much more inefficient than was the case during the period of competition between the company and the Corporation, Mr. W. E. Gauntlett, the district manager of the company, has given some figures of tests in order to prove that the general efficiency of the telephone system in Swansea at the present moment has greatly improved during the past twelve months, during which the company has acquired the Corporation system. For instance, he states that tests made by an officer entirely independent of the local operating staff, on a large number of calls in October, 1907, showed that the average time taken to answer a call was 4·4 seconds, and the time to clear after the ring off was 4·7 seconds, making a total time for the operation of 9·1 seconds. Comparative tests made in June of this year showed that the time to answer had been reduced to 3·6 seconds, and the time to clear after the ring off to 3·4 seconds, thus reducing the total time for the operation to 7 seconds.

TASMANIA: *Launceston Tramways.*—A local syndicate has been formed for the construction of tramways in Launceston. Tracks, where double, will be laid 10 ft. centre to centre and upon the standard gauge. Rails weighing 90 lb. to the yard on the straight and 96 lb. to the yard on the curve will be laid, the British Standard Specification being adopted. The rails are to be laid on sleepers in blue stone ballast. A combination type of car will be adopted, which was first designed by Messrs. Noyes Bros. for the Freemantle tramways; it has also been adopted by the Victorian Government for the Brighton-St. Kilda tramways.

TWICKENHAM: *Noisy Tramcars.*—The District Council has decided to call the attention of the Chief Commissioner of Police to the matter of noises arising from defective tramcars running through the district.

URUGUAY: *Electric Lighting.*—A Consular report states that the electric supply installation was completed a month or two back, but owing to some question between the municipality and the Government in connection with the cost it has not been put into use.

WALSALL: *Tramways Supply.*—The Council have agreed to the recommendation by the Electricity Committee that the South Staffordshire (Lessee) Tramway Co. be supplied with electricity at 1½d. per unit, less 10 per cent. discount, subject to revision every three years, and that the estimated cost of laying cables, &c., namely, £800, be paid by the Corporation.

Tramwaymen's Grievances.—After ascertaining by inquiry from 83 towns that in only 18 was extra pay allowed for Sunday work, and that in other respects the conditions of work in Walsall were more favourable than in other towns, the Tramways Committee report that they cannot comply with the men's request for time and a quarter on Sundays.

WALTHAMSTOW: *"Association" for Electric Supply.*—A reciprocal arrangement has been entered into with Leyton District Council to supply current at 1½d. per unit for the tramways in the event of a breakdown, and Leyton will supply current to Walthamstow, if necessary, at the same price.

WOLVERHAMPTON: *Electric Lighting Profits.*—The Electricity Committee report that £14,117 will be set aside out of the past year's profits to the Improvement Rate Fund.

YORK: *Trials of an Electrobus.*—We understand that an electrobus, similar to those which are now running in London, will shortly be running trial trips in the streets of York for the members of the Corporation and others interested in the opening out of the city and suburbs, with a view to establishing a service in York.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Miscellaneous

FRANCE.—A Consular Report states that there is an opening for small electric motors in the Amiens district.

LONDON: *London County Council.*—The Fire Brigade Committee report that metal filament lamps have been experimentally used at the Clerkenwell Fire Station, with the result that the consumption of energy has been considerably reduced, and the illumination nearly doubled. They accordingly propose that similar lamps shall be installed at the chief station of the brigade, and at the Shepherd's Bush, Bayswater, Kilburn, West Hampstead, Islington, Scotland Yard, and Whitefriars stations, upon which an estimated expenditure of £136 is recommended.

Generating Stations, Sub-stations, Mains, &c.

CORNWALL.—The Great Western Railway Co. invites tenders for the erection of an electricity generating station at Fowey, Cornwall. Particulars from the Engineer, Plymouth (North Road) Station, and tenders to the Secretary, at Paddington, by August 3rd.

FINCHLEY.—The Council invite tenders for the supply and erection of a generator panel and accessories, for 2,000 amperes. Full particulars from Mr. E. Calvert, Electrical Engineer to the Council (fee, £1 1s., returnable), and tenders to the Town Clerk by August 6th.

LONDON: *Battersea.*—The Highways Committee of the London County Council recommend the granting of a loan of £8,558 for electric lighting purposes; £733 of this is in respect of excess expenditure over loans already sanctioned. The rate of interest is £3 17s. 6d. per cent.

Hammersmith.—A loan of £10,000 in connection with the electricity works is to be applied for.

Shoreditch.—The Highways Committee of the London County Council recommend sanction to a loan of £4,365, repayable in 30 years at £3 17s. 6d. per cent., for electric lighting purposes. The committee also recommend sanction to a further loan of £7,000, repayable in five years, which is the approximate expenditure during the next few years, in connection with the change of pressure from 150 volts to 240 and 480 volts on the three-wire system.

Stepney.—A loan of £6,000 is recommended by the Highways Committee of the London County Council for extension of mains, repayable in thirty years.

Stoke Newington.—A loan of £3,148 is recommended by the Highways Committee of the London County Council for the erection and equipment of a generating station in connection with a dust destructor.

Woolwich.—Subject to the conversion of 13 lamps *en route* from gas to electricity, distribution mains are to be extended along the west side of Court Road, and a feeder is to be laid from Eltham High Street sub-station, at a cost not exceeding £2,000, including the provision of necessary switchgear at the station. In order to meet an application for current for power purposes, the Borough Electrical Engineer has been instructed to carry out extension of mains at an estimated cost of £1,820.

NETHERLANDS.—The Communal Council of Kattendijk (Zeeland) have granted provisionally, for one year, to Messrs. Barger & Co., of The Hague, a concession for constructing and working an electric installation for lighting and tramway traction.

TONBRIDGE.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £4,000 for extensions to the electricity works. There was some opposition on the part of the Ratepayers' Association. Mr. M. P. Plunkett, the Council's Electrical Engineer, stated that the £4,200 was made up as follows:—150-kw. steam dynamo, condenser, and spare armature, £966; steam and water pipes, £508; extension to switchboard, &c., £246; foundations and brickwork, £80; tools at works, £30; Lancashire boiler, &c., £540; extension to economiser, and alteration to brickwork, £120; steam and feed piping, £70; contingencies, £340; expenditure on mains, meters, &c., to March 31st, 1908, £412; future extensions of mains and other capital expenditure, £887.

WALSALL.—The Local Government Board has sanctioned a loan of £4,000 for extensions to the electrical undertaking.

WALTHAMSTOW.—Application is to be made to the Local Government Board for sanction to borrow £1,299 for mains extensions and house service connections.

WEST HAM.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £51,600 for the purposes of the electricity undertaking. The West Ham Municipal Alliance and the Forest Gate Ratepayers' Association both opposed the application, whilst Mr. E. Robb also opposed on behalf of the India-rubber, Gutta-percha & Telegraph Works Co., Ltd., on general grounds. This firm, he said, were large ratepayers, and last year contributed no less than £7,312 in rates. It came out in the inquiry that, included in the amount now sought, the sum of £13,566 represents excess expenditure over previous loans. Mr. Robb and the other objectors contended that the rates now charged in West Ham for electric supply are unremunerative, and certain specific contracts asked for were refused by the Corporation. A good deal of discussion took place on this point, and after Mr. A. H. Seabrook, the Electrical Engineer to the Corporation, had refused to give the prices charged in one specific instance, the inspector stated that they had apparently come to a deadlock, because if he did not know what prices were being charged, he did not see how they could get on with the inquiry. The inquiry, which had lasted two days, was thereupon adjourned *sine die*, the inspector remarking that

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he would report to the Local Government Board that the Corporation could not supply him with the information.

WOLVERHAMPTON.—The scheme for lighting the Tettenhall Road district at a cost of £750 has been confirmed by the Corporation.

Wiring

LONDON.

N.W.—The St. Pancras Council have passed plans by the Skinners' Co. for the erection of business premises on the site of Nos. 45—113 Euston Road, inclusive.

Hospital for Invalid Gentlewomen in Lisson Grove. Architect, C. W. Herrier, 11 Waterloo Place, S.W.

Church rooms (£3,000), St. Stephen's Church, Hampstead (Rev. H. N. Bate, vicar).

S.E.—House at Southwood Road, Eltham. Hodgkinson & Son. architects, 22 Wellington Street, Strand, W.C.

Three blocks of buildings in Upper Kennington Lane. Architects, Hayward and Maynard, 14 John Street, Adelphi, W.C.

Deptford Borough Council have acquired sites for a central public library and a branch library. G. W. Preston, Town Clerk.

Extension to the Borough Polytechnic. W. M. Richardson, secretary.

Buildings in Rotherhithe for H. J. Enthoven & Sons, Ltd., 153–5 Leadenhall Street, E.C.

S.W.—Wandsworth Workhouse Infirmary. J. S. Gibson, 5 Old Bond Street, W. Builders, Johnson & Co., Belle Vue Road, Wandsworth Common.

Motor garage (250,000 to 400,000 cubic feet) in Lea Grove Road, Fulham. Architect, A. F. Nigers, 4 Fredericks Place, Old Jewry, E.C.

The wiring of Chelsea Town Hall is to be thoroughly overhauled and renewed by the Borough Council.

W.—180 New Bond Street is to be rebuilt by W. Cubitt & Co., 258 Gray's Inn Road, W.C., builders.

New refreshment saloon at the Lyric Opera House, Hammersmith. Architects, F. Matcham & Co., 9 Warwick Court, W.C.

W.C. Alterations and additions to St. Clement Danes Vestry Hall. Architect, John Murray, 11 Suffolk Street, Pall Mall East, S.W.

Block of shops and offices in Kingsway and Vernon Place. Surveyors, Grant Taylor and Atkinson, 39 Bloomsbury Square, W.C.

Business premises in Baldwin's Place, Holborn for Willmott & Sons, machine rulers, 55 Bartholomew Close, City.

PROVINCES.

ACTON.—A committee of the Council (W. Hodson, Clerk) are considering proposed additions to the hospital.

New Schools (£17,345). Architects, E. C. P. & H. Thomson, 182 High Street, Acton. Builder, A. Monk, Lower Edmonton.

AVELEY (Essex).—School to accommodate 120 children. Architect, Christopher M. Shiner, 10 John Street, Adelphi, W.C.

BOOTLE.—School. Architects, Grayson & Ould, 31 James' Street, Liverpool.

BRENTWOOD (Essex).—Grammar School. Architects, Chancellor & Son, Chelmsford.

BROMLEY.—Children's Home. Architect, Mr. Ladd, c/o Clerk to the Board of Guardians.

CHELMSFORD.—Offices (£5,000) for Essex Education Committee. J. H. Nicholas, secretary.

CROYDON.—Secondary School for Girls (£16,000 to £17,000). Builder, R. E. Nightingale, Albert Embankment, S.E.

DARTFORD.—Eleven houses, Nelson Road. Surveyors, Dann & Lucas, 23 Budge Row, E.C.

DERBY.—Extensions (£12,000) to asylum. G. Trevelyan Lee, Town Clerk.

DONCASTER (Near).—Church. Architect, C. Hodgson Fowler, The College, Durham.

DOVER.—Alterations to almshouses (£1,059). Architects, Worsfold & Hayward.

ENFIELD.—Secondary school and institute (£12,379). Builder, Treasure & Son, Holloway. Architect, H. G. Crothall, Guildhall, Westminster. Additions and alterations to the Grammar School (£6,155). Builders, Knight & Son, Tottenham. Architect, Mr. Crothall.

EPSOM.—Nurses' home and for additions and alterations to the workhouse. Architect, A. C. Williams, 14 Great James Street, Bedford Row, W.C.

GARNDIFFAITH.—Public hall and institute (£1,735). Architect, W. Beddoe Rees, 3 Dumfries Place, Cardiff. Builders, Bailey Bros., Pontnewynydd.

GOSPORT.—School (£7,500). Architect, E. J. Tench, Norwich.

GRAVESEND.—Schools (£9,353). Architect, J. J. Robson, 335 High Holborn, W.C. Builders, G. Gates & Sons, Frindsbury, Rochester.

HENDON.—Ten shops, Golder's Green Road. Builder, J. Gibb, Golder's Green Road, N.W. Motor garage, Woodstock Road. Builder, J. Gibb, jun., Golder's Green Road, N.W. Twenty-two houses, Dartmouth Road. Architect, H. Shaw, 6 Nicoll Road, Willesden, N.W. Two churches for Garden Suburb. Architect, E. L. Lutyens, 29 Bloomsbury Square, W.C. Nine shops, North End Road. Architect, A. W. Cleaver, 54-5 London Wall, E.C.

ILFORD.—Additions to laundry in Ley Street. Surveyors, B. Bailey & Co., 21 Ironmonger Lane, E.C. Church in Baxter Street. Architect, E. T. Dunn, 7 Roding Street, Ilford. Nine houses. Builder, F. B. Harrison, 166 Balfour Road, Ilford.

MANCHESTER.—Two schools. Henry Price, City Architect.

NEW MALDEN.—Three houses in Blagdon Road. Architect, Arthur Cole, "Mogok," Thurlestone Road, West Norwood.

NOTTINGHAM.—Addition to Baptist Church (£948). Architects, Geo. Baines & Son, 5 Clement's Inn, Strand, W.C. Additions (£7,200) to lace factory. Architect, A. Harrison Goodall, South Parade, Nottingham.

PLYMOUTH.—Workhouse infirmary (£32,000). Architects, Thornely & Rooke, 11 The Crescent, Plymouth.

RADCLIFFE (Lancs.).—Fire station. W. L. Rathenell, Surveyor, District Council.

SANDOWN (Isle of Wight).—Church institute. Rev. J. Agg-Large, St. John's Vicarage, Sandown.

SALTNEY.—School (300 places). Surveyor and Architect, S. Evans, County Offices, Mold, Flints. Builder, P. Williams, Overton-on-Dee, Ellesmere, Salop. Cost, £2,956.

SOUTH BANK (Yorkshire).—School (£9,400). J. C. Wrigley, Secretary Education Committee, Northallerton.

TWICKENHAM.—Leslie & Co., builders, Kensington Square, W., are to carry out additions to Cambridge Park House Laundry.

UXBRIDGE.—A new post office is to be put up by H.M. Office of Works, Storey's Gate, S.W.

WOLVERHAMPTON.—New works (to cover 10 acres) for Chubb & Co. Architect, G. Gordon Stanham, 26 and 27 Bush Lane, E.C

WORTH (Kent).—Residence (£754). Architects, Worsfold & Hayward, Market Square, Dover. Builders, G. H. Denne & Son, Deal.

WREXHAM.—Two houses (£955). Builder, W. H. Thomas, Oswestry. J. E. Yate, architect, 9 High Street, Wrexham.

TENDERS RECEIVED AND ACCEPTED

BELFAST.—For the supply of house service cut-outs and trolley wire, the tenders of Messrs. W. Lucy & Co., Ltd., and the British Insulated & Helsby Cable, Ltd., have been selected.

DUBLIN PORT AND DOCKS BOARD.—A recommendation has been made to accept the tender of the Vulcan Boiler and Insurance Co., for insuring electrical machinery of the Board at £173 10s. 9d. per annum, but this, together with other tenders, has been referred to the Engineer for report.

LONDON: *London County Council.*—The following tenders have been received for the road work and plate-laying for the reconstruction on the underground conduit system of the existing tramways (equal to 5·5 miles of single line) from Euston Road via Hampstead Road, High Street, Camden Town, Camden Road, and Parkhurst Road, to Holloway Road :—

	£	s.
R. C. Brebner & Co.	58,485	15
W. Manders (recommended) ...	59,761	6
Dick, Kerr & Co.	61,272	13
John Mowlem & Co.	61,471	0
J. G. White & Co	62,144	14
Robert W. Blackwell & Co. ...	63,114	5

The following tenders have been received for the roadwork and plate-laying, exclusive of the supply of rails and special trackwork for (1) the reconstruction for the overhead trolley system of electric traction of the existing tramways from Loughborough Junction to Norwood, and the construction for the same system of the new tramways from Hammersmith to Putney, and (2) the execution of paving works in connection with street widenings along the latter route. The amounts of the tenders, after correcting arithmetical errors, are as follows, the first column representing tramway works, and the second paving works :—

	£	s.	£	s.
G. Wimpey & Co.	45,713	4	2,595	16
W. Manders	45,976	10	2,404	16
Dick, Kerr & Co.	46,986	11	2,586	9
Fry Brothers	47,440	1	2,664	10
Reid Brothers	48,211	7	2,808	15
J. G. White & Co.	48,823	19	2,799	15
John Mowlem & Co. ...	49,593	10	2,096	11
Robert W. Blackwell & Co.	49,335	8	2,904	15
J. A. Ewart	57,504	8	3,330	6

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The Highways Committee recommend that the tender of Messrs. G. Wimpey & Co. for the tramway works, and that of Mr. W. Manders for the paving works be accepted.

The following tenders have been received for the supply of two turntables and the covers required for use at the tramways central car repair *depôt* :—

	£
W. G. Bagnall, Ltd. (recommended) ...	250
Bolling & Lowe	360
Isca Foundry Co.	420
Cowans, Sheldon & Co	720

For the supply of laminated belting at the central car repair *depôt* the following tenders have been received :—

	£	s.
J. Hendry & Co. (recommended) ...	308	6
R. H. Haylock	332	1
G. Angus & Co.	335	11
S. E. Norris & Co.	339	10
Buck & Hickman	342	16

The following tenders have been received for the supply of 140 tons of rolled steel bars for magnetic brake shoes in connection with the Council's tramways :—

	£	s.
The Lilleshall Co. (accepted)	980	0
The Earl of Dudley's Round Oak Works	1,052	10
Frodingham Iron & Steel Co.	1,050	0
Henry Bessemer & Co.	1,260	0
Cammell, Laird & Co.	1,295	0

Woolwich.—The Borough Council has accepted the tender of Siemens Bros. Dynamo Works, Ltd., in substitution for that of the British Thomson-Houston Co., Ltd., for the supply of a motor alternator. At the last meeting of the Council, the Electricity Committee reported that in submitting for approval the final specification and conditions as agreed with the Borough Electrical Engineer, the British Thomson-Houston Co. declined to conform to the Council's Standing Order requiring them during the continuance of the contract to display upon the site of the works a copy of the rates of wages and hours of labour to be observed in carrying out work for the Council. The committee therefore approached three other firms whose guaranteed efficiencies of the alternator were appreciably near to that of the British Thomson-Houston. Siemens Bros.' Dynamo Works, Ltd., were prepared to agree to all the conditions of contract and to the Borough Electrical Engineer's specification without qualification, and if allowed to increase the amount of their tender from £775 5s. to £799 5s., were prepared to guarantee an increased efficiency as follows :—Full load, 83; three-quarter load, 81·5; half-load, 77·5; quarter load, 62 (guaranteed efficiency in original tender : full load 81, 75·6, 68·6, and 51·6 respectively). The offer of increased efficiency and the consequently amended tender has been accepted. The amount of the tender of the British Thomson-Houston Co. was £784 10s.

MIDDLESEX.—The County Council has received the following tenders for the construction of tramways :—Four miles one furlong 2·90 chains length in Finchley Road, Hendon, to the Great North Road, Finchley; 7 furlongs 5·5 chains length from the Edgware Road to Finchley Road, Hendon :—

Thomas Adams	£120,095
Dick, Kerr & Co., Ltd. (accepted)	£116,978
A. Fasey & Son	£127,978
Clift Ford	£116,978
Wimpey & Co.	£119,991
The County Engineer's estimate was	£121,346

Length of 1 mile 4 furlongs 9·6 chains from Green Lanes, Southgate, to Market Place, Enfield :—

Thomas Adams	£41,709
Dick, Kerr & Co., Ltd.	£40,643
A. Fasey & Son	£43,820
Clift Ford	£40,643
Holloway & Co.	£40,719
Law & Co.	£41,405
J. Mowlem & Co.	£40,342
C. Wall, Ltd.	£45,027
Wimpey & Co. (accepted)	£40,220
The County Engineer's estimate was	£41,349

WALSALL.—The tender of Messrs. Callender's Cable & Construction Co. for the cables in connection with the supply to the South Staffordshire (Lessee) Tramways Co., has been accepted at £800.

WALTHAMSTOW.—The Council has accepted the tender of A. Blackmore & Co. for twelve months' supply of 500 tons of anthracite washed peas from the Yniscedwyn Colliery at £1 1s. per ton. The offer of Babcock & Wilcox, Ltd., to provide and fix a coal elevator and distributing chutes at the generating station for £99 10s., has been accepted. For alterations and additions to the generating station the following tenders have been accepted : builders' work, W. Richardson, £530; steelwork, Norton Bros. & Co., £670.

COMPANIES' MEETINGS AND REPORTS

ANGLO-AMERICAN TELEGRAPH CO.—The report for the June half-year shows receipts, including the balance of £2,478 brought forward from the last account, amounting to £195,258. The traffic receipts show a decrease of £15,625, as compared with the half-year ended June 30th, 1907. The working expenses amounted to £73,296, being a decrease of £1,467, as compared with the corresponding period of 1907. The directors have set apart the sum of £10,000 to the renewal fund, leaving a balance of £111,962. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, were paid on May 1st, 1908, absorbing £52,500, and second quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500, will be paid on August 1st, 1908. The balance of £6,962 will be carried forward to the next account. The meeting is to-morrow.

BRITISH THOMSON-HOUSTON CO.—The report for the year ended March 31st, 1908, states that during the year the company has developed a line of low-pressure turbines, several of which have been sold. All the Curtis turbine patent rights for the United Kingdom, with the exception of the marine rights, have been acquired. Under the terms of the trust deed securing the issue of the company's debentures the company had to pay to the trustees on February 28th last the sum of £3,339, to be applied by them in purchasing debentures in the market. Debentures of the par value of £1,160 were purchased prior to March 31st (the end of the year under review), and since the closing of the books the trustees have purchased an additional amount of £2,400, making the total par value of debentures retired £3,560. The trading profit for the year, after deducting general and technical expenses, discounts, debenture and other interest, amounts to £28,058. The whole of this profit, with the exception of £1,394 carried to the balance-sheet, has been applied, as shown in the profit and loss account, to various depreciations. The amount carried forward last year was £1,071, which, added to the above amount of £1,394, makes the total carried forward this year £2,466. On the balance-sheet of last year the balance of the excess cost incident to the establishment of the manufacturing business of the company amounted to £16,707 (£51,000 having been previously written off). Nothing was added to this account during the year, and the directors have decided to write off a further sum of £6,707, leaving a balance of £10,000, which will be written off from time to time until finally disposed of. The directors record with regret that during the year Mr. W. A. McArthur resigned as Chairman and director of the company. It is not proposed to fill the vacancy on the Board at present, and Mr. J. F. Nauheim has been elected to act as Chairman of the company. The meeting is to-day.

BRUSH ELECTRICAL ENGINEERING CO.—An extraordinary general meeting was held on Tuesday confirming resolutions passed on July 7th consolidating the fully-paid non-cumulative 7 per cent. shares of the company, and also the ordinary shares.

BUENOS AYRES NEW TRAMWAYS CO.—For the eighteen months ended March 31st, 1908, there is a credit balance, after providing for interest on the debenture stock, debenture and bonds, of £31,238. After deducting the debit balance of £29,806 from previous years there remains £1,432 to be carried forward.

CITY & SOUTH LONDON RAILWAY CO.—At the annual meeting on Tuesday the report and accounts given in our last issue were adopted. Mr. C. B. Stuart Wortley, K.C., M.P., the chairman, who presided, said that, notwithstanding all the additional charges which the extension to Euston had entailed, the working expenses still stood at the small proportion of only 46·28 per cent. of the receipts. With regard to the fire which had occurred at Moorgate Street Station on July 16th, he was not able to suggest any cause, owing to the matter now being the subject of a Board of Trade inquiry, but the company's officers were busily at work removing every discoverable thing that could possibly lead to a recurrence of such a fire, and every possible addition was being made to the existing provisions and regulations for securing the safety of the passengers. In answer to questions, the chairman said he could not promise that steel sleepers would be substituted for the present wooden ones all over the lines at once.

CROMPTON & CO.—At the annual general meeting on Monday the report and accounts given in our last issue were adopted. Mr. John Trotter, who presided, referring to the present position of the electrical industry, said that during the past three years reductions in the contract prices of electrical machinery had taken place varying from 16 per cent. to 25 per cent., owing to excessive competition. Fortunately, however, the company had made such an advance that they were able to refuse orders which did not leave a proper margin of profit. Sooner or later it would be necessary to increase the permanent capital of the company in order to cope with the growing expansion of the business.

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CRYSELCO.—The balance sheet and accounts for the year ending May 31st, 1908, show that the business of the company continues to steadily improve, the profit for the year, including balance brought forward, being £6,081 1s. 9d. The number of lamps sold shows a substantial increase, and notwithstanding the very keen competition existing throughout the year, which has necessitated a still further reduction of price, it is satisfactory to note that a larger profit has been made. During the past twelve months the directors have spared no efforts to secure the company's position in regard to the development of the metal filament, and they have reason to believe that they will be successful during the present year in placing upon the market a metal filament lamp which should satisfactorily replace the demand for carbon filament lamps which is undoubtedly ensuing. Success will necessitate an increased working capital, which the directors hope may be met out of the revenue of the company, but it is possible that it may be necessary to raise additional capital. The directors recommend the payment of the usual dividend at the rate of 10 per cent. for the year.

DIRECT UNITED STATES CABLE CO.—The accounts of the half-year to June 30th, show a revenue of £51,367, against £57,056 for the corresponding period of last year. Working and other expenses amounted to £24,932, leaving a net profit, including £6,396 brought forward from the previous half-year, and £2,299 adjustment of income tax of £35,131. Three quarterly dividends of 4s. per share, and a final dividend of 4s. per share is now proposed, with a bonus of 1s. per share, making 4¼ per cent. for the year. After transferring £5,000 to the reserve fund, there is a balance of £2,812 to be carried forward.

DUBLIN UNITED TRAMWAYS CO. (1896).—The directors' report for the half-year ended June 30th, 1908, states that the amount available for division is £41,594, out of which it is recommended that dividends be paid for the half-year at the rate of 6 per cent. per annum on the preference shares, and at the rate of 6 per cent. per annum, free of income tax, on the ordinary shares. The dividends recommended will absorb £35,100, leaving £6,494 to be carried to next account, in addition to £4,749 unexpended out of the sum set aside last half-year for reconstruction and maintenance. At the meeting on Tuesday the report and accounts were adopted.

ELEKTRISCHE STRASSENBAHN VALPARAISO AKT.-GES, BERLIN.—The returns for the year ended December 31st, 1907, show that the number of car-kilometers has increased from 2,676,060 in the previous year to 4,061,960. The receipts have increased from $865,891 to $1,189,541, and the expenses from $638,189 to $922,260. The increased expenses were due to the damage caused by the earthquake of August last. The small balance remaining after deducting business expenses in Berlin and interest on debentures, has been placed to renewals account.

GENERAL ELECTRIC CO.—Mr. G. Byng presided at the annual general meeting on Friday, when the report and accounts given in our last issue were adopted. The Chairman said that the cause of the diminished profit was the necessity for writing down their stock owing to the sudden fall in the price of raw materials. Discussing the unsatisfactory position of the electrical industry, the Chairman said that some suggestion had recently been made that a league should be started as a combination of manufacturers in order to combat foreign competition. Personally, however, he did not think any permanent improvement would be made until our fiscal policy was altered.

METROPOLITAN RAILWAY CO.—The report for the half-year ended June 30th shows total receipts of £356,787, and expenses £199,780, leaving a profit of £157,007. Compared with the corresponding half-year of 1907 the receipts show an increase of £11,267, and the expenses an increase of £6,419. The net revenue account, after providing for the interest upon the debenture stocks and other fixed charges, and the dividend upon the preference stocks, shows a balance of £18,002 available for dividend upon the ordinary stock. The directors accordingly recommend a dividend upon the ordinary stock for the past half-year at the rate of 10s. per cent. per annum, and to carry forward the balance of £3,672 to the next half-year's accounts. The Surplus Lands Committee announce that the dividend on the surplus lands stock for the past half-year will be at the rate of £2 15s. per cent. per annum. During the half-year the train services have been considerably increased, and a greater mileage has consequently been run. The full benefit has not yet been felt in the receipts, but it is expected that as the greater facilities offered by the company become better known among the travelling public the traffic will respond. It is now more than twelve months since the last of the tube lines was opened, and the immediate effect of that competition is therefore known. The opening of the several tubes has caused a serious diversion of traffic from the Metropolitan line, but it has at the same time given rise to a large increase in the amount of local travel generally which will be a continuing benefit to this company. On some sections of the line the traffic during the half-year has shown a healthy expansion, and on others, where there has been a falling-off through competition, steps are being taken to prevent further loss and to regain the business. Owing to the delay in the completion and opening of the Franco-British Exhibition, the traffic from that source was not so great during the past half-year as was contemplated. It has, however, increased since the beginning of July, and it is fully expected that it will develope largely as the holiday and excursion season advances. Throughout the half-year the electrical plant and machinery have given every satisfaction in working, and the current continues to be produced at a figure which compares very favourably with other installations.

NATIONAL TELEPHONE CO.—At the half-yearly ordinary meeting on Thursday, Mr. George Franklin, Chairman, presiding, the report and accounts given in our issue for July 16th were adopted. The Chairman said the accounts were regarded by the Board as eminently satisfactory. The income for the half-year was £1,452,825, as compared with £1,315,038 in the corresponding period. The net income, after deducting Post Office Royalties, was £1,313,279, as against £1,189,739. There are now 463,869 stations, an increase of 16,761. The working expenses amounted to £832,638, an increase of £82,878, partly due to the normal growth of the business and partly to exceptional items. Maintenance and renewal of lines and instruments have increased by £27,629, indicating the resolve of the Board to keep the plant in a state of efficiency, a policy which should commend itself to the shareholders, since the purchase price to be paid for the business in 1911, on its transfer to the Post Office, would be based on plant values. Administration and management charges had increased by £38,178. The net result for the half-year was £480,641, against £439,979, being an increase of £40,661, and, as £596 more was brought forward, there was an additional sum of £41,257 to dispose of. Against this £7,518 represented increased debenture and other interest, £26,433 extra dividend, and £10,000 more to reserve fund. The reserve fund stood at £2,664,960, and its main purpose was to cover any possible shrinkage in the capital on the transfer of the undertaking in 1911. Some shareholders seemed to think that the reserve fund constituted excess provision. It might be so. If too great, the fund would remain the property of the shareholders, but if it were inadequate the shareholders of 1911 might have just cause of complaint against the directors. In the last week or ten days some eminent financial authorities had been attempting to forecast the price at which the deferred stock would be paid off in 1911. The Board had no responsibility for those forecasts, and saw no safe ground for such prediction. It might, and probably would, happen that arbitration would be resorted to in order to ascertain the purchase price payable, and it would be manifestly unwise for the directors to speculate on the subject or to do anything to create false hopes on the one hand or undue depression on the other. The rentals carried forward had grown from £1,210,117 to £1,314,591, an increase of £104,474 in the half-year. The capital expenditure had increased to £14,042,959, representing the amount expended on their 463,869 stations ,and giving an average cost of £30 5s. 6d. per station. Adding the amount expended upon land and biuldings, £685,309, a total of £14,728,269 was reached. Of this the share and debenture holders had provided £11,221,593, leaving an excess of capital expenditure of £3,506,676. The total of the assets in the balance-sheet was £5,157,456, which had been provided by rentals in advance, £1,187,629, creditors' balances, £935,438, and the reserve fund, £2,664,960, leaving a balance of £369,426, which was appropriated for the dividends, including 6 per cent. per annum on the deferred stock, for the addition of £140,000 to the reserve fund, and for the balance of £10,676 carried forward. Dealing with the adoption of the measured rate system of charging, the Chairman pointed out that there were now upon that system something like 100,000 stations, and it was gratifying that, after careful investigation of their agreements and of the proposed method of operation, a number of the more important municipalities, notably Liverpool and Belfast, had approved of the principle contended for. The company had adopted it only in regard to new subscribers, the old flat-rate subscribers being undisturbed. The adoption of this principle would, at all events, secure to the shareholders a fair and equitable return upon the capital which had now to be spent. The number of staff had increased during the year from 17,421 to 17,946, and the number of the shareholders showed a gratifying increase from 12,217 to 13,031. The number of exchanges was 1,513, and the number of stations, exchange and private, 463,869. The present rate of effective calls was 656,755,000 per annum, or of messages, including call and reply, 1,313,511,000. The accrued revenue per telephone station worked out at £6 3s. 4d., and the average cost per message to a subscriber was 0·48d., the average per week being 2s. 4d., or 4d. per day, including Sundays. So far as the London system was concerned, in December last the Post Office had 46,355 stations and the company 93,020; in June the corresponding numbers were 49,690 and 99,068, so that there had been an increase of 3,335 on the Post Office system against 6,048 upon that of the company.

SIEMENS BROS. DYNAMO WORKS.—The accounts for 1907 show a profit of £1,416.

TORQUAY TRAMWAYS CONSTRUCTION CO.—The accounts from the incorporation of the company (August 24th, 1905) for December 31st, 1907, show a profit of £2,271, which the directors recommend shall be carried forward.

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UNITED RIVER PLATE TELEPHONE CO.—The report for the year ended March 31st last states that the gross receipts in the River Plate were £250,750, as against £216,204 for last year. Deducting expenses in Argentina and London, debenture interest, dividend on preference shares, and interim dividend on ordinary shares, and adding interest on investments, transfer fees, &c., there remains a profit of £77,739, to which is added £4,070 brought forward, making an available balance of £81,809. After applying £25,000 to the reduction of special replacement account, and meeting the cost of paying off the old debenture stock and the issue of the new, the directors recommend that a final dividend of 5 per cent. be paid upon the ordinary share capital, making, with the interim dividend paid December 31st last, a return of 8 per cent. for the year, free of income tax, and that £4,904 be carried forward. At the meeting on Tuesday the report and accounts were adopted.

WESTINGHOUSE AKT. GES., BERLIN.—The report for the year 1907 shows a loss of 83,945 Mk. The total loss up to date amounts to 185,624 Mk.

MISCELLANEOUS CITY NOTES

BRISTOL TRAMWAYS & CARRIAGE CO.—An interim dividend, at the rate of 6 per cent. per annum for the half-year ended June 30th, has been declared.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—A dividend at the rate of 5 per cent. per annum for the three months ended June 30th, together with an additional dividend at the rate of 1 per cent. per annum, on the deferred ordinary stock, is announced.

BROMPTON & KENSINGTON ELECTRICITY SUPPLY CO.—An interim dividend for the half year ended June 30th at the rate of 9 per cent. per annum on the ordinary shares is recommended.

CENTRAL LONDON RAILWAY CO.—Dividends of 3 per cent. on the undivided ordinary stock, 4 per cent. on the preferred ordinary stock, and 2 per cent. on the deferred ordinary stock have been declared. The carry forward is £29,125.

CHELSEA ELECTRICITY SUPPLY CO.—An interim dividend of 4 per cent. per annum (2s. per share) has been recommended on the ordinary shares for the half year ended June 30th.

CITY OF BUENOS AYRES TRAMWAYS CO. (1904).—A dividend of 1s. 3d. per share, less tax, has been declared for the three months ended June 30th.

ELEKTRISCHE LIEFERUNGS AKTIEN-GESELLSCHAFT OF BERLIN.—An extraordinary general meeting has been convened for the purpose of passing resolutions for increasing the capital of the company from 5,000,000m. to 15,000,000m.

IMPERIAL TRAMWAYS CO.—An interim dividend, at the rate of 8 per cent. per annum for the half-year ended June 30th, has been declared.

METROPOLITAN RAILWAY CO.—A dividend of 10s. per cent. per annum is recommended on the ordinary stock for the past half year, carrying forward £3,600. The dividend on the surplus lands stock will be at the rate of 2¾ per cent. per annum, carrying forward £1,800.

NORTH METROPOLITAN TRAMWAYS CO.—An extraordinary general meeting will be held on August 12th to consider a resolution that the capital be reduced from £499,153 10s. divided into 110,923 shares of £4 10s. each, to £488,061 4s. divided into 110,923 shares of £4 8s. each, by returning to the holders of the 110,923 issued shares capital to the extent of 2s. per share.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—An offer is being made to the holders of shares and profit-sharing secured notes, of £1,000,000 of 5 per cent. prior lien bonds to bearer maturing on November 1st, 1920. Interest is payable, free of income tax, half-yearly, on May 1st and November 1st. The bonds are offered at 93, and will be secured by a first specific charge on stocks and shares of the affiliated railway companies having a face value of £14,579,990.

VICKERS SONS & MAXIM.—An interim dividend of 1s. per share free of tax for the June half year is announced upon the ordinary shares.

APPOINTMENTS AND PERSONAL NOTES

Mr. Harry W. Turner, who, as Consulting Engineer, has, for the last two years, been occupied in advising firms in matters relating to insulation and winding, will, from August 1st, be associated exclusively with the Sterling Varnish Co., at Brougham Street, Blackfriars Road, Manchester.

The Imperial College of Science and Technology.—It is announced that the Royal Commissioners of the Exhibition of 1851 appropriated the whole of the remaining site of their estate at South Kensington for the purposes of the Imperial College of Science and Technology. The new mining and metallurgical buildings are to be proceeded with at once. Several additional appointments have been made, among which the Hon. R. J. Strutt, F.R.S., has been elected to an additional professorship of physics.

COMPANY MORTGAGES, &c.

ALSOP FLOUR PROCESS (1906).—Particulars have been filed of an issue on June 3rd of £196 9s. 6d. 5 per cent. second debentures, part of series created March 20th, 1908, securing £1,500, charged on the company's undertakings and property present and future, including new capital (subject to a prior debenture, of which £1,500 is still outstanding). The total amount previously issued of the same series is £901 8s. 9d. There are no trustees.

AMAZON TELEGRAPH CO.—A statement has been filed pursuant to Section 12 of the Companies Act, 1907, of the total amounts outstanding on July 1st, in respect of mortgage and charges created prior to that date, and not required to be registered under Section 14 of the Companies Act of 1900. The particulars are 5 per cent. debenture, dated August 5th, 1897, securing £136,700.

BRITISH WESTINGHOUSE ENGINEERS' CLUB.—A debenture has been registered, dated June 17th, 1908, securing £675 charged on the company's undertakings and property, present and future, including uncalled and unpaid capital. The holders are the British Westinghouse Electric & Manufacturing Co.

BRITANNIA ELECTRIC LAMP WORKS.—The appointment of Mr. J. J. B. Cress, of 65 Lindsey Road, Hornsey, as receiver and manager, has been filed, pursuant to Section 11 (2) of the Companies Act, 1907.

BUENOS AYRES ELECTRIC TRAMWAYS COMPANY (1901), LTD.—An acknowledgment of indebtedness under seal, dated June 29th, 1908, to secure a further £7,000 Second or "B" Debenture stock (ranking *pari passu* with and supplemental to £71,600, forming part of a total authorised sum of £100,000 similar stock, secured by a trust deed dated March 30th, 1906, and two acknowledgments of indebtedness dated March 7th, 1907, and May 27th, 1908), has been registered. Property charged:—certain tramway concessions, freehold land, rights, and the company's undertaking and property, present and future, including uncalled capital. Trustees: W. Greenwell, 2 Finch Lane, E.C., and F. C. Tiarks, 145 Leadenhall Street, E.C.

D. P. BATTERY COMPANY, LTD.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Section 14 of the Companies Act, 1900, has been filed pursuant to Section 12 of the Companies Act, 1907. Particulars are debentures, bearing various dates in 1899, securing in all £4,500.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—A statement has been filed pursuant to Section 12 of the Companies Act, 1907, of the total amount outstanding on July 1st, in respect of mortgage and charges created prior to that date, and not required to be registered under Section 14 of the Companies Act, 1900. This relates to a mortgage dated November 19th, 1890, securing £320,000 debenture stock.

NATIONAL TELEPHONE CO.—A statement has been filed pursuant to Section 12 of the Companies Act, 1907, of the total amounts outstanding on July 1st, in respect of mortgage and charges created prior to that date, and not required to be registered under Section 14 of the Companies Act, 1900. The particulars are a trust deed constituting a first charge on the company's undertakings and property dated November 8th, 1894, securing £1,100,000; 3½ per cent. debenture stock, and two supplemental deeds dated March 9th, 1895, and December 6th, 1898, securing £363,448 and £536,552 respectively.

SANDYCROFT FOUNDRY CO.—Particulars have been filed of an issue on June 25th of £3,100 6 per cent. debentures, part of series created April 15th, 1908, securing £20,000 charged on the company's undertakings and property present and future, including uncalled capital. There are no trustees, and there has been no previous issue of the same series.

SAXON ENGINEERING CO.—Particulars have been filed of an issue of £2,000 6 per cent. third debentures created June 4th, 1908, charged on the company's property present and future, including uncalled capital. There are no trustees.

SYNDICATE OF ELECTRICAL ENGINEERS.—A statement has been filed pursuant to Section 12 of the Companies' Act of the total amount outstanding on July 1st, in respect of mortgages and charges created prior to that date, and not required to be registered under Section 14 of the Companies' Act, 1900. The particulars are a mortgage on leasehold land and premises in Southampton Row, dated September 28th, 1905, securing £13,800.

TRAMWAYS & LIGHT RAILWAYS ESTATE CO.—A statement has been filed pursuant to Section 12 of the Companies' Act of the total amount outstanding on July 1st, in respect of mortgages created prior to that date, and not required to be registered under Section 14 of the Companies' Act, 1900. The particulars are a charge dated September 23rd, 1902, securing £700 upon property at Moxham's Yard, Oystermouth Road, Swansea.

Mining Institute of Scotland.—A general meeting will be held at the Oddfellows' Hall, Kilmarnock, on Saturday, August 8th, when a Paper on "Experiments with Two Electrically-driven Pumps" will be read by Mr. T. Lindsay Galloway.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 10s. to £61 per ton (last week, £59 10s. to £60 per ton).

ANNUAL HOLIDAYS.—The works and offices of Messrs. Parmiter, Hope & Sugden, Manchester, will be closed from 12 noon on Saturday, August 8th, until 9 a.m. on Monday, August 17th, 1908, for the annual holiday. No goods will be received between these dates, but a small staff will be in attendance to deal with urgent matters.

The Arc Works, Chelmsford, will be closed from noon, Saturday, August 1st, until Monday, August 10th. No goods should be dispatched to arrive during that period. Messrs. Crompton & Co.'s head office, Salisbury House, London Wall, will, however, remain open for business as usual.

CHANGE OF ADDRESS.—Messrs. Davidson & Co., Ltd., have removed to larger premises at Egypt House, New Broad Street, London, E.C Telephone No., London Wall 2246.

DISSOLUTION OF PARTNERSHIP.—F. W. Cross and A. A. P. D. Stone, trading as electrical engineers, &c., at Pleck Road, Walsall, have dissolved partnership.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Cornwall Electric Power Syndicate, Ltd., is to be wound up voluntarily. Particulars of claims to the liquidator, J. A. Stoneham, 89 and 90 Cheapside, London, by August 31st.

The Allan Electrical Syndicate, Ltd., is to be wound up voluntarily. Mr. H. Garton Ash, 52 Coleman Street, London, E.C., is liquidator.

A meeting of the Llanelly Tramways Co., Ltd., will be held at 52 Stepney Street, Llanelly, Carmarthenshire, on Thursday, August 27th, at 3 p.m., for the purpose of hearing the liquidator's account of the winding up.

A meeting of the Dolter Electric Traction Co., Ltd., will be held on Wednesday, August 5th, at 2.30 p.m. at the office of the liquidator, Mr. W. S. Ogle, 90 Cannon Street, London, E.C., to determine whether application shall be made to the Court for the appointment of any person as liquidator in the place of, or jointly with the liquidator appointed by the company, or for a Committee of Inspection. The creditors of Reeds Electrical Co., Ltd., are requested to send in particulars of their claims by September 7th to the liquidator, Mr. D. S. Fripp, 90 Cannon Street, London, E.C.

The trustee in the bankruptcy of E. J. Muddle, electrical fitter, 69 Cromwell Road, Hove, has been released.

The adjourned public examination of Ernest Albert Gresham, late electrical engineer, 6 Harehills Avenue, Leeds, late Westborough, Scarborough, was held last week at the County Court House, Albion Place, Leeds, before Mr. Regr. Cautherley, the liabilities being stated at £203 with assets £19. The debtor started business in Scarborough in 1889. A further adjournment was ordered.

The public examination of Francis Benjamin Egginton, electrical engineer and contractor, 11 Tempest Street, Wolverhampton, was held last week at the County Court, Wolverhampton, the deficiency being stated at £82. Debtor said the trade had declined considerably, and competition had been very keen. An adjournment was ordered.

The adjourned public examination of Alfred William Bennett (lately trading as Bennett & Co.), electrical engineer, 43 Elford Grove, late 32 Park Cross Street, Leeds, was held last week at the County Court House, Albion Place, Leeds, before Mr. Regr. Cautherley, the deficiency of £1,124 being ascribed by the debtor to bad trade and competition. The case was adjourned.

NEW COMPANIES

MALLINSON BROTHERS (1908).—This company was registered on July 11th, with a capital of £500 in £1 shares, to carry on the business of tool-makers, iron-founders, mechanical and electrical engineers and manufacturers of dynamos, motors, carriages, vehicles, and engines, and to acquire the business carried on at Mytholm Foundry, Hipperholme, Yorks, as Mallinson Brothers, and to adopt an agreement with J. Mallinson and W. Mallinson. Private company, with only two subscribers, viz.: J. Mallinson and W. Mallinson, machine tool-makers, of 15 Waverley Terrace, Hipperholme, taking one share each. The number of directors is not to be less than two nor more than five. The first are J. Mallinson and W. Mallinson, and each may retain office while holding £50 shares.

PREMIER ELECTRIC CONTROL.—This company was registered on July 9th, with a capital of £7,000 in £1 shares (1,500 preference), to acquire the business carried on at 11 Red Lion Street, Clerkenwell, E.C., as "E. P. Allam & Co.," to adopt an agreement with L. I. Robinson and A. E. Ralph, and to carry on the business of manufacturers of electrical controlling gear and motor starters and regulators, electrical engineers and contractors, electricians, &c. Private company, with only two subscribers, viz., A. E. Ralph, 11 Red Lion Street, E.C., engineer, and H. E. Aldridge, 16 Warwick Street, Regent Street, W., solicitor, each taking one share. The number of directors is not to be less than two nor more than seven; the first are L. I. Robinson and A. E. Ralph. Qualification, £500. Remuneration of original directors, £15 per annum, divided, in respect of every completed sum of £1,000, by which the share capital of the company paid up, or credited as paid up, may be increased beyond £6,000; of other directors, £25 each per annum. The directors (including original directors) are further to receive 15 per cent. of the surplus profits remaining after 10 per cent. is paid on the ordinary shares. Registered office: 11 Red Lion Street, Clerkenwell, E.C.

RUGBY LAMP CO.—This company was registered on July 4th with a capital of £10,000 in £1 shares, to adopt an agreement with B. H. C. Fox, of Maplewell, near Loughborough, and T. Hunter of Rugby, for the acquisition of a piece of freehold land fronting Lower Hillmorton Road, Rugby, and to carry on the business of manufacturers of and dealers in arc, incandescent, and other electric lamps, lighting appliances of all kinds, &c. Private company with three subscribers, viz.:—T. Hunter, J. Findlay, T. H. V. Hunter. The number of directors is not to be less than two nor more than five; the first are T. Hunter and J. Findlay. Qualification, £250. Remuneration as fixed by the company. The said T. Hunter and J. Findlay may not reduce their respective holdings below 2,000 and 500 ordinary shares respectively during the first five years, except in the event of the death or removal from office of either of them, when the shares of the deceased or retired director shall be offered to the survivor at a price to be fixed by the auditors. Registered by Jordan & Sons, 116-117, Chancery Lane, W.C.

SYNDICATE LAMP CO.—This company was registered on June 29th, with a capital of £2,000 in £1 shares, to adopt an agreement with the Metallfadenlampenwerk, Perlin, G. m. b. H., and to carry on the business of manufacturers of and dealers in filament or other lamps, electricians, engineers, suppliers of electricity, &c. The subscribers are R. Hilditch, J. Makin, N. R. Stirling, T. D. Jones, G. R. Makin, H. B. Walton, and E. W. Barnaby. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first. Qualification, £50. Registered office: 56 Spring Gardens, Manchester.

Marathon Race.—It is of interest to note, in connection with this historic event, that the signal for the start was conveyed by H.R.H. the Princess of Wales by means of an electrical device. This consisted of an indicating apparatus fixed in a suitable position behind the competitors, which was operated by a special push on the table in front of the Princess. Mr. J. S. Huddleston, of Messrs. Siemens Brothers & Co., Ltd., who was one of the stewards, fitted up the apparatus, which was made at the Woolwich Works of the above company.

Associated Municipal Electrical Engineers (Greater London).—The annual general meeting of this association was held at the Frascati Restaurant on Friday, the 24th inst., and the following officers were elected for the ensuing year:—President, C. Newton Russell (Shoreditch); Vice-Presidents, G. G. Bell (Hammersmith), W. C. P. Tapper (Stepney), W. C. Ullmann (East Ham); Treasurer, G. G. Bell (Hammersmith); Auditors, A. J. Fuller (Fulham), P. E. Rycroft (Heston); Hon. Secretary, A. H. Shaw (Ilford); Council, S. W. Paynes (St. Pancras), J. R. J. Bowden (Hackney), A. C. Cramb (Croydon), C. S. Davidson (Mortlake), A. Gay (Islington), A. C. Gilling (Epsom), C. F. McInnes (Gravesend), L. L. Robinson (Hackney), E. Sayer (Hampstead), A. H. Seabrook (West Ham), N. Staniland (Hornsey), J. E. Tapper (Beckenham).

Telegraph Traffic. Communication between Cayenne and Salinas has been restored, and this renders possible through communication *via* Hayti to Brazil. The Venezuela cables are still inoperative, while the Port Arthur-Chifu cables, closed during the Japan-Russian War, have not yet again been opened. The Las Palmas-Arecife, Pera-Dardanelles, Sierra Leone-Accra, Cadiz-Tangier, and Djedda-Suakim cables are not yet in working order, although the first three have been interrupted since May last. The Kwandang-Merado and Cotoron-Grand Bassam cables also still remain broken. The cable steamer *Mexican* put into Halifax, Nova Scotia, after repairing a Western Union Co.'s cable damaged 150 miles off that port, and eventually sailed for New York. A new cable is being laid connecting Sevastopol and Varna in Bulgaria, while the Bulgarian Government are also in negotiation for the installation of a Marconi wireless station at Varna. Telegraph construction is going ahead in Africa, judging by the large number of offices which have been opened recently. Telegrams may now be accepted for Kadugli in Egypt, Nyanga in Cameroon, Kpandu in Togoland, and Baro, Katcha, Kuta, Offa in Northern Nigeria, and Ede, Ilegbo, Ikerun, Iwo, Lalupon, Okuku, Olodo, Origo, Ozo Road, Shaki, Itu, and Uwet in Southern Nigeria, while two new stations have been opened at Tamale and Wa in the Gold Coast.

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ELECTRICAL ENGINEERING

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SUMMARY

An article by Messrs. W. F. Mitchell and J. Fernie considers a number of points in connection with the possibility of keeping down the cost of small house services—an important necessity in view of the reduced revenue per consumer, consequent upon the advent of the metal-filament lamp. (Page 203.)

Reviews of the following appear in this issue:—"Power Gas Producers," by P. W. Robson; "The Post Office Electrical Engineers' Journal," Vol. I., Part II. (Page 205.)

The tramway system of the Manchester Corporation has been extended to the amount of seven miles during the past year, and now comprises 177 miles of single track. The accounts show that the working costs during the year amounted to 7·07d. per car mile, excluding capital charges, or 10·87d., including capital charges. The total receipts amounted to 10·87d. per car mile, against 11·12d. for the preceding year. The gross balance for the year's working was £271,153, and after meeting all charges, and setting aside £87,790 for reserve, renewals and depreciation fund, a contribution to the rates of £55,000 was made. (Page 206.)

The London and District Electricity Supply Bill was read a second time in the House of Commons on Thursday. Mr. Chaplin (Wimbledon) moved the rejection of the Bill, and was supported by representatives of Fulham, Bethnal Green, Dartford, Kingston-on-Thames, Woolwich, Westminster, and Kent (Sevenoaks). Mr. McKinnon Wood said that he felt bound to vote for the second reading for the reason that, although he preferred a complete municipal scheme, there was no possibility of it being put forward, and he was not justified in voting in such a manner as to bring about further delay. He did not approve of the terms of purchase, but these could be left to the Committee. Mr. Winston Churchill, the President of the Board of Trade, in moving that the London County Council be mentioned in the Bill as the purchasing authority, said that the Board of Trade intended to apply a common policy to all three Electric Supply Bills now before Parliament, namely, that the London County Council should be the purchasing authority. In supporting the present Bill the Board of Trade did not approach the matter from the party point of view. This was the fifth successive year in which attempts had been made to pass such a scheme, and the uncertainty had hung like a pall all the time over the electrical industry. Having regard to the conditions in London, he held the view that the House of Commons would take a very grave responsibility if it disregarded the proposals now put forward without giving them de-

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tailed attention at the hands of a Committee of the House. (Page 207.)

In a recent article in an American periodical, Mr. J. S. Peck compares the British, American, and German standards for electrical apparatus. In general, he finds that the American standards are stricter than the German, while the British standards are about halfway between the two. (Page 207.)

A short article gives some particulars of the operations of the Rio de Janeiro Tramway, Light, & Power Co., including one of the largest water-power installations yet constructed. (Page 208.)

The electrical equipment of the Ferndale Collieries is a fine example of the application of electrical distribution of power to mines. Current is supplied to a group of eight pits from a steam-driven power station containing slow-speed alternators. The transmission to the pits nearest the power station is at 2,200 volts, and to the more distant pits at 6,600 volts, by overhead lines. Electricity is used in the mines for ventilation, haulage, pumping, and lighting, as well as for driving workshops on the surface. A large electric winder on the Ilgner system is being erected. (Page 209.)

A method of manufacturing reinforced concrete poles for tramway work or for distribution lines has been introduced recently into this country. The process, which is the invention of Mr. Hans Siegwart, of Lucerne, consists in pressing concrete on to a sheet metal core, which is surrounded with a skeleton reinforcement consisting of longitudinal rods and spirally-wound wire. This skeleton becomes completely embedded in concrete, and when this is set the internal sheet metal core is withdrawn. This leaves a hollow pole of reinforced concrete. Poles manufactured by this process have already been used on distribution lines in Switzerland and elsewhere. (Page 217.)

The first portion of a series of definitions of terms used in electrical engineering which have been prepared by a sub-committee of the British Committee of the International Electrotechnical Commission has been issued. (Page 218.)

Some extensions are in progress to one of the elevated railways in Chicago. Details of the steel structure and track equipment are given in an article, and may be regarded as typical of American overhead railway construction. The third-rail system is adopted. (Page 221.)

A note is given under Electrometallurgy and Electrochemistry of the way in which sulphur can be entirely eliminated from the charge in the Heroult form of electric steel furnace. An installation of a group of 750-kw. Keller furnaces which have recently been set to work at Unieux is also described. (Page 223.)

Under Electrical Science, in the British and American Section, some recent work on the temperature coefficient of the resistance of silicon is described. In the Papers abstracted in the Continental Section, E. Branly deals with the wireless control of mechanisms and with thermoelectric detectors, and Cotton and Mouton investigate the electric double refraction in nitrobenzene. (Page 223.)

A new form of drawing-in tape for interior conduit work has been introduced. (Page 224.)

Among the Patent Specifications published by the Patent Office on Thursday last is that of C. H. Stearn and C. F. Topham for the "Stearn" multiple metal-filament lamp, which consists of a number of lamp units in series. A specification by C. H. Hyde describes a method of making conducting joints between the filaments and the leading-in wires of metal-filament lamps. The Allgemeine Elektricitäts Gesellschaft has one relating to the speed regulation of single-phase commutator motors, particularly to regulation at speeds above that of synchronism; and a specification by Siemens & Halske describes a simple process for removing the carbon from metal filaments by heating the filament in an atmosphere of acetic acid. An application for amendment to a patent relating to electric igniters for internal combustion engines has been made by De Dion Bouton, Ltd. A patent for a process for the evacuation of lamp bulbs, taken out by A. Maligani, and another for a diaphragm for electrolytic cells, by M. Kiliani and others, expire during the current week. (Page 225.)

Negotiations have been carried on between the London, Brighton & South Coast Railway Co. and the Brighton Corporation for a supply of electricity to the railway company's works there. The company will take a supply for five years, but it will be discontinued between 5.30 p.m. and 8 a.m. during December and January. The terms of payment are a fixed charge of £750 per annum, plus 0·56d. per unit. It is estimated that the consumption will be from 500,000 to 750,000 units per annum.—The Edinburgh Corporation has decided to transfer £9,794 of the surplus electric lighting profits for the past year to the relief of rates.—The tenth anniversary of the opening of the State telephone service in Guernsey was celebrated last week.—No further action will be taken by the Greenwich Borough Council with regard to Major Cardew's experiments for deodorising sewer gases by means of ozone generating apparatus.—A suggestion has been made to the Islington Borough Council by the London County Council that the period for repayment of loans, namely, 42 years, should be shortened in respect of loans already sanctioned, but the Borough Council do not approve of it.—For the second financial year of the Marylebone electric lighting undertaking there is a gross income of £161,492, compared with £158,459 for the previous year. After meeting capital charges there is a deficiency of £3,136, which the Committee attribute mainly to the low average price obtained, namely, 1·389d., against 1·45d. per unit for the previous year.—A resolution will be moved at the next meeting of the Stepney Borough Council opposing the continuance of experiments with the G.B. surface-contact system in the Mile End Road. (Pages 227 to 229.)

Local Government Board inquiries have been held at Dartford (£2,880) and Eccles (£16,278) for electricity extensions. An electric lighting plant is required at the Nurses' Home, Upper Edmonton. The Manchester Electricity Committee require a storage battery at the Stuart Street station, and low-pressure pipework, &c., at Dickinson Street station. A storage battery, motor-driven booster, and switchboard is required on the training ship *Exmouth* by the Metropolitan Asylums Board. The Watford Corporation requires a surface condenser and steam-driven pumps. Sixteen electric cranes are required at Auckland (N.Z.). For the information of wiring contractors we give particulars of a large number of buildings about to be erected in London and the provinces. (Pages 229–230.)

After providing for interest and rents, and for a dividend of 4 per cent. on the preference shares, the accounts of the Baker Street and Waterloo Railway Co. show a balance of £9,834; a dividend of ¾ per cent. per annum is declared upon the ordinary shares. The accounts of the Central London Railway Co. show a balance of £74,125, after providing for interest and debenture stock, &c. A dividend of 3 per cent. per annum is declared on the undivided ordinary stock, and 4 per cent. on the preferred ordinary stock. The report of the Charing Cross, Euston & Hampstead Railway Co. for the June half-year shows a balance of £832, after providing for interest and rents. At the half-yearly meeting of the East London Railway Co. last week Lord Claude Hamilton stated that the estimated

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cost of converting the lines to electric traction was £59,600 under one scheme, and £79,600 under another. There is a balance of £419 upon the working of the Great Northern & City Railway for the June half-year. A dividend of ¾ per cent. has been declared upon the ordinary shares of the Great Northern, Piccadilly, & Brompton Railway Co. There is a balance carried forward of £4,886. The report of the Edmundson's Electricity Corporation for the year to March 31st, states that there is a net profit, after payment of debenture interest, of £2,610, to which is added £17,807 brought forward. The directors recommend that both these sums be carried forward. After providing for rent charges, interest on debentures, and other charges, there is a deficit of £8,957 upon the working of the Metropolitan District Railway for the June half-year. (Pages 231 to 233.)

In another column will be found the first portion of a series of definitions of terms used in electrical engineering, which have been prepared by a sub-committee of the British Committee of the International Electrotechnical Commission. The object of these definitions is not so much the provision of a glossary to explain the meaning of the various terms to students or laymen, as a laudable endeavour to facilitate uniformity in nomenclature by indicating such terms as are considered by the committee as suitable, and distinguishing them from those in common use, which for various reasons are not recommended. It may be questioned, however, whether the gain obtained by persuading the few engineers who will be induced to discontinue the use of the offending expressions is at all commensurate with the immense labour involved in the preparation of this electrical dictionary, containing, as it does, much of the obvious. We do not suggest that when completed the work will be without its uses; for example, it should be of great assistance to various compilers of engineering literature and to foreign firms tendering to British specifications, although the latter reason may not meet with unmixed approbation. We trust that our foreign friends will see the advisability of assisting our own manufacturing firms in a similar manner, both by compiling such dictionaries and by abating some of the high tariffs against imported electrical machinery. The attempt to standardise phraseology of any kind naturally involves many debatable points, and probably before the definitions are finally adopted some modifications will be made. We notice that the term "dynamo" is to be limited to continuous-current machines only, and "generator" is recommended as the general designation of apparatus for converting mechanical into electrical energy. We would suggest that the derivation and recognised use of the word dynamo renders it fitted for this general employment, and although the word generator will undoubtedly remain, it is unsuitable for international purposes, owing to the employment of "*generateur*" in French in the sense of boiler, while to increase the confusion "*generatrice*" is the equivalent of the English term generator. Taken as a whole, the definitions are excellently worded, although we do not like the expression "induced part of one motor" in the definition of cascade connection. Much difference of opinion has always existed regarding the relative merits of "continuous" and "direct" current. Although in some ways the term continuous is to be preferred, we think that it is useless to attempt to suppress the well-known abbreviation D.C., and substitute C.C., which is already often used to signify concentric cable; nor do we consider that the endeavour to prevent the field magnets of dynamos being spoken of as fields will meet with much success. We heartily agree with the limitation of the term electrocution—it it is to be used at all—to the form of capital punishment, which was the subject of such revolting experiments in America not long ago. We must, however, protest most strongly against the use of "diversity factor" in the sense usually understood by the term "load factor," that is, ratio of average to the maximum load, and would remind the committee that the meaning of the expression diversity factor as adopted by all engineers is: the ratio of the sum of the consumer's maximum demands to the maximum demand on the station. As the date of the meeting of the International Commission in London is drawing near, some more definite statement of the work to be done and the proposals to be put forward would be acceptable. We cannot think that the activities of the British Committee have so far been limited to the production of the first part of a glossary, the need for which has not been urgently felt in this country at any rate, and in the unofficial issue of an ingenious but fantastic proposal for an entire re-modelling of the system of physical symbols used by present-day writers.

The second reading debate upon the London and District Electricity Supply Bill in the House of Commons on Thursday was remarkable for a very broad-minded statement by the President of the Board of Trade upon the question of electric power supply in London, although the discussion showed strong signs of that purely party feeling which has prevented so many Bills in the past from being considered upon their merits. Mr. Winston Churchill's speech was a model of fairness compared with the remarks of some other speakers in the debate, who ignored the real facts and referred to the Bill as giving the company unrestricted powers in every conceivable direction. The Bill now goes to a Committee of the House of Commons with special powers to deal with the question of purchase; if any serious alterations are made in the Bill in this respect it would appear that they will come from the Committee itself, for the London County Council have intimated that they are satisfied with the Bill and have not lodged a petition against it, and none of the other opponents before Lord Cromer's Committee based their case upon this point. The application of one principle with regard to purchase to all three Bills will open up quite a new controversy before this Committee on a point which was not before Lord Cromer's Committee, for the reason that the two Bills of the electric lighting companies did not deal with purchase at all. Presumably considerable opposition may be expected from the Borough Councils to the proposal of the Government that all purchasing powers shall be delegated to the London County Council. It is even conceivable that the companies may oppose if the new position thus created has the effect of making the terms of purchase more favourable to the purchasing authority. But whatever may be the result to the interested parties, a very complicated situation will have been made much more simple if this principle is applied in a satisfactory manner. All the doubts which now exist under the

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Electric Lighting Acts as to the actual terms of acquiring the existing companies should disappear, together with the involved question of compensation for "severance," which has been brought into existence by the facts that there are so many Borough Councils in the county of London with small areas, and that there are companies whose areas include portions of several of these local areas. In the light of the views expressed on behalf of the Government in the second reading debate upon the London and District Electricity Supply Bill, viz., that a bulk supply scheme for the metropolitan area is needed, it is reasonable to suppose that the proceedings before the House of Commons Committee will take a somewhat different aspect from those before former Committees. This is the first definite official pronouncement upon the subject, and it would seem to leave the Committee no alternative than to pass the Bill with the alteration indicated by the Government. Taken altogether there seems to be every prospect of the final settlement of a matter, the uncertainty surrounding which during the past five years has, it is admitted by the Government, "hung like a pall upon the electrical industry." After Mr. Churchill's speech we have a right to expect his energetic assistance to improve the status of the electrical engineering industry, not only in the metropolis but over the whole British Isles, for he has definitely asserted his view that "cheap electricity is scarcely less important than cheap and abundant food."

Occasions for the commemoration of anniversaries in connection with engineering and applied science are rarer than in the case of general national, international, or political history. A war between nations is usually decided by a particular battle, epoch-making alliances are made by treaties adopted on particular dates, and the same applies equally to the signing of the Magna Charta and the passage of Acts of Parliament of great social or political importance; but the subjugation of the great sources of power in Nature for the use and convenience of man is a gradual process, and it is often difficult to assign a definite date or even the name of a particular pioneer to some of the greatest discoveries and inventions that have been made in the realms of engineering. Submarine telegraphy is an instance in point. The laying of the first submarine cable in 1850—between England and France—was due to the enterprise and persistent energy of Jacob and John Brett. The first cable failed almost directly it had been laid, but a second cable, which was enabled to be laid in the following year by the assistance (both financial and otherwise) of Crampton, enabled public messages to be interchanged. A more definite date, somewhat later in the history of submarine telegraphy, is August 5th, 1858. Yesterday was the fiftieth anniversary of the completion of the first telegraph cable across the Atlantic Ocean, and although it was but two months before the insulation of this cable failed, it enabled the whole theory and practice of long-distance submarine telegraphy to be placed on a definite and permanent basis. The history of this cable was so recently related by Prof. Silvanus Thompson in his commemorative lecture upon the life and work of Lord Kelvin (Electrical Engineering, Vol. III., p. 692), that it need only be referred to briefly here. The Bretts were again concerned in the initiation of the scheme, and Cyrus Field, Charles Bright, and William Thomson (Lord Kelvin) are three names that stand out prominently in connection with it. Had it not been for these enthusiasts, the attempt would not have been repeated after two failures, and after the cable broke down within two months of its completion on account of Thomson's advice having been disregarded, it was to him that the success of the next cable was due. The cable completed fifty years ago yesterday was a good piece of engineering work, although it succumbed to the method of operation employed, and August 5th, 1858, may be put down as one of the most important dates in the history of the world, and one of those that identifies Great Britain with the supremacy in the great engineering industries.

Telegraph Traffic.—Very little alteration has taken place in the records of land-line and submarine cable interruptions and repairs which we published in our last issue. The only restoration of communication to be notified is that between Rome and Constantinople, which was again in working order on the 29th ult. Once again we have to record the failure of telegraphic communication between Trinidad and British Guiana, the cable having become interrupted on the 31st ult. As usual, every sailing and steamer opportunity will be availed of to send messages forward. Work on the wireless installation between Trinidad and British Guiana is being taken in hand. The Lodge-Muirhead system is already working between Trinidad and Tobago, and the same system will be employed in the new installation. The Turkish Government are about to lay a cable about 22·437 kilometres in length to connect the Imbros Islands with some place on the European coast. A land-line about 12·5 kilometres in length will connect Parayia, where the telegraph office is situated, with Ayia Toufolia, and the cable, which will land in the Dardanelles, will be connected by land-line with the cable between Kilid-ul-Bahr. The line between Rome and Pera was again down on the 1st inst. A new telegraph office has been opened at Kanus, in German South-East Africa, and at Mulondo, in Angola; while Hillstation and Wilberforce in Sierra Leone are now telegraphically connected. We are able to announce that the Russian administration opened the submarine telegraph cable between Sevastopol and Varna on the 2nd inst. for traffic.

The Brakpan Station of the Victoria Falls Co.—Some particulars of the steam plant which the Victoria Falls Co. is erecting at Brakpan, near Johannesburg, to supply electric power until they complete the scheme for bringing power from the Falls are given in our contemporary, *African Engineering*. The machinery now being installed will consist of two turbo-alternators, each of 3,000 kw. These are being erected on one side of the old power-house, but in an independent building. The generator house, which is built entirely of steel framework and brick, measures about 50 ft. by 120 ft., whilst the boiler-house is of the same length, but about 20 ft. wider. A third building has been put up on the opposite side of the old power-house to cover the transformers and switchgear. It is 100 ft. long by 60 ft. wide. The turbo-alternators will generate three-phase current at 10,000 volts, which will be transformed up to 40,000 volts for transmission. They are erected on high concrete foundations, so as to enable the condensers, &c., to be arranged beneath. The air and circulating pumps are driven by separate electric motors, and a 20-ton travelling crane runs along the whole length of the building. The boiler-house, which is covered with corrugated iron, contains eight Babcock & Wilcox water-tube boilers of 1,500 h.p. each, fitted with superheaters, and the economisers, coal-bins, &c. Forced draught is to be adopted, and the steam will be supplied to the turbines superheated about 100° C. A special feature about the boiler-house will be the coal-handling gear, which, in conjunction with the chain-grate stokers, will eliminate practically all manual labour. The transformer house is a three-storey brick and steel building, divided into four departments. At one end the transformers and lightning arresters will be installed, whilst the opposite end will be devoted to two accumulator batteries and a motor-generator for charging the batteries. The switches are all to be operated electrically from a separate room, and the switchboards are to be of marble throughout.

Sheffield-Warrington Electric Railway.—It is stated that a scheme is being inaugurated for the construction of an electric railway between Sheffield and Warrington, passing through Macclesfield, Chelford, Buxton, and Nutsford.

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ON THE COST OF SMALL HOUSE SERVICES

By W. F. Mitchell and J. Fernie

THE arrival of metallic filament lamps and the consequent expected decrease in units sold per lighting consumer, has made the question of the cost of house service connections to small consumers one of considerable importance.

The cost of a service connection depends, of course, on its length and on the demand of the consumer. Fortunately, as a rule, the smaller the demand of any lighting consumer the cheaper is his service cost. This is because a small house generally stands back only a short distance from the street, and a small section of cable, and a meter and fuses of only small capacity are required to supply it. Thus shops with a frontage on the street, houses with a basement, flats, "flatted villas," and rows of cottages can all be connected up quite cheaply; it is villas and houses standing well back from the street that are expensive to connect, but these are generally, from the station point of view, among the best lighting consumers.

The writers believe that a draw-in system of mains can be shown to be the cheapest to connect house services from, as well as the all round cheapest for other reasons. It is somewhat remarkable that, in discussions on central station design and costs, the design of the generating station is minutely elaborated, whereas the distribution system is generally dismissed as costing so much per kilowatt, without any particular system of laying the cables being specified. It can, however, be shown that the first cost and the maintenance of any distribution system, considered as a whole, are greatly modified by the system adopted.

The cost of services are much influenced by the position the supply authorities' fuses and meter are made to occupy. Discretion should be used, when deciding their position, to ensure that they shall be free from moisture, and that the apparatus shall be reasonably safe from mechanical injury. Considerable tact is often necessary to convince a consumer that the most desirable position from the supply authorities' point of view is also the best for him. An authorised authority is not legally bound to carry the service lines beyond the boundary wall of a consumer's premises. Most corporations have a free limit, up to which service lines are carried in free, but above which the consumer has to pay for the extra distance. This free distance might with advantage be reduced in some cases, so as to cheapen the average house service costs.

Service-leads off a draw-in system must be led from an accessible box built on the ducts. Such a box may be built of brick lined with cement, and having a cast-iron frame, and preferably hinged, drained, and ventilated lid, filled up with concrete. The hinging of the cover on to the frame, and the draining of the latter, has been found very satisfactory with ventilated box covers. If the ducts are laid in the pavement, such a box (about 15 ins. by 15 ins. inside) can be installed complete for about 18s., including mason's time for building, and checking pavement, bricks, cement, sand, and frame and cover.

The whole of this cost, which in unfavourable circumstances should not be greater than 20s., is, of course, not borne by one consumer. The box is always built opposite the parting wall dividing two sets of premises, so that half the cost only belongs to any one service (except in the case of isolated consumers). Further than this, in many cases the cost may be divided among as many as eight consumers. This is the case when a supply is given to a tenement building, there being six consumers living in flats on the common stair, and two ground floor houses on each side of the stair, each with independent access. To supply such a building then, one box is built, one pipe led into the common stair, one concentric service cable pulled into the pipe, and one pair of main fuse boxes put up. The owner of the property runs a pair of mains up the stair from the main fuses, supplying sealable fuses for each consumer on their respective landings. Each consumer has his meter inside his flat. Putting the cost of the box at 20s., the pipe (galvanised iron) at 20s. installed, the cable (lead-covered concentric) at 12s., the fuse boxes at 7s. 6d., jointer and mate's time at 4s., jointing material 2s., cartage 1s. 6d., the whole cost, exclusive of meters, is £3 7s. Divide this by eight, add cost of meter (30s.), and cost of testing, &c. (say), 1s., and the cost per consumer works out at rather less than £2.

It will be seen that if this service were put in to supply a single consumer, the cost would be, using a bigger meter, about £5 10s. But, as pointed out, one box can nearly always be made to serve at least two consumers, and small cottages, shops, town houses, and any premises with a frontage on the street, will probably require a shorter length of pipe and cable than allowed for above; indeed, where the service line can be led into a cellar or an area the actual length of line is often only three or four feet. The cost of a service may then be anything from £2 up to £6, and if consumers requiring long services are made to pay for the additional length, the average cost per service should be well under £6, and considering small consumers only, the writers consider that between £3 and £4 is a fair average.

Suppose the service cost of a small consumer is as much as £5, if interest, sinking fund, and depreciation charges on the service cost amount to 10 per cent. per annum, this means an annual charge of 10s. to be borne by this service. Now the class of consumer here considered, whose total service cost, including meter, may be as low as £2, will in general use chiefly one room, which may be lighted by one or two lamps, but he will be a good long hour consumer, and will use perhaps 100 units in a year; at 3d. per unit, this equals 25s. Deducting 10s. for the cost of his service, this leaves 15s. to pay for his proportion of the station standing charges, and running costs on 100 units. Now ½d. per unit is certainly not too little for the running cost, therefore, deducting 100 units at ½d. = 4s. 2d. from 15s., leaves (say) 10s. for standing charges.

Ten per cent. is a liberal allowance for interest, sinking fund, and depreciation. The life of meters has been recently estimated by Mr. R. Hammond at 10 years, by Mr. J. F. C. Snell at 15 years, and by Sir William Preece at 12 years, but there seems no reason why some meters should not have a much longer life.

The type of house-service fuse-box allowed for in these estimates consists of two 3 ins. break single-pole fuses, enclosed in separate cast-iron boxes, lined inside, and mounted on varnished wood board.

It will be noticed that the cost of the material used for the actual service joint is only 2s. This represents solder, resin, wax, bitumen lapping, proof tape, and benzine. The whole joint is suspended in air in the manhole, and can be made perfectly sound with a good wax and proper lapping. Since there is no lead sleeve over the joint, the lead of the distributors off which the service is tapped is necessarily broken, unless a bond be put on round the joint. The distributors are supposed to be single cables. The writers regard it as an advantage to break the continuity of the lead covering

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at any such joints. The joint is every bit as good as the elaborate sealing boxes often used for lead-covered fibrous insulated cables; the outside tapes can be regarded as taking the place of the porcelain or metal box into which the cables are sealed with wax, the wax, in the case of the joint, being replaced by wax and lapping, which, if put on properly, form a homogeneous mass, equally as adherent as wax alone.

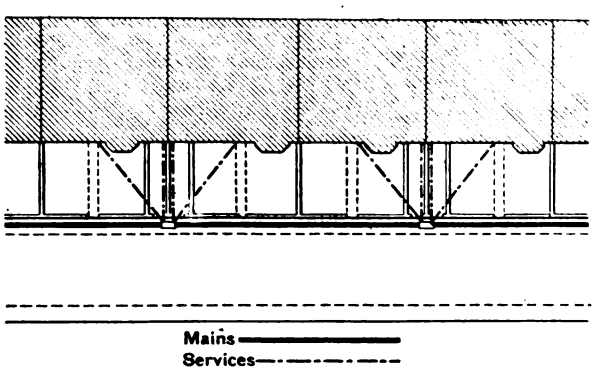

Fig. 1.—Sketch showing Eight Services to "Flatted Villas," from Two Service Boxes.

There are many special cases in which services may be cheapened; for instance, it is often possible to supply two consumers from one service pipe. Two single cables are better than a concentric cable in this case. The fuse-boxes of each consumer are placed back to back one on each side of the dividing wall, and a tapping taken through the wall. This method is, of course, only applicable to a limited number of services, and is not always to be recommended. Within recent years in many suburban districts, small houses built on the "flatted villa" principle, where each tenant has a separate front entrance, have come into fashion. Service costs to this class of property average out higher than the tenement consumer already quoted, but it is possible that economies may be effected if a draw-in system of mains is employed, in which case four services may be tapped on to the mains in one manhole, see Fig. 1.

In such cases as the above it is found cheaper to substitute an armoured concentric service cable, laid direct,

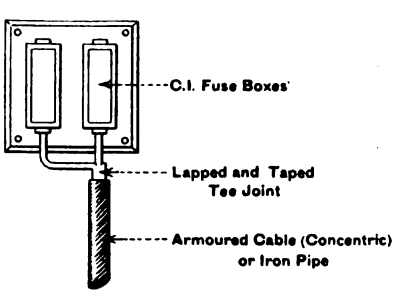

Fig. 2.

in place of the ordinary concentric cable drawn into a galvanised iron pipe.

Provided a good position has been selected for the fuses to be fixed, it seems to be quite unnecessary to use a cable-sealing chamber in conjunction with the fuses. A system of splitting the concentric cable below the fuses, as shown in Fig. 2, has given satisfaction, and has the advantage of low cost.

In many residential districts it is frequently found more efficient to lay distributing mains on one side of the road, only crossing to the opposite side as required, with services as shown in Fig. 3.

Several attempts are being made to dispense with meters for small consumers, a charge per lamp installed per annum being made. In these cases, however, a consumer is generally very generous in his consumption of energy. Blocks of offices can be supplied through a main meter, for which the landlord is responsible, including the use of light in the rent. Such consumers are horribly bad from the station point of view, and are certainly not worth a meter each; if insisted on a meter rental should be charged.

Attempts have also been made to cheapen service costs by running distributors through blocks of houses, either under the floors or under the roofs. In such cases it seems probable that an attempt would be made to hold the supply authority responsible for any fire that breaks out.

The invention of a good cheap meter would considerably simplify the problem of supplying small consumers.

Low watt lamps should have a directly beneficial effect in reducing the maximum demand of the unprofitable short hour consumer, and cannot attract many

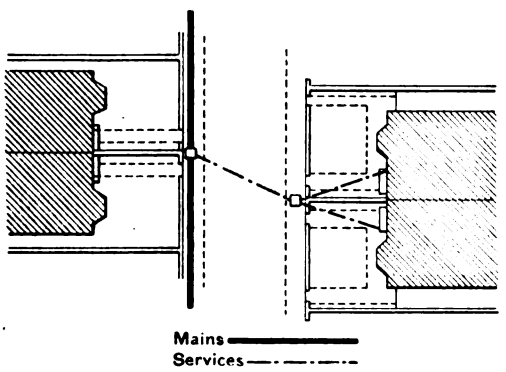

Fig. 3.—Sketch showing Mains Laid on one side of Road with Service Crossing to the Other Side.

more of this undesirable type, because they are nearly all connected already, at any rate where a flat rate charge is in force.

New Telephone Charges.—At a meeting of the Liverpool Chamber of Commerce last week it was decided to support a resolution of the London Chamber of Commerce to the effect that the Permanent Telephone Committee of the Association of Chambers of Commerce of the United Kingdom be dissolved, as not having the confidence of the Association. It will be remembered that this Committee was formed a few months ago for keeping in touch with the Postmaster-General and the National Telephone Co. on matters relating to the telephone service throughout the country, and especially with regard to the new system of charging.

Electrical Power in Australian Mines.—The *Australian Mining Standard* states that following the success of the earlier portion of the electrical equipment of the Mount Lyell mines, a contract has been placed for an electrically-driven air compressor with a capacity of 2,000 cubic feet of free air per minute and a final pressure of 80 lb. per square inch. This represents the application of electricity for compressing purposes on a far larger scale than anything previously undertaken in Australasia. Some new pumping plant is also on order. The North Lyell mine was the first in Australia to install an Ilgner main electrical winding plant. The new compressor will be of the two-stage type, manufactured by Messrs. Thompson & Co., of Castlemaine (V.), and will be driven at a constant speed of 144 r.p.m. by an A.E.G. three-phase induction motor, 350 h.p., 3,000 volts, mounted direct on the shaft between the high and low pressure cylinders. As the output of the compressor cannot be economically altered by varying the speed of the motor, an automatic mechanical device will be provided, which will cause the compressor to run light immediately a predetermined maximum pressure is reached in the receiver, and again run fully loaded as soon as the receiver pressure has fallen a few lbs. below normal. The motor will be controlled by a liquid starter. The new pumping plant consists of four Pearn treble-ram electric mine pumps, each with a capacity of 6,000 gallons per hour, against a vertical head of 400-450 feet. The whole of the castings, valves, valve seats, plungers, &c., coming in contact with the water, will be made of high-grade gun metal, to resist the excessive corrosive nature of the mine water. Two of the pumps will be placed about 700 ft. below the top of the shaft, and the other two 450 ft. lower. The pumps in each chamber will be placed over the well, and will be automatically stopped and started by A.E.G. patent float controllers. The motors driving the pumps will be of the three-phase slip ring induction type, having a normal rating of 25 h.p. at 525 volts, but will be capable of running continuously, if necessary, at 30 h.p. The efficiency of the pumps is guaranteed at 80 per cent., and that of the motors at 89 per cent.

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REVIEWS OF BOOKS

Power Gas Producers. By Phillip W. Robson. 244 pages 5¼ in. by 8½ in.; 105 illustrations. (London: Edward Arnold.) Price 10s. 6d.

This book is divided into three sections; the first deals with general principles, with the chemical reactions involved, and with suction gas producers; the second and third describe pressure producers for non-bituminous and for bituminous coal respectively. In each section the theory of the subject is first indicated, and then the manner in which it is more or less applied by various manufacturers is discussed. The admittedly difficult subject of the chemical reactions occurring in a producer is described in a lucid manner to an extent sufficient to enable an engineer to grasp the theory on which gas producers are built. A numerical example is worked out in considerable detail, and will greatly assist the reader in understanding the chemical principles involved. The author lays great stress on the amount of steam blown into the producer; he shows that there should not be more than 0·8 lb. of steam per lb. of fuel, and that since this is equivalent to saturation at an air temperature of 85° Fahr., it is easy to have too much steam, because the pre-heated air has a temperature of about 160° Fahr. If, therefore, the vaporiser is not carefully arranged and the water supply duly regulated, the amount of steam may be excessive, with the consequent lowering of the furnace temperature, resulting in inferior gas. For this reason, amongst others, he prefers the "flash boiler" type of vaporiser to those in which there is practically an unlimited supply of water.

In Chapter III. the essential features of a suction producer are described, such as the furnace, the vaporiser, and the firegrate, and the merits and demerits of the arrangements adopted by various manufacturers are discussed in a most impartial manner. We desire to emphasise this point, because the author is connected with the National Gas Engine Co.; this has not, however, in our opinion, affected the impartiality of his judgment. The construction of generators is dealt with in Chapter IV., and it is stated that up to about 100 h.p., cast-iron is the most suitable material for the bodies; beyond this size rivetted steel plates are best. The author favours cast-iron in all cases for the vaporisers (on account of corrosion), a view which will not receive universal acceptance. Special attention is called to the importance of making a good job of the fire-brick lining of the furnace, and specially shaped fire-brick lumps giving radial joints are recommended. The object, of course, is to prevent air leakage into the upper part of the furnace. A great number of suction producers are illustrated and described.

The function and design of scrubbers, fire-bars, and grates, and other important details, are considered in Chapters V. and VI. An interesting calculation is given whereby the amount of cooling water required in a scrubber is obtained—it comes out to just over one gallon per B.H.P. It is also explained that the temperature of the water at the outlet must not exceed 130° F., else vapour is produced which tends to carry forward the tarry matter and dirt in the gas. Suction plants for bituminous fuels are exemplified by the Deschamps producer, and the Fichet and Heurtey producer—they are both on the down-draught principle. The author is sceptical as to practical use of such producers, because the complexity of the apparatus for cleaning the gas, and the difficulties arising in the gas engine itself, lead to greater expense than the saving in the cost of fuel. Moreover, the probable solution will be the coking of such bituminous fuels to obtain the bye-products on a large scale, the resulting coke being suitable for ordinary suction producers. In the next chapter much practical information and many useful hints are given as to working and management of producers, and in the following chapter various causes of trouble are mentioned, and information is given as to how to detect and remedy them. The last two chapters of Section I. contain several examples of the practical application of suction plants, and information as to working results in respect of fuel and consumption. According to the author, the only authoritative comparative tests are those which were carried out by the Royal Agricultural Society, at Derby, in 1906. He also quotes tests made by Mr. R. E. Mathot on a Tangye plant. These tests are most instructive, and show a fuel consumption as low as 0·71 lb. of anthracite per hour.

Pressure producers for non-bituminous fuel are dealt with in Chapter II. (Section II.), and, since the chemical reactions are the same as in suction producers, only the points of difference are considered, such as the separate steam boiler and the steam and air injector for producing the pressure. Several examples of application to practice are given. There is also a short description of the Dellwik-Fleischer water-gas producer, which requires to be alternately blown with steam and air, and depends on the fact that when the velocity of the air over the glowing carbon is high, CO_2 is formed instead of CO.

The last chapters, 13 to 15 (Section III.), are devoted to pressure producers for bituminous coal, and give some particulars in connection with the recovery of ammonia with the Mond plant. Attention is called to the large amount of steam required for this process, which is three times greater than the best theoretical amount, a point which is confirmed by the experiments made in 1906 on a Mond plant by Messrs. Bone and Wheeler; these experiments are given in some detail. This large amount of steam is, however, necessary with coal, but with peat the proper amount of steam can be used, because the moisture in the peat keeps the upper layers at the proper temperature for distilling the bye-products. The author does not refer to this point, but his prophecy that peat producers may be an important *future application* is already fulfilled. The book concludes with a description of the various methods of washing and cleaning the gas; we note that the Theissen washer, which is much used in Germany, is not mentioned.

We can fully recommend this book to any engineer who wishes to become acquainted with the extremely important subject of power gas producers.

The Post Office Electrical Engineers' Journal. A Quarterly Journal. Vol. I., Part II.; 84 pp., 9¾ in. by 6 in. (London: H. Alabaster, Gatehouse & Co.) Price 1s. net.

The excellent quality of some of the articles in the second issue of this quarterly, and the fact that it has the support of the Engineer-in-Chief to the Post Office, who has contributed some notes on the education of telegraph engineers in France, makes us lothe to criticise the policy of this enterprising institution in regard to its journal. Yet there are two matters to which attention has already been drawn, and upon which we consider it our duty once more to comment in an adverse sense. Although presumably the services of the editorial staff and contributors are given gratuitously—whether by themselves or by their employer, the Post Office, it is perhaps unnecessary to ask—a further subsidy is apparently required to enable the journal to be published, and this is supplied by a certain number of manufacturers of telegraph and telephone material and stores whose advertisements are inserted in the journal nominally as a *quid pro quo*. In all probability the committee of Post Office engineers who conduct the journal does not receive these payments directly, but whether a definite sum is paid to them for each advertisement, or whether the profit is derived as a set-off

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to the price paid to the firm who print and publish the paper does not affect the principle, which is an extremely bad one. Advertisements of material and plant of a nature that is purchased by a Government department should be rigorously excluded from a newspaper belonging to the staff whose duty it is to recommend the placing of orders and to make the reception tests of the material purchased.

The second matter in which the proprietors of this new publication have departed unwisely from precedent is in the contents of the journal itself. As a rule, the contents of an institution's "journal" consist of full reprints of the Papers read before the institution and full reports of the discussions at its meetings. Instead of these forming the main contents of the journal, they are deliberately omitted.

The present issue includes articles on a motor-driven Wheatstone transmitter, the design of telegraph and telephone cables, pneumatic tube joints, pot heads, the Richmond telephone exchange (a full C.B. exchange replacing a "C.B.S." exchange), &c. It is surprising to find, in addition, no less than three serial articles in a magazine published only at three monthly intervals, and a highly mathematical article, "On the Propagation of Plane Electromagnetic Waves along a Plane Conducting Surface, and its Relation to Wireless Telegraphy," is particularly unsuitable for this treatment. To the article by the Engineer-in-Chief we have already referred; the printers should be informed that his name is O'Meara, and not Omeara.

MANCHESTER CORPORATION TRAMWAYS ACCOUNTS

IN the report which accompanies the accounts of the Manchester Corporation Tramways for the year ending March 31st, 1908, it is stated that during the year under consideration additions and extensions amounting to over seven miles of single track have been opened for traffic. The aggregate length of single track open for traffic (including the lines over which the Corporation are exercising running powers) is at present nearly 177 miles. The number of cars in stock at March 31st, 1908, was 566. This included 309 single-truck cars, 115 with covered tops, and 194 without; 87 double-truck cars, 125 with covered tops and 87 without; and 45 other cars. About 6½ acres of land have been purchased as a site for a new car-shed, which will accommodate, when complete, 250 cars. The population served by the tramways is approximately 850,000. The number of passengers carried during the past year was 151,477,138, as against 143,264,501 in the previous year. The number of car-miles has increased from 15,523,459 to 16,974,955. The working expenses per car-mile (including power cost) amounted to 7·07d., or 65 per cent. of the total receipts. The following is an analysis of the working expenses and capital charges:—

Analysis of Expenses per Car Mile.

	Year ended Mar. 31, 1907.	Year ended Mar. 31, 1908.
	d.	d.
Traffic expenses—		
Salaries and wages	2·310	2·289
Cleaning cars and depot expenses	0·420	0·450
Cleaning, salting, and sanding track	0·044	0·043
Ticket check	0·150	0·154
Uniforms	0·088	0·084
Miscellaneous	0·028	0·030
	3·040	3·040
General expenses—		
Salaries and wages	0·161	0·150
Rent, rates, and taxes	0·530	0·510
Insurance, law, and other expenses	0·146	0·229
Miscellaneous	0·143	0·109
	0·980	0·998
Repairs and maintenance—		
Permanent way	0·143	0·190
Electrical equipment of line	0·110	0·106
Cars and electrical equipment	0·660	0·660
Buildings and miscellaneous	0·067	0·056
	0·980	1·012
Power expenses—		
Cost of current at 1·143d. per unit.	2·030	2·020
Total costs, excluding capital charges	**7·030**	**7·070**
Rental of leased lines, &c.	0·392	0·317
Interest	0·774	0·690
Sinking fund	0·610	0·590
Income tax	0·074	0·087
Expenses of 1907 Bill	—	0·068
Reserve, renewals, and depreciation fund	1·355	1·240
	3·205	2·992
Total costs, including capital charges	**10·235**	**10·062**
Total receipts per car mile	11·120	10·870

The following additional figures are of interest:—

	1906–7.	1907–8.
Electrical energy—Total number of units used	25,072,791	29,955,070
Electrical energy—Number of units used per car mile	1·61	1·76
Percentage of working expenses to receipts	63·18	65·00
Average traffic revenue per car mile	11·02d.	10·76d.
Average traffic revenue per mile of single track	£4,556	£4,640
Average car miles per day per car	100	98·5
Average fare paid per passenger	1·19d.	1·21d.
Average number of passengers per car mile	9·23	8·92
Average journeys per head of population per annum	179	178

It will be noticed that the traffic receipts per car-mile have gone down from 11·02d. to 10·76d. This is mainly attributable to the inclement weather experienced during the whole of the year. The working expenses have been increased by 0·04d. per car-mile. This is accounted for by a large increase in the cost of compensations and a slight increase in the cost of the maintenance of the permanent way, which is unavoidable as the track gets older. The total working expenses amounted to £500,023, and the receipts from all sources reach the figure of £771,176 (including £1,220 from the parcels' department and £2,103 for interest on surplus revenue). Of the balance of £271,153 thus given, £22,427 was required for rental of leased lines; interest, sinking fund, and income-tax absorbed £49,035, £41,749, and £6,197 respectively; £4,847 was required for Parliamentary expenses; and £87,790 was transferred to reserve, renewals, and depreciation fund. The surplus of £59,108 was divided as follows:—£55,000 was contributed in aid of rates, and £4,108 was expended on street improvements.

The following is an analysis of the net capital expenditure on the undertaking as at March 31st, 1908:—

Permanent way	£607,476
Electrical equipment of line	174,705
Land	67,932
Buildings and fixtures	234,244
Rolling stock	357,243
Machinery and plant	9,740
Cost of Carriage Company's undertaking	277,492
Miscellaneous	47,797
	£1,776,629

Manchester Local Section of the Institution of Electrical Engineers.—The annual report of the committee of the Manchester Local Section of the Institution of Electrical Engineers has just been issued. During the last session ten meetings have been held, the discussions at which have been reported in our columns from time to time. The average attendance at meetings has been well maintained, and considerable interest has been shown in the Papers, which have covered a wide field. The membership of the section is 787, including 339 students, which is an increase of 47 over last year. The report of the students' section, which has held ten meetings and made nine visits to works, is issued separately.

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LONDON AND DISTRICT ELECTRICITY SUPPLY BILL

THE second reading debate upon the London and District Electricity Supply Bill took place in the House of Commons on Thursday.

Mr. CHAPLIN (Wimbledon) moved the rejection of the Bill in order to obtain the exclusion of Wimbledon and Merton. Mr. T. DAVIES (Fulham) and Mr. PICKERSGILL (Bethnal Green) supported the motion for the rejection of the Bill, for the reason that they objected to the creation of a monopoly with competitive powers against the existing municipal undertakings. The latter gentleman remarked that it was proposed to create a company with a capital of £4,500,000 to sell electrical energy in bulk and detail, not only in London, but in an enormous area around London; the company was to be authorised to tear up the streets and lay mains, to abstract 200,000,000 gallons of water daily from the Thames, and to carry their cables through the Blackwall and Rotherhithe tunnels of the London County Council, whether the latter liked it or not. So grotesque a scheme was never conceived outside the domain of Gilbertian opera. Other speakers, following on the same line of argument, and who opposed for the reason that their constituencies were included in the area of the Bill, were Mr. ROWLANDS (Dartford), Mr. CAVE (Kingston-on-Thames), and Mr. CROOKS (Woolwich).

Mr. MCKINNON WOOD said the matter had been referred to as a very simple one indeed, but he did not know of a more complicated subject than the present position of electric power supply in London. Whilst holding no brief for the power company, he felt bound to point out that the prices proposed in the Bill were the lowest ever inserted in such a Bill, and it should also be remembered that the London County Council refused to carry out a scheme itself. Personally he would prefer a complete municipal scheme, but this year there was no possibility of a municipal Bill, and he was not justified in voting against the Bill and so bringing about further delay. He did not approve of the terms of purchase, but these could be argued in Committee. With regard to competition, these powers were carefully safeguarded, and although there had been no whisper of opposition to the proposals of existing companies with regard to linking up, he was of the opinion that without a bulk company such as this, they would hear of no more cheap electricity, so far as the existing companies were concerned, once the linking-up powers were granted. The Borough Councils had taken a purely parochial view in their opposition to the Bill, and had not regarded the matter from the point of view of London as a whole. The London County Council was continually receiving applications from the Borough Councils for capital to extend their generating stations, which were in most cases inadequate, too small for economic working, and too badly placed to supply cheap electricity. A cheap bulk supply was the only remedy for this state of affairs, and he should therefore vote for the Bill.

Mr. DICKINSON (St. Pancras) expressed the opinion that if the Bill went to a Committee, with the instructions that the London County Council should be the purchasing authority, it would come back to the House in such a form as would enable the public to enter into their rights. This was the first time a bulk supply Bill had included a purchase clause.

Mr. BURDETT-COUTTS (Westminster) referred to the special circumstances in his district, which were fully gone into before Lord Cromer's Committee, and was concerned as to the effect of the Board of Trade's proposed clause upon the special clause given to the Westminster City Council by Lord Cromer's Committee.

Sir JOHN BENN supported the view of Mr. McKinnon Wood, and said that those who voted for the rejection of the Bill would really be retarding municipal development.

Mr. FORSTER (Sevenoaks Division of Kent) opposed the second reading for the reason that part of his constituency was scheduled in the Bill, and would come to some extent under the control of the London County Council eventually, a position which they did not wish to be in.

Mr. WINSTON CHURCHILL, President of the Board of Trade, referred to the opposition to the second reading as an "unholy alliance," consisting as it did of Labour members, Unionists, and Liberals, a strange combination, he said, to fight for the interests of London. Although they were only discussing one Bill, the Board of Trade intended to ask the House to apply a common policy to all three. This was to afford every facility to develop electrical supply in London, and to transfer it at the earliest possible moment to the London County Council. With regard to the present Bill, this promised to give a supply of electricity at the lowest price ever put into such a Bill; there was compulsion to supply, there was limitation of dividends by a sliding scale, and there was provision that the powers should lapse unless £600,000 was subscribed in the first year, and substantial progress made with the works by the second year. In addition, by sending the Bill to Committee, there would be a thorough inquiry as to whether the terms of the Bill as a whole were satisfactory. The Board of Trade did not approach this matter from the party point of view. They had to have regard to the greatness of London, with its 6,000,000 people, living under conditions of highest artificiality, and they saw that cheap electricity was scarcely less important than cheap and abundant food. This was the fifth successive year in which attempts had been made to pass such a scheme, and the uncertainty had hung like a pall all the time over the electrical industry. The initiative of private promoters had been seriously discouraged; meanwhile municipal enterprise had not advanced to fill the gap, and there was no immediate prospect of it so doing. In the view of the Board of Trade, therefore, the House of Commons would take a very grave responsibility if it disregarded the elaborate proposals now put forward without giving them the most detailed attention which only an impartial Committee of the House of Commons could give. A Committee of the House of Commons went into the question in great detail two years ago, and decided that the need for a bulk supply scheme for London was important and pressing.

Mr. LYTTELTON, representing St. George's, Hanover Square, which is within the City of Westminster, stated that the proposal to transfer to the London County Council all the powers of purchase now possessed by the Westminster City Council, could not be accepted.

The debate was closured at 11 p.m., and the amendment in opposition to the second reading of the Bill was rejected by 48, the figures being:—For the amendment, 90, against 138.

The Bill was then read a second time.

STANDARDS FOR ELECTRICAL APPARATUS

A Comparison of British, American, and German Rules

THE following comparison of the standardisation rules of the British Engineering Standards Committee with those of the American Institute of Electrical Engineers, and the Verband Deutscher Elektrotechniker, is taken from an article by Mr. J. S. Peck, in the *Electric Journal* (Pittsburg).

A comparison of the standard rules issued in Great Britain, Germany and America is of considerable interest as showing the views of engineers in the different countries as to safe operating conditions. The temperatures, overloads, and testing voltages called for in the standard specifications of the three different countries are given in Tables I., II., and III. The indicated temperature instead of the rise in temperature is given, as this is really the value which determines the rate of deterioration of the machine. In America and Great Britain, the temperature rise is given above a room temperature of 25 degrees C., while in Germany a room temperature of 35 degrees is permitted. This in itself adds ten degrees to the allowable working temperature under German conditions.

In the German rules, different temperature rises are permitted for different classes of insulation. Cotton insulation demands the lowest temperature, paper insulation comes next, with about ten degrees higher rise, while mica, asbestos, and similar insulating material is permitted a temperature about thirty degrees higher than is allowed for cotton insulation. In the British and American standards it is stated that where special heat resisting insulating material is used, higher temperatures may be allowed than with the ordinary insulating material, but no limits are given. This distinction in permissible temperature rise for machines insulated with different kinds of material seems a step in the right direction, for there is no reason why a machine insulated with asbestos and mica throughout should be operated at as low a temperature as a machine insulated with cotton and similar perishable material. The great danger in this classification appears to be in the opportunity it offers for fraud; on account of the inability of the customer to determine whether all of the insulation in a machine is really of a fireproof nature or not. Everyone familiar with the insulation of electrical apparatus knows that many of the so-called fireproof insulating materials are anything but fireproof, and while it is not likely that responsible manufacturing companies who have had wide experience with different classes of insulating materials will put out apparatus which will not give a reasonable life, there is the possibility that manufacturing companies with less experience may be tempted to operate at higher temperatures than the insulating materials will stand. It is not probable that any conservative British or American engineer would ever

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accept electrical apparatus operating at a temperature of 125 degrees, regardless of the class of insulation employed, and it is doubtful whether many German engineers would accept such machines. Nevertheless, this temperature is permitted by the German rules with certain classes of insulating material.

Table I.

Maximum Operating Temperatures of Electrical Apparatus, as Specified by the Engineering Standards Committee of Great Britain, the American Institute of Electrical Engineers, and the Verband Deutscher Electrotechniker.

	American.		British.		German. Cotton.		Paper.		Mica.	
Part of Machine.	T*.	Rt.	T*.	Rt.	T*.	Rt.	T*.	Rt.	T*.	Rt.
Windings, stationary	75	75	—	85	—	95	—	105	—	125
,, moving ...	75	75	75	85	85	—	95	—	115	—
Commutators and brushes	80	—	—	—	—	—	—	—	95	—
Collector rings... ...	90	—	—	—	85	—	95	—	115	—
Bearings	65	—	—	—	—	—	—	—	—	—
Squirrel cage rotors...	80	—	—	—	85 +	—	105 +	—	125 +	—
Transformers	75	75	75	75	95	—	105	—	125	—
Railway motors—										
Continuous rating.	100	125	—	—	—	—	—	—	—	—
One hour rating ...	—	—	—	—	105	105	115	115	135	135

To obtain temperature rises, subtract 25 degrees from American and British temperature and 35 degrees from German temperature. T* stands for thermometer readings, Rt for increase in resistance readings. All temperatures in degrees C.

Table II.

Overload Requirements.

	American.		German.	
Generators ...	25 per cent. for 2 hours		25 per cent. for ½ hour	
Motors	25	,, 2 ,,	25	,, ½ ,,
	50	,, 1 min.	40	,, 3 mins.
Rotary converters...	25	,, 2 hours	25	,, 30 ,,
	50	,, 30 mins.	40	,, 3 ,,
Transformers ...	25	,, 2 hours	40	,, 3 ,,

Table III.

Insulation Tests.

	American.	German.
Minimum testing voltage	1000 for one min.	100 for 30 mins.
Apparatus for voltages between 5000 and 10,000	Double for one min.	Normal + 5000 for 30 mins.
Apparatus for voltages over 10,000	,, ,,	Normal + 50 % for 30 mins.

In general it may be stated that the American standards are much more conservative than the German, while the British standards come somewhere between the two, but are nearer to the American than to the German. In Europe, the keenness of the competition in the sale of electrical machinery has made it necessary for manufacturers to take advantage of every possible means for reducing the cost of their apparatus.

ELECTRICAL ENTERPRISE IN RIO JANEIRO

SOME particulars of the operations of the Rio de Janeiro Tramway, Light & Power Company are given in a recent Consular report. This company, which is registered in Toronto, has been operating here since 1905, and has practically, March, 1908, completed its hydro-electric installation on the River das Lages, in the State of Rio de Janeiro, about 51 miles from the city. The works, which are said to comprise one of the most complete hydro-electric installations yet constructed, include a concrete dam 110 ft. high and 700 ft. long on the top, creating a reservoir with a capacity of 221,000,000 cubic metres of water. From this reservoir the water is conducted to the power station through steel pipes a distance of about 7,420 ft., the fall in this distance being about 1,080 ft. The power station, which is located on the river, is of steel construction, with concrete walls for the lower portion and brick for the upper, the dimensions being 232 ft. long by 102 ft. wide between the main columns. There are six wheels of 9,000 h.p. capacity each for the generators, and two wheels of 400 h.p. capacity for the exciters, all of the impulse type. These transformers are of the oil- and water-cooled type. The transmission line, which is 51 miles in length, is located upon the private right of way of the company in its whole extension, the width varying from 132 ft. in Rio de Janeiro to 300 ft. in the country districts of the State. The power is received over four circuits suspended on two lines of steel towers, 1,052 in number, in the whole distance between the power station at Rio das Lages and the terminal station, which is situated at Rue Frei Caneca in the city. This terminal station is of steel construction, with concrete walls for the lower portion and brick for the upper, the dimensions being 243 ft. long by 133 ft. wide. The distribution system of the three-phase 6,000 volts leaving the terminal station is in the suburbs made by aërial lines suspended on iron poles, and in the central part of the city with branches to all the populous districts by underground lead-covered cables. For the purpose of the underground work there has been built a network of conduits, of which, up to the present, there have been laid over 1,400,000 lineal feet, connected with 74 subterranean transformer vaults. For the service of the works the company has constructed a railway 16½ miles in length, connecting the Central, or Government, Railway with its power station at Rio das Lages. To provide power for construction purposes and for use in Rio de Janeiro pending the completion of the large power station, a temporary plant of 3,400 h.p. was installed. The energy produced at this installation was used for the illumination of Rio de Janeiro and vicinity, as also for the operation of the street-car systems, factories, &c., pending the completion of the permanent power-house. As all coal is imported, the cost of steam power in the city is very high. The company estimate this steam power now in use to be at least 20,000 h.p., which they expect to be replaced by electrical power within a few years. This is exclusive of the amount which will be required for electric lighting and tramways. In addition to the Rio das Lages power, which will have a maximum capacity of 50,000 h.p., the company has obtained a concession from the State of Rio de Janeiro to divert the waters of the River Pirahy, which flows in a valley adjacent to that of the Rio das Lages. The amount of the water flowing in the Pirahy is much greater than that in the Lages, and by means of the use of the flood waters of that river with the power of the Rio das Lages, the capacity can, by an extension of the power station, be increased to 100,000 h.p., or even more if required. This diversion can, it is asserted, be made at comparatively small expense, by the construction of a small dam and a tunnel about two miles in length.

The company, either by concessions made to it directly, or by subsidiary companies controlled by it, exploits the following public services.

The company is the owner of the share capital of the Companhias São Christovao, Carris Urbanos and Villa Isabel, which provides about three-quarters of the tramway service of Rio de Janeiro, under concessions from the municipality of the Federal District. By a contract made in the month of November, 1907, with the municipality, these concessions were consolidated and extended until the year 1970; the Rio de Janeiro Tramway, Light & Power Company undertaking to electrify them within a period of about three years and construct about twenty miles of new lines. The lines of the Villa Isabel are already electrified, and the work of transforming the traction of the other companies is commenced.

The Société Anonyme de Gaz de Rio de Janeiro, a Belgian company, acquired by the Rio de Janeiro Tramway, Light & Power Company, controls the whole of the illumination of the city by gas and electricity in virtue of a concession from the Federal Government to 1945, with monopoly to 1915. All parts of the city are now illuminated by gas, the electric lighting being confined for the present to the new avenues recently opened and the central commercial section. It is expected that during the present year the electric lighting will be greatly extended.

The company, by virtue of a concession from the municipality of Rio de Janeiro, enjoys monopoly for the distribution of electric power, produced in an hydraulic installation, until the year 1915, and thereafter the right continues without monopoly until the year 1990. At the present time only about 3,000 h.p. is furnished for use, but now that the permanent installations of the company are practically completed, they expect within a few months to greatly increase this, as many factories now using steam power seem ready to change it for electric.

The telephone concession, which was formerly exploited by a German company, recently acquired by the Rio de Janeiro Tramway, Light & Power Company, gives exclusive right for telephones in the Federal District. The system has been recently largely reconstructed, the building where the installation is situated, which was recently destroyed by fire, having been rebuilt and installed with a new central energy telephone board of the most modern design. There are now about 2,500 subscribers, and the company expects within another year to increase this to the full capacity of the present board, which is 5,000. In addition to the reconstruction of the building and installation of the new switchboard, all of the subscribers' instruments have been changed for improved instruments. The street circuits have been rebuilt, and a large amount of aërial cables has been installed to take the place of the network of overhead wires in the streets, thus greatly improving the service. A large part of the system is in underground cables, and it is expected that this will be extended from year to year, until all overhead wires in the populous districts have been removed.

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ELECTRICAL EQUIPMENT AT THE FERNDALE COLLIERIES

THE advantages to be obtained by the use of electricity in mining are being realised at an increasing rate by colliery proprietors in Great Britain, and already a large number of coal mines, especially in the South Wales district, have completed or have under construction electrical equipments of considerable magnitude. An interesting example is to be found in the group of pits belonging to Messrs. D. Davis & Sons, in the Rhondda district, known as the Ferndale Collieries. These comprise nine pits in all, situated fairly close together, for the supply of which the colliery owners have constructed a large steam-driven generating station. Electrical power is used for ventilating, pumping, and for extensive underground haulage, and a complete main shaft electrical winding engine is being erected at one of the newer pits. There is, of course, a good deal of electric lighting both above and below ground, and the greater part of the surface machinery, screening plants, &c., is electrically driven. The change over to electric power is still proceeding, but already a considerable load is taken from the power station. Electric haulage was practised in the mines pending the completion of the company's own supply arrangements, and current was taken from the South Wales Power Company's system; owing to this fact the supply has been developed on the three-phase 25-cycle system.

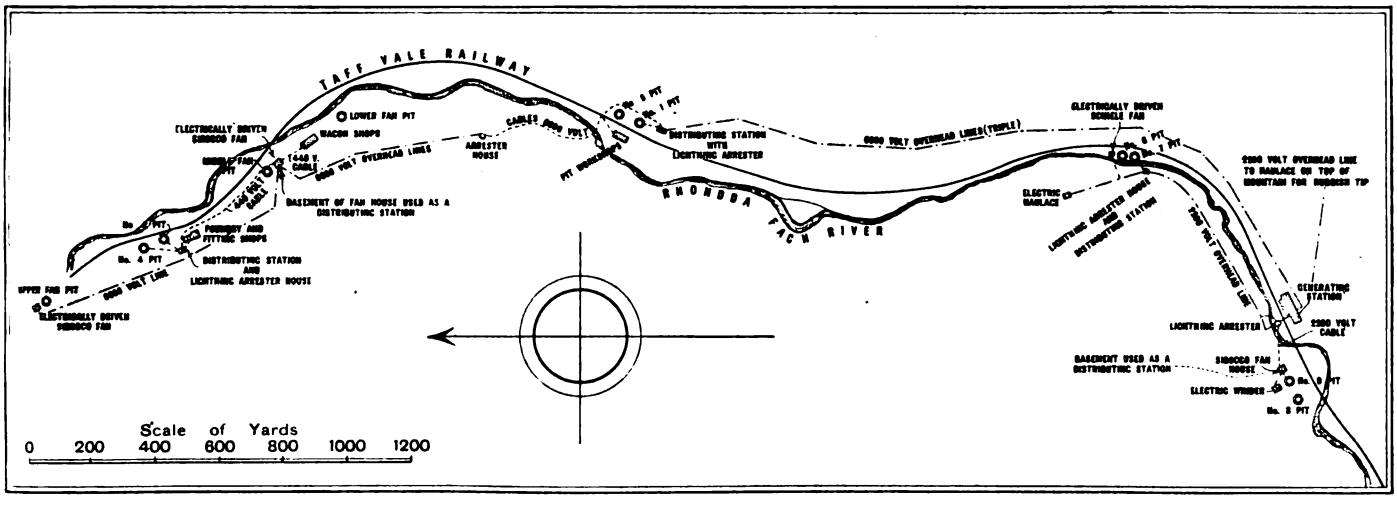

FIG. 1.—GENERAL PLAN OF FERNDALE COLLIERIES, SHOWING POSITIONS OF PITS, GENERATING STATION, SUB-STATION, TRANSMISSION LINES, &C.

A general idea of the extent of the collieries and supply system can be obtained from the sketch plan in Fig. 1. The power station adjoins the Taff Vale Railway Co.'s line at Tylorstown, and is close to the new "No. 9" pit, where the electric winder is being installed. By the side of this pit is the No. 8 pit, and about 900 yards away are Nos. 6 and 7 pits. Nos. 1 and 5 pits are at Ferndale itself, about 2,500 yards distant; and some 2,000 yards further up the valley are Nos. 2 and 4 pits. All these pits are in the "Rhondda Fach" valley, supplied from the Tylorstown power station; but the remaining pit, No. 3, which is situated at Bodringallt in the adjoining "great" Rhondda valley, is still supplied from the South Wales Power Co. The Tylorstown station commenced running in January last, and an uninterrupted supply has been maintained since that time.

A plan and elevations of the power station are given in Fig. 2, and Fig. 3 is a general view of its exterior. The building itself consists principally of a commodious engine-room, with a boiler-house parallel to it. The cooling towers are placed at one end, while the other end is free for extensions. The external appearance is that of a handsome red-brick building, much more artistic in its general features than many power stations, although without any unnecessary elaboration. The building is constructed on a steel frame, which sustains the whole weight of the roof and upper floors; the brickwork, therefore, merely serves to clothe the skeleton. This type of building was adopted on account of the ever-present possibility of subsidence at the surface of a colliery. The engine-room walls are faced with glazed brick, and the floor is finished with red tiles, which give a very pleasant effect. The north end of the building is temporary, in view of future extensions.

The boiler-house at present contains four water-tube boilers of the three-drum type, made by the Stirling Boiler Co., each having 6,209 sq. ft. of heating surface. Each boiler is provided with two underfeed mechanical stokers, and a superheater of the McPhail type with 800 sq. ft. heating surface, and is capable of evaporating 30,000 lb. of water per hour at a pressure of 180 lb. per sq. in., and imparting a superheat of 150° F. These boilers are arranged in two batteries, each battery being connected by a breeches piece to a steel chimney 7 ft. diameter and 75 ft. high. These chimneys are quite independent, and are not in any way connected by flues. Forced draught is supplied to the grates by a pair of Musgrave fans, each belt-driven by an electric motor.

The coal-conveying arrangements are of some interest. The coal used, which is "Ferndale Small," is run into Messrs. D. Davis and Sons' private siding from the Taff Vale Railway, and an ingenious arrangement of hydraulic rams is provided for tilting the wagons. This is supplied with water direct without the use of any accumulators from the boiler-feed pumps. This arrangement was practically complete at the time of our visit, but had not yet been taken into actual use. The coal is to be thus tilted into a hopper below the ground-level, from which it is carried by a motor-driven inclined band conveyor into and along the boiler-room, where, by means of a throw-off carriage, the coal is discharged in the usual way into the overhead bunkers in the boiler-house. These bunkers have a capacity of 150 tons, and the coal is carried by shoots at the bottom of the bunkers to the stoker hoppers. The conveyor is driven through suitable gearing by a continuous-current motor of about 7 B.H.P. situated at the extremity of the conveyor at the south or permanent end of the

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boiler-house. As the inclined and elevated portions of the conveyor are, in plan, in the same straight line, and the supply hopper is at a little distance from the temporary end of the station, all that will be necessary when dealing with extensions to the boiler-house is to prolong the horizontal portion of the conveyor running over the bunkers, and make the angle of the inclined portion somewhat steeper. The capacity of the conveyor is 20 tons of small coal per hour, and consisting, as it does, of a band conveyor pure and simple, it runs with remarkably little noise. The ash from the stokers is removed by opening a sluice valve under the boilers, when the ash falls into narrow-gauge trucks in the boiler-room basement.

The water supply is obtained by pumping from the No. 8 pit, close by, and is stored in a large cast-iron tank outside the building. There is also storage in a large tank 100 ft. long under the boilers. The feed-pumps, of which there are three, are all steam-driven, and were supplied by Messrs. Clarke, Chapman & Co., of Gateshead. They are of this firm's tandem-compound type, and each is capable of delivering 5,000 gallons of water per hour against the boiler pressure. As already mentioned, they will also supply water to the rams of the coal-wagon tip. The steam supply to the feed-pumps is taken from a separate steam range connected to all the boilers on the boiler side of the superheater, so that they are fed with saturated and not superheated steam.

The exhaust steam from the pumps is taken to a Cochrane open-type exhaust steam heater, where it heats the feed-water on the suction side of the pumps. For use in emergency a Worthington tank pump is provided, which draws from the river in the unlikely event of water from the mine failing.

The feed-water is all passed through a recording water-meter on the Venturi principle of Messrs. George Kent and Co.'s make, the indicating portion of which is situated on the switchboard gallery. In this apparatus the quantity of water passing is measured by observing the difference of head at two points in a pipe where the diameters are different, and where, therefore, the velocity of the water is different. The difference of pressure is measured by means of a mercury U tube, in one arm of which is a float. This float carries a rack which communicates with an ingeniously arranged clockwork discontinuous integrating gear, by means of which a dial counter is propelled forward periodically by an amount corresponding to the position of the float; a direct reading pointer at the same time indicates the rate of flow of the water at any instant. Careful records are kept of the behaviour of the boiler furnaces as revealed by analysis of the flue gases by means of a " Sarco " CO_2 Recorder supplied by Messrs. Sanders, Rehders & Co. (see Electrical Engineering, Vol. II., p. 558), and the degree of superheat of the steam can be ascertained in the engine-room by reading of the dials of a series of Steinle steel-mercury thermometers.

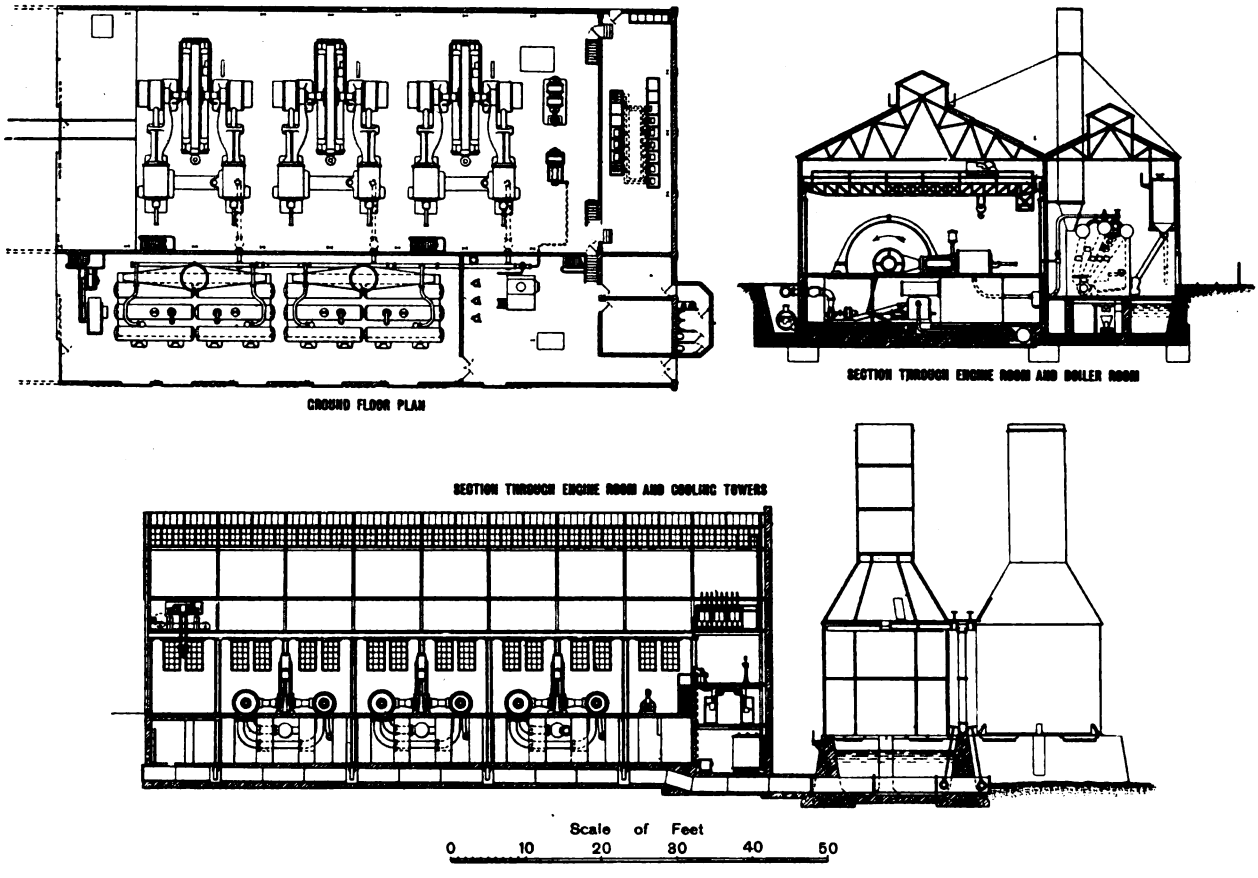

Fig. 2.—Plan and Sectional Elevations of Power Station.

A general view of the engine-room is given in Fig. 4. The three main generating sets, which form the instalment of plant already erected, consists of large slow-running revolving-field three-phase alternators each of 1,600 kw. capacity, and directly coupled to horizontal cross compound engines. These engines were manufactured by Messrs. Sulzer Brothers, of Winterthur, Switzerland, and are of their standard drop-valve type. Each engine is capable of giving 2,500 B.H.P. at normal load at a speed of 94 r.p.m. The diameter of the high-pressure cylinders is 33½ in., and of the low-pressure cylinder 56 in. diameter, with a stroke of 55 in. They are supplied with steam at a pressure of 170 lb. per sq. in., with a superheat of 150° F. at the stop valve. Each engine is provided with two jet condensers and feed heaters. The air pumps for these condensers are driven from the connecting rods of the engines, and with the condenser are situated in the basement directly below the engines. The feed heaters are very com-

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pactly arranged above the condensers. The injection water is taken from cooling-tower concrete tanks through a 4 ft. diameter main buried in the engine basement floor, and after passing through the condensers is collected in the wrought-iron hot well main. The circulating water is lifted to the cooling towers by centrifugal pumps connected to the hot well. There are three natural draught circular steel cooling towers 33 ft. in diameter at the base and 83 ft. high. The circulating water enters at a level about 30 ft. from the base, and is discharged into wooden troughs, which evenly divide the water as it falls on cross timbers beneath, and so break it up into a fine rain. After cooling the water is collected in the concrete tanks under the towers.

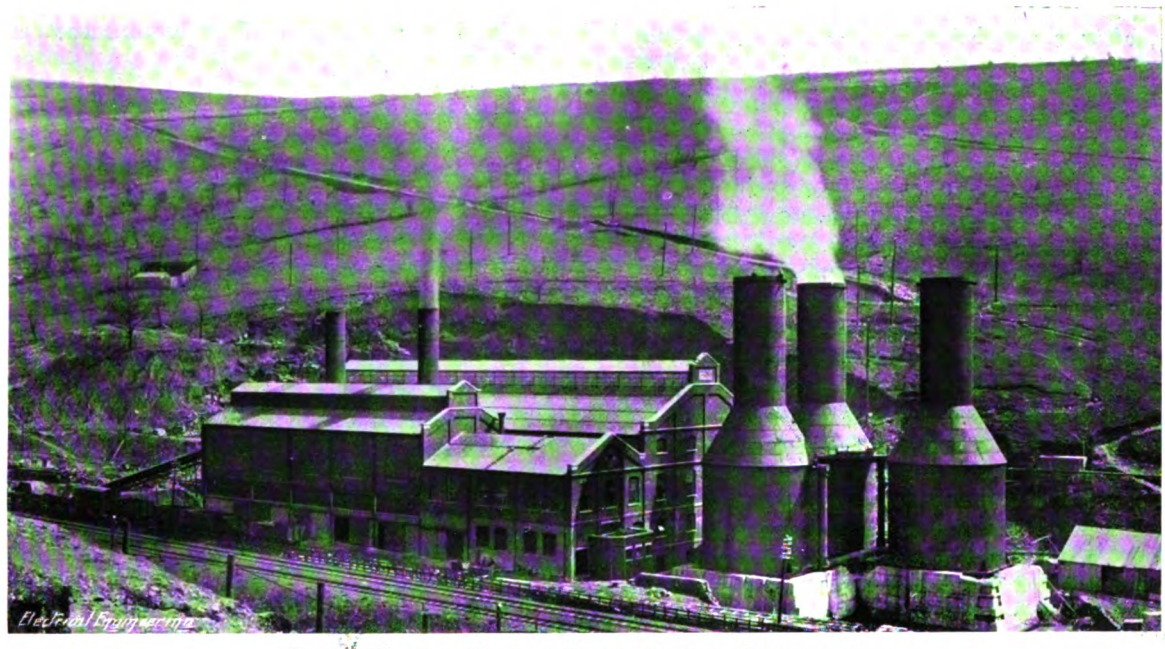

FIG. 3.—GENERAL VIEW OF POWER STATION, TYLORSTOWN.

The alternators, which, together with the whole of the electrical equipment, was supplied by the Lahmeyer Electrical Co., are, as already stated, coupled directly to the Sulzer engines. They are of the revolving fly-wheel type, and each has a normal continuous output

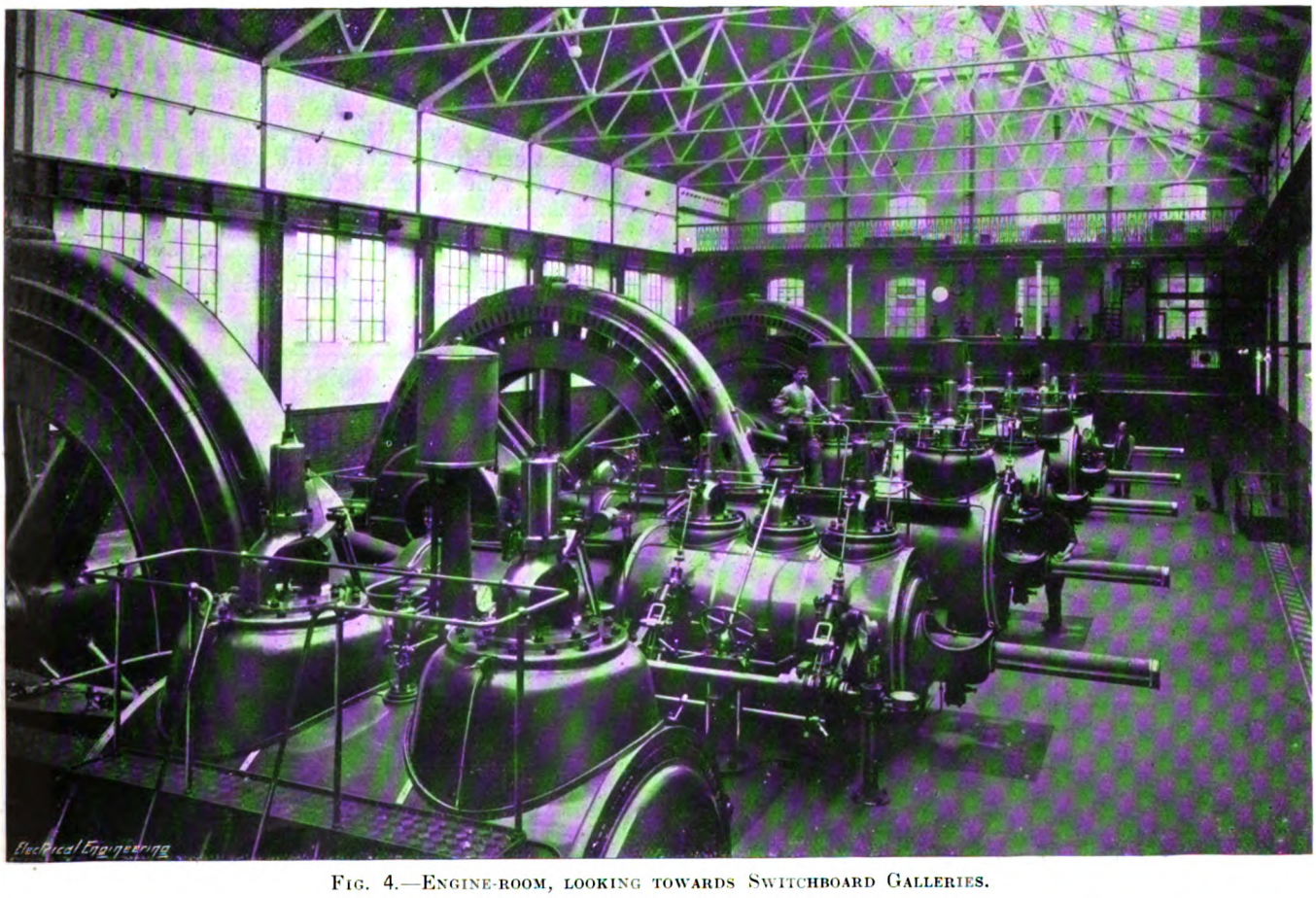

FIG. 4.—ENGINE-ROOM, LOOKING TOWARDS SWITCHBOARD GALLERIES.

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of 1,600 kw. at a power factor of 0·85 and a pressure of 2,200 volts three-phase. They are further capable of overloads of 20 per cent. for two hours, or 30 per cent. for half-an-hour. The temperature rise was guaranteed not to exceed 45° C., as measured by thermometer, after a ten hours at full load. The total

battery can also be charged by the Bellis set, the generator of which is so arranged that its voltage can be increased to 290 volts in order to allow of its acting as a spare in case of a breakdown in the motor-generator set.

This battery is left floating on the excitation

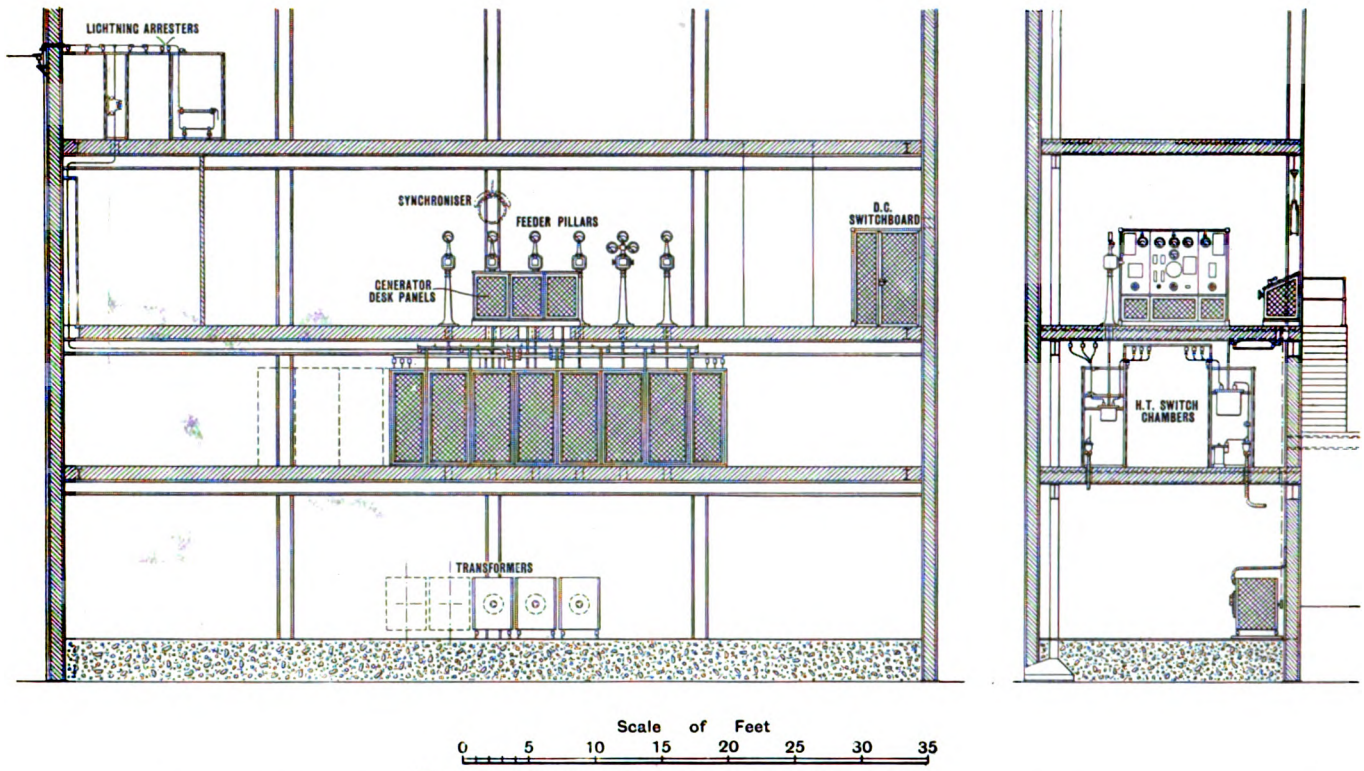

Fig. 5.—General Arrangement of Switchgear.

Note.—Since the drawing from which this illustration is reproduced was made, certain modifications have been effected in the arrangement. For example, the D.C. switchboard has been placed at the other end of the gallery and the order of the feeder pillars rearranged.

weight of each generator is 107 tons; of the revolving field approximately 75 tons.

The generators are separately excited at 200 volts from a 75 kw. Bellis-Lahmeyer steam-driven exciter, running at a speed of 525 r.p.m. As spare to the steam exciter there is a 100/120 kw. motor generator booster set, consisting of a 180 B.H.P. 2,200-volt three-phase

bus-bars, which are also used for station lighting, for driving a certain number of the auxiliary motors in the station as well as for the tripping circuits of the automatic switchgear. The 7 B.H.P. coal hoist motor, which might be required to be used when the alternating plant is shut down, is supplied from the continuous-current circuit. One of the forced draught fans

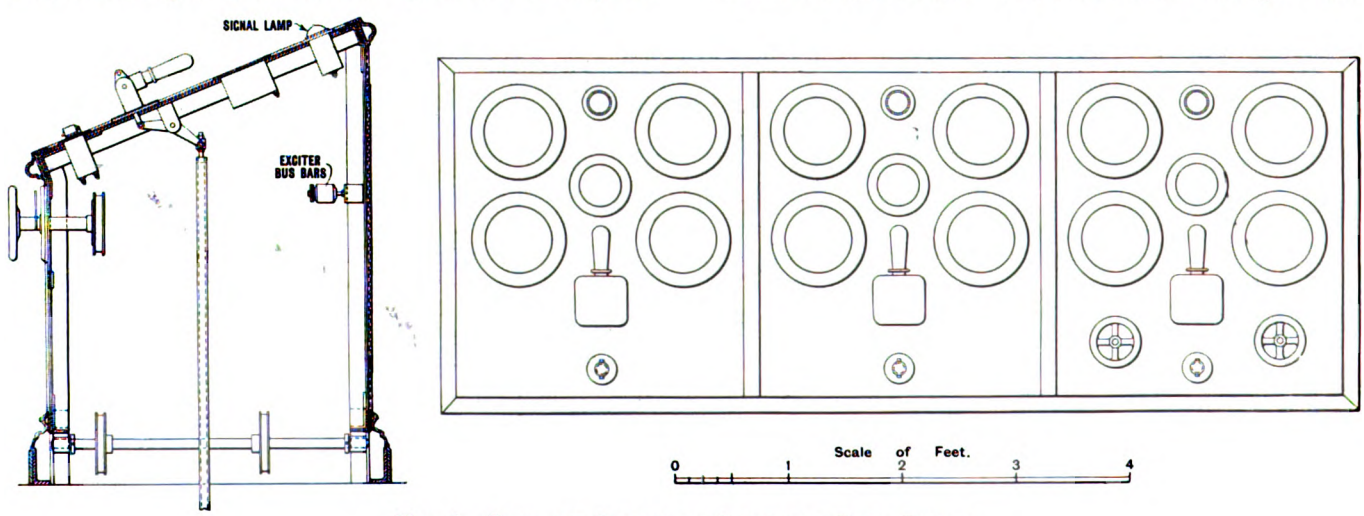

Fig. 6.—Plan and Section of Generator Desk Panels.

motor, coupled to a shunt-wound 120 kw. generator. The booster is mounted at the end of the shaft, and is capable of raising the voltage from 200 to 290 volts to charge the station battery; the latter has a capacity of 380 ampere hours when discharging at a 38-ampere rate, and consists of 115 Tudor cells. The regulation is done by hand by a 21-contact regulating switch. The

is driven by a 20 B.H.P. continuous-current motor, but the other is coupled to a three-phase induction motor of the same power running direct off the 2,200-volt circuit. All the circulating pumps are driven by three-phase motors. The engine-room is spanned by an overhead travelling crane of Messrs. Herbert Morris & Bastert's manufacture, constructed for dealing with 25

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tons. The span is 67 ft., and the hoisting speed, when fully loaded, is 12 ft. per minute. The crab traverses at 80 ft. per minute, and the crane travel speed is 130 ft. per minute.

The electric current is taken from the generators to the main switchboard, which is situated at the south end of the building, and presents a number of interesting features. A general idea of its arrangement can be obtained from Fig. 5, which shows the disposition of the apparatus on the four floors. In the basement are placed the field rheostats, worked by chains from the operating gallery, and also the main step-up transformers for the extra high-tension transmission lines. Above this, slightly below the engine-room floor, is the high-tension switch-room, over which is the switchboard gallery proper, containing a board of the desk pattern, from which the generator circuits are controlled, and a series of switch-pillars for the feeders. These desks and pillars merely carry switch-handles and low-tension instruments. The actual switches themselves are in the high-tension chamber below. This has the advantage of giving ample room for the disposition of the high-tension gear in a chamber which need only be visited for the purposes of inspection, and leaves the switchboard operators free to attend to their duties on the platform. The arrangement may be said to be even safer than a switchboard of an ordinary low-tension station. The switchboard for the exciter and continuous-current auxiliary circuits is at the end of the operating gallery. The top floor is devoted to high-tension apparatus, including lightning arrestors, &c., in connection with the outgoing aërial lines.

Details of the three Lahmeyer desk-boards which form the generator panels is given in Fig. 6. The lever handle which controls the oil switch below through a system of rods is placed in the centre of the sloping top of the desk, and is surrounded by round-pattern instruments sunk flush with the board. The hand-wheels controlling the rheostat switches in the basement are mounted on the vertical front panels. The instruments on each generator panel, all of which are worked by current or potential transformers in the high-tension chamber, comprise an ammeter, machine voltmeter, exciter ammeter, and synchronism voltmeter. Indicating lamps showing whether the oil switches are "on" or "off" are also provided, and these are sunk into the instrument panels. A rotary lamp synchroniser is placed in full view of the operator at the desks, suspended from the upper gallery. The generator oil switches are fitted with automatic releases actuated by Ferranti maximum and reverse current time-limit relays. The excitation bus-bars are carried through the interior of the desks, but the field circuits are made and broken by a special switch provided with carbon contacts and discharge resistance attached to the rheostats in the basement and actuated mechanically when the last contact is reached.

One of the feeder pillars is shown in Fig. 7. They are mounted directly above the feeder oil switches, and carry the switch handle and feeder ammeters. The feeder oil switches are provided with overload relays only. Starting from the right-hand side, the first two pillars relate to the duplicate feeders leading to Nos. 8 and 9 pits. Duplicate feeders are also provided to Nos. 6 and 7 pits, but only one pillar is provided for these, as the change-over is effected by links in the basement with porcelain handles, which can be withdrawn and replaced after the manner of switch fuses. Another panel, provided with a set of three voltmeters for leakage detection, is connected to the 2,200-volt station circuit, on which the auxiliary motors, &c., are run. The remaining three-feeder pillars are for the circuits to the step-up transformers in the basement, which feed the 6,600-volt transmission lines to the more distant groups of pits. The secondaries of these transformers are connected direct to the lines without further switches. There are at present installed three three-phase transformers, each of a capacity of 500 k.v.a., but one of these is about to be replaced by a 1,000 k.v.a. transformer.

The arrangement of the switchgear in the high-tension chamber is very straightforward. The apparatus is not contained in brick or concrete cells, as is sometimes the case, but is mounted on an iron framing divided into sections enclosed in perforated metal sides, each directly under and relating to its own panel. Thus the generator gear is on one side of the room, and the feeder gear on the other. The bus-bars are at the top, and form a closed ring which can be sectionalised at a number of points by the removal of isolating links.

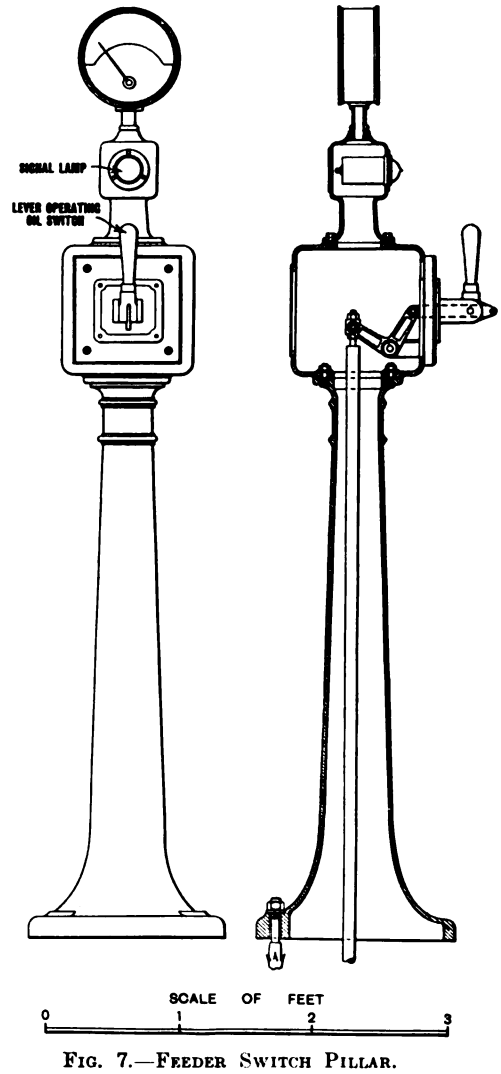

Fig. 7.—Feeder Switch Pillar.

The bus-bars are protected from the effects of abnormal voltage surges by spark gaps in series with glycerine resistances. The oil switches are mechanically operated from the control panels upstairs, and, as already stated, are fitted with tripping gear worked by the 200-volt continuous-current bars, and provided with Ferranti relays. These relays are placed in the high-tension switchroom on the outside of the cell to which they refer. The only circuit not provided with release gear is the station 2,200-volt circuit already mentioned, which is provided with a plain oil switch and the Lahmeyer type of high-tension oil-immersed spring break fuse. The distributing "board" for the station circuits is also in the high-tension room at the side.

The gear for the outgoing overhead lines on the top floor includes oil fuses for each line and the lightning protection apparatus, consisting of disc-shaped choking

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coils and horn spark gaps with water resistances. No switches are provided, but there are disconnecting links by means of which any line can be isolated.

The continuous-current board in the operating gallery does not call for much remark. It is of white marble, and consists of two machine panels provided with automatic cut-out at each end for the steam and motor-driven exciters respectively, while the central part of the board serves as battery and distribution panel.

The current is taken from the power station by main feeders to distributing centres at the various pits. The motors are generally worked at 2,200 volts, but in certain places, in accordance with the Home Office Rules, the current has to be stepped down by transformers to 440 volts.

As already stated, duplicate 2,200-volt cables are taken to Nos. 8 and 9 pits, which are close to the generating station. Nos. 6 and 7 pits are about 900 yards from the power station, and current is taken to them at 2,200 volts by an overhead line. This does not start from the station itself, but from a lightning arrester house near the river. At the pit end this line terminates in a combined lightning arrester house and distributing station. The only other 2,200-volt overhead line in the scheme is that which is to be constructed up the side of the mountain to supply an electrically-driven rubbish tip.

In the case of Nos. 1 and 5 pits at Ferndale, which are 2,500 yards away, and Nos. 2 and 4 pits, which are some 2,000 yards further up the valley, the current is transmitted by a triplicate overhead line at 6,600 volts. This line is taken direct from the generating station in the first place to the distributing station, from which the supply to Nos. 1 and 5 pits and the adjoining workshops is given. This distributing station can be seen in Fig. 8. A 6,600-volt cable is also taken from this distributing station across the river and on a little way to a lightning arrester house, from which a further overhead 6,000-volt line is taken to another distributing station in the basement of the fan house at what is known as the middle fan pit. This line continues to another distributing station supplying Nos. 2 and 4 pits, the foundry, and fitting shops, and is taken further to the upper fan pit. The middle fan house distributing station is also connected by 440-volt cables to the electrically-driven shops, where the company construct their own railway wagons, and to Nos. 2 and 4 pits.

The overhead lines are carried on wooden poles entirely without cross-arms. The insulators are of the three-shed pattern, made all in one piece, and 3½ in.

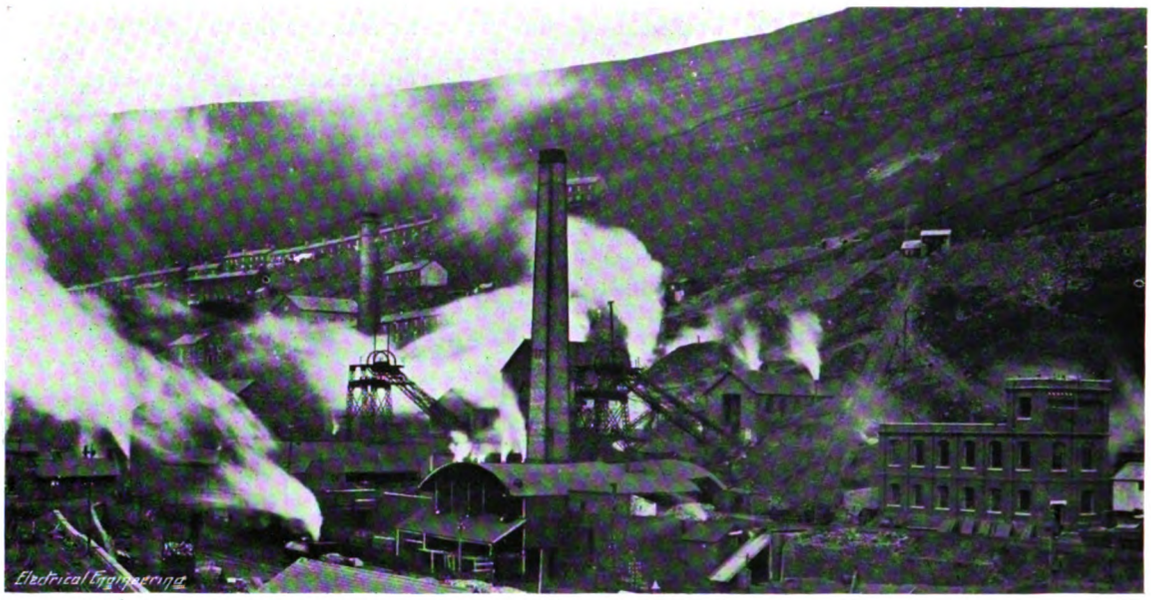

Fig. 8.—General View of Nos. 1 and 5 Pits, showing Distributing Station.

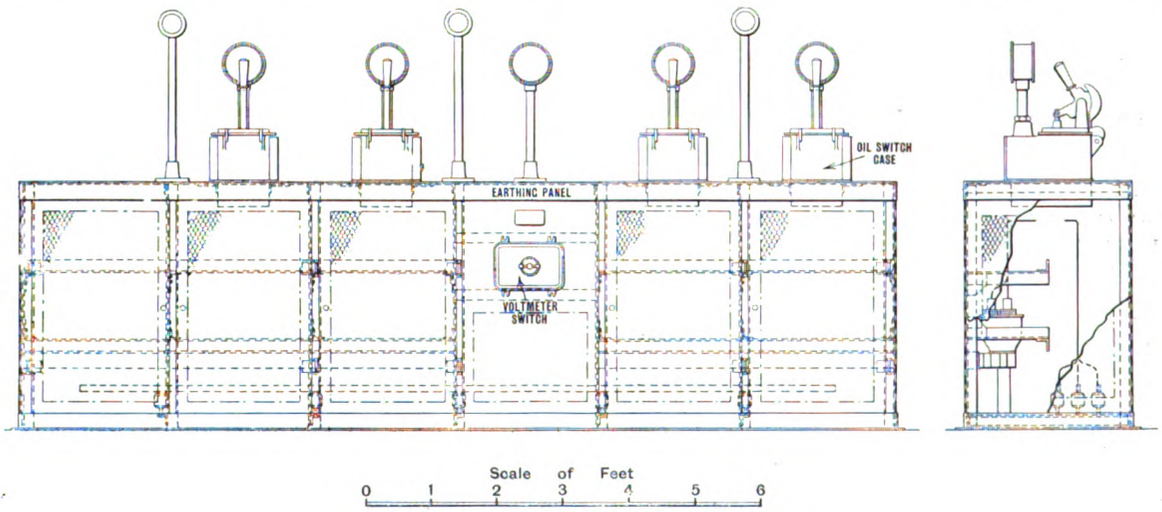

Fig. 9.—Distributing Board of Middle Fan Pit.

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high overall. They are carried on malleable iron pins supported on short iron brackets affixed on alternate sides of the poles. All these brackets are connected to a galvanised-iron wire running helically round the pole and leading to an iron wire strung above the conductors and affixed to the tops of the poles and efficiently earthed at certain points.

The sub-stations are all similarly equipped, and only vary as regards their capacity and the arrangement of the apparatus in the particular buildings in which they are situated. They are usually combined with lightning-arrester houses, and in two cases form the basements of buildings, where electrically-driven ventilating fans are at work. It will suffice to indicate the general features of their equipment as it is unnecessary to describe each in detail. The transformers are principally of the Lahmeyer oil-immersed pattern, but some air-cooled Berry transformers supplied by the British Electric Transformer Co. are also used for the all the apparatus fully enclosed in cast-iron cases. The panels for the incoming feeders are similar to the branch circuit panels, and the bus-bars are taken horizontally along the back inside the cases; each distributing cable is also provided with an earthing panel for measuring the leakage on each phase. The oil switches are fitted with automatic overload releases, which can be set to any required overload by means of a key without opening the cases.

From these sub-stations cables of a special armoured mining type are taken down the pits; the vertical portions in the shaft are held by a special form of wood cleat, spaced at intervals of every ten yards. These are each 3 ft. in length in the direction of the cable; the backs are in one piece, but the fronts are in separate pieces, so that where there are several cables any one can be removed without disturbing the others. These cables lead to underground switch-rooms containing enclosed switchgear of an exactly similar type

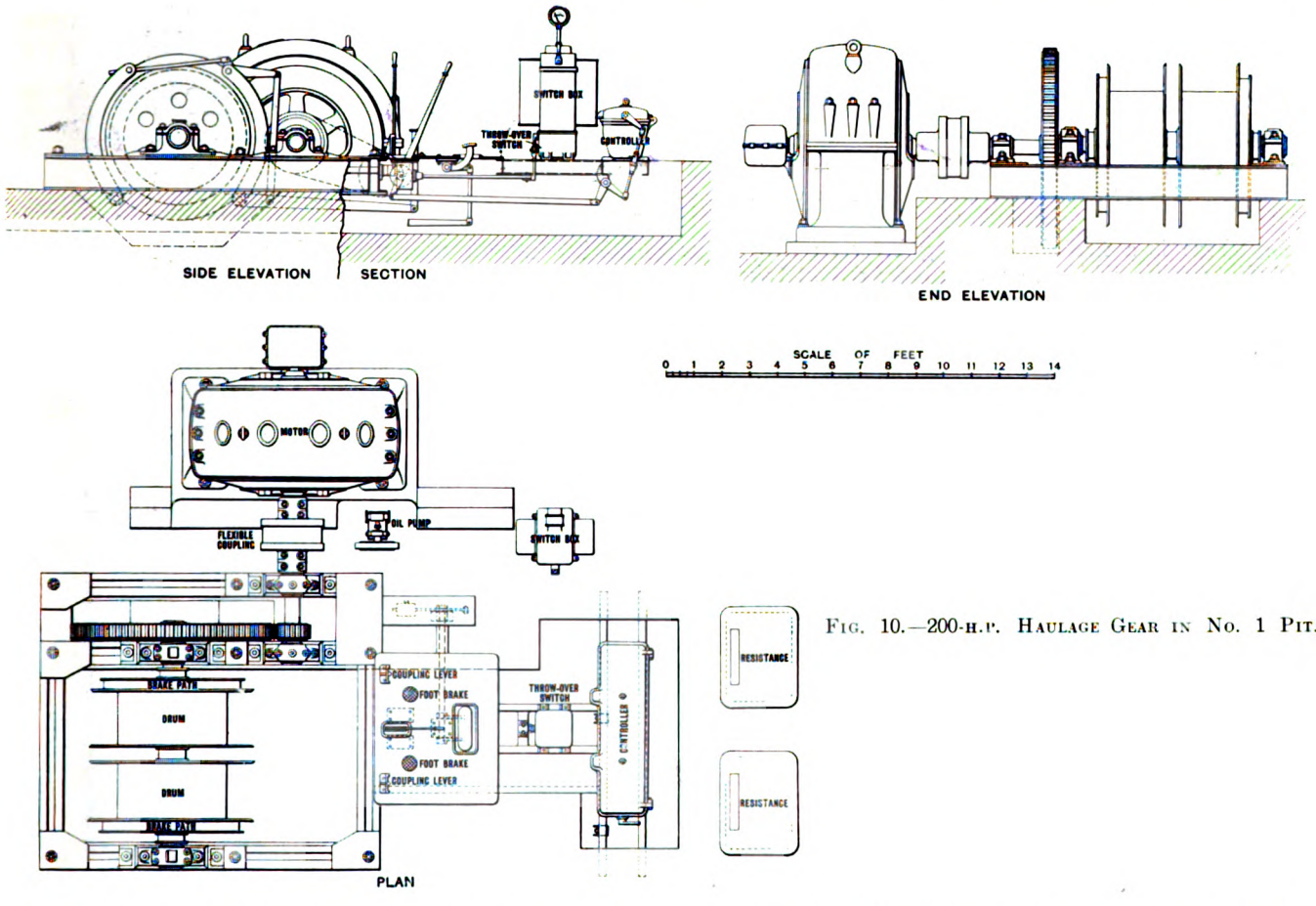

Fig. 10.—200-h.p. Haulage Gear in No. 1 Pit.

440-volt circuits. The lightning arrester arrangements have already been referred to, and each line entering a sub-station can be isolated by a disconnecting link.

The surface lighting at 220 volts at the pits is mostly supplied by continuous current from motor-generators. There is, for example, in the distributing station forming the basement of the fan house at No. 9 pit, a motor-generator consisting of a 2,200-volt induction motor driving a continuous-current generator, but an alternative supply is provided for in the event of breakdown of this set by means of a spare generator, which can be belt-driven from one of the large three-phase motors driving the fan.

The most interesting feature, however, of the sub-stations is the switchgear, which is of a special enclosed type developed by the Lahmeyer Co. for mining work. Details of the arrangement of a typical distribution board are shown in Fig. 9, which represents part of the gear used at the middle fan pit. The gear in all cases built up of a number of similar units, with to that in the sub-stations on the surface already described. The method of taking cables along the walls of the galleries underground is of some interest. They are sunk in the walls on timber shelves let into the wall, and covered by a wooden cover. The cables are thus well protected, but extremely accessible.

One of the most important of the various ways in which electric power is utilised in the Ferndale Collieries is for underground haulage. Some twenty-two of these electric haulage gears are being installed, varying in size from 200 h.p. to 50 h.p. The gears were made specially heavy to Mr. W. H. Patchell's specification by the Uskside Engineering Co. Slow-speed motors have generally been adopted, and the electrical equipment is of massive construction, supplied by the Lahmeyer Co. The controllers are of a new design arranged by the Consulting Engineer, in which special attention has been paid to obviating any possibility of the troubles which have arisen in some other cases through burning of the contacts. These

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haulage gears are illustrated in Figs. 10 and 11. They are generally of main and tail type, and work at a speed of six miles an hour. They are principally driven through single-reduction gearing, but in some cases, to suit the exigencies of the positions in which they had to be installed, double-reduction gearing was chosen. In all cases there is a flexible coupling between the motor and the gearing, which to a very large extent takes the jar of the gear off the motor. The motors are of the slip-ring induction pattern with enclosed slip-rings. We are informed that these electrically-driven gears are very popular with the drivers; and, owing to their reliability and ease of working, not only have great economies been effected over the old steam-driven haulage gears, but it has also been possible to obtain a greatly increased output, as there are no delays in starting up, for the haulage gear commences work immediately the driver manipulates the lever. A considerable proportion of these electrical haulage gears had been in operation for some time before the completion of the Tylorstown power station, on the mains of the South Wales Power Company.

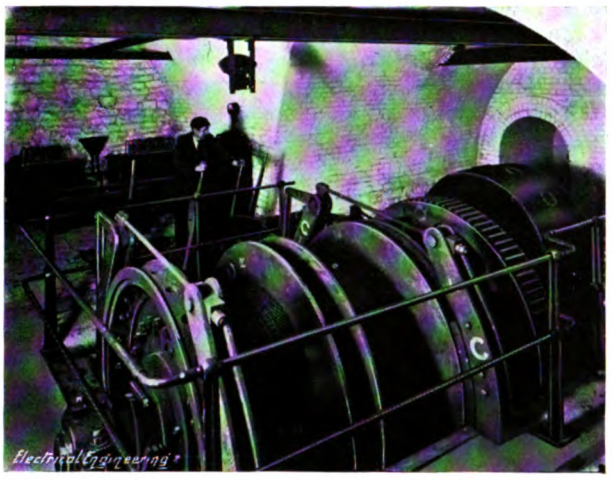

Fig. 11.—200 h.p. Underground Haulage Gear.

Pumping in these mines is not such a serious matter as in many collieries, as the amount of water in the pits is not excessive. Practically the whole of the underground pumping is now being handled electrically, in some cases by three-throw pumps made by the Uskside Co. and in other cases by high-lift Sulzer centrifugal pumps.

The conversion of the ventilating plant to electrical driving is now nearly complete. This is a most important part of the work, not only from the Colliery Manager's point of view, but also inasmuch as the continuous use makes it a most desirable load for the power station.

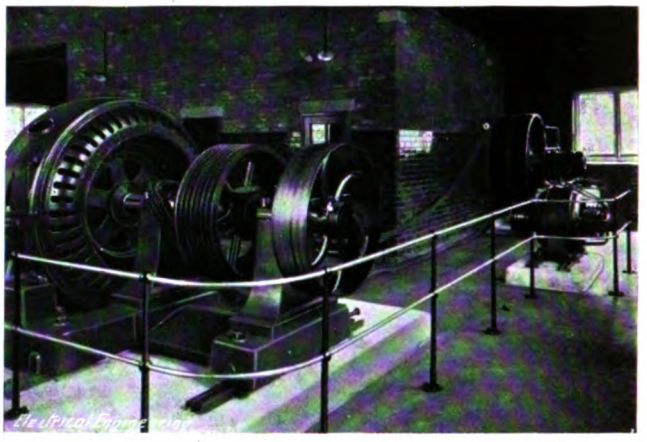

Fig. 12.—One of the Motors driving Sirrocco Fan at No. 9. Pit.

The positions of the principal fans are shown in the plan in Fig. 1. At No. 9 pit a "Sirocco" fan has been put down to handle 300,000 cubic feet of air per minute at a 4-inch water gauge. This fan is driven electrically from either end of its shaft by two Lahmeyer motors working at 2,200 volts. One of these motors is shown in Fig. 12. This fan runs continuously day and night except for a period of about half-an-hour once a week for cleaning. One of the "Schiele" fans at No. 6 pit, which have been driven for several years by a steam engine and doing 300,000 cubic feet of air per minute at 3·5-inch water gauge, has lately been con-

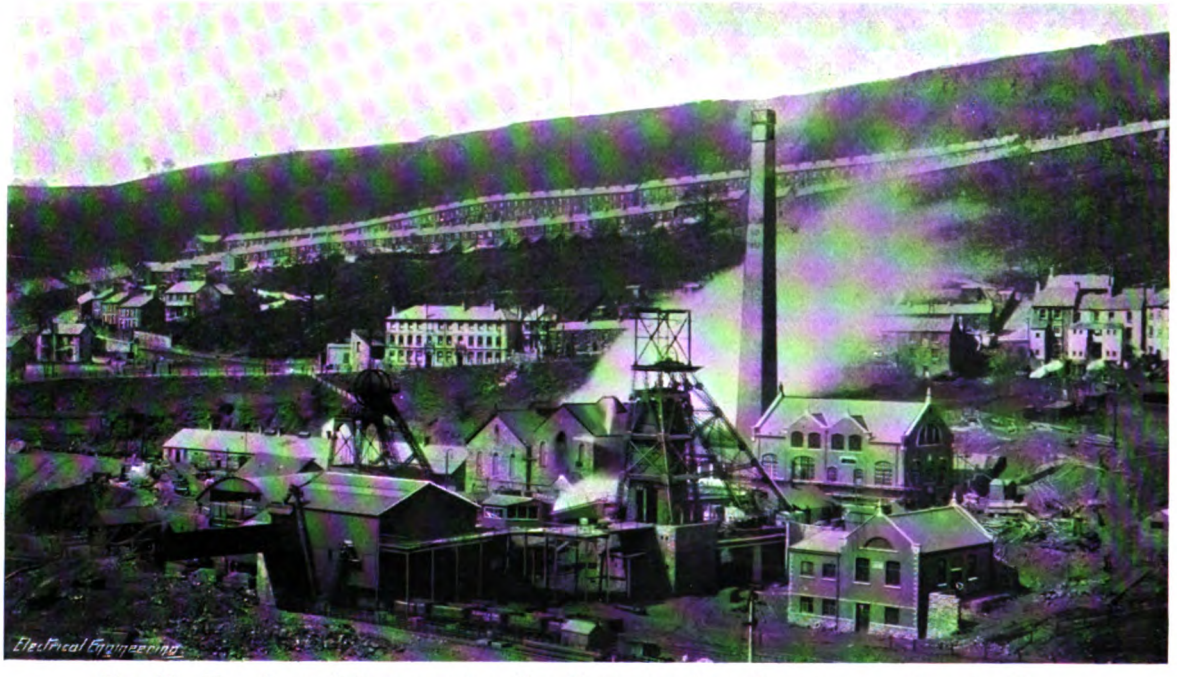

Fig. 13.—Nos. 8 and 9 Pits, showing Fan House and New Building for Electric Winder.

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verted to an electrical drive. Two further "Sirocco" fans are at present being installed, each capable of doing 125,000 cubic feet of air per minute at 4-inch water gauge. These are to take the place of steam-driven Waddle fans, which have been at work for over thirty years.

Perhaps the most interesting part of the installation is the main-shaft electric winder, which is being erected at the No. 9 pit. This will work on the "Ilgner" system, in which the excessive demands for power required for starting are met by a flywheel converter, and the control of the main continuous-current winding motors is effected by regulating the excitation of the flywheel generator. The electrical equipment is being supplied by the Lahmeyer Electrical Co., and is of a similar nature to that of the winder at the Matthias Stinnes mine at Carnap, in Westphalia, described in Electrical Engineering, Vol. II., page 605, and other well-known examples of main-shaft winding machines supplied by the firm. The machine differs, however, from the example mentioned in that a cylindrical drum is used instead of the Koepe pulley, which finds so much favour on the Continent. The installation is designed to raise 1,800 tons of coal per day from a depth of 570 yards. The actual winding drum and a portion of the mechanical gear was supplied by Messrs. Fraser & Chalmers. The winding of the shaft is being done at present by a temporary steam winding engine, which will be removed when the new electric winder is complete. The old and new winding engine-houses are shown in Fig. 13. We must defer a complete description of this interesting installation until its erection is in a more advanced stage.

Electrical power is employed for a number of purposes on the surface, including the driving of the screening plant, &c., wagon shops, and general workshops.

The Consulting Engineer, Mr. W. H. Patchell, M.Inst.C.E., of Caxton House, Westminster, has for many years been largely identified with the introduction of electricity for mines and was the Electrical Member of the Home Office Departmental Committee for the drafting of suitable rules for the use of electricity in mines. He has collaborated throughout with Mr. David Hannah, Manager to the Ferndale Collieries, to whom in a great measure credit for the success of the Ferndale installation is due. We wish to express our thanks to both of these gentlemen for giving us particulars of the installation and putting at our disposal the drawings and photographs from which the illustrations in this article were prepared. We should also like to acknowledge the facilities for inspecting the plant accorded to our representative by Mr. F. Llewellen Jacob, sub-agent to the collieries, and Mr. C. Kemp, engineer in charge of the power station.

HOLLOW REINFORCED CONCRETE POLES.

For Tramways and Overhead Distribution Lines

A NEW process for manufacturing hollow poles and pipes of reinforced concrete has just been introduced into this country by Messrs. Siegwart, Ltd., of 1 Great Chapel Street, Westminster. It is the invention of Mr. Hans Siegwart, of Lucerne, Switzerland, who is well-known as the inventor of a system of reinforced concrete fire-resisting floor construction made up of hollow tubular beams laid side by side. Fig. 1 gives the general arrangement of the machine for manufacturing Siegwart poles and pipes, as it has been erected at the works of Messrs. W. Cubitt & Co. at 260 Gray's Inn Road, London, W.C. This view shows the machine in an open concrete pit, with a track on either side, upon which trestles can be run, and a stage over the machine carrying a concrete mixer which

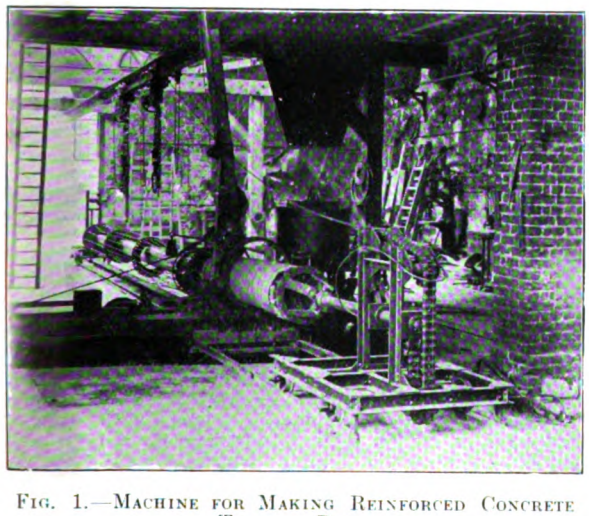

Fig. 1.—Machine for Making Reinforced Concrete Tubular Pole.

discharges into a receptacle below on the machine itself. The concrete used in the manufacture of poles and pipes is made of clean screened Thames grit, which mostly consists of sand, with occasionally small stones not larger than ½ in. maximum diameter, proportioned 3 to 1 of Portland cement. The concrete is mixed very dry, so that it only feels moist to the hand, and does not even stick together when pressed in the hand. It coheres in the manufacture by reason of the great pressure which is applied to it. The concrete, discharged from the mixer into the hopper, falls from the latter into a sheet metal drum. This drum holds about eight cubic feet, which is sufficient, as a rule, to make one pole or pipe. The hollow space in the interior of the poles or pipes is formed by means of the core of sheet iron, which is removed after the concrete has been applied to it. Gauge rings are arranged on the core at suitable distances from each other, and steel rods or wires of small section are passed through holes in these gauge rings, and arranged to lie longitudinally upon it. In the pipes these wires or rods are not stretched, for the operation of applying the concrete draws them taut, but in the poles the wires are stretched. Upon the track two trestles are placed, as shown in

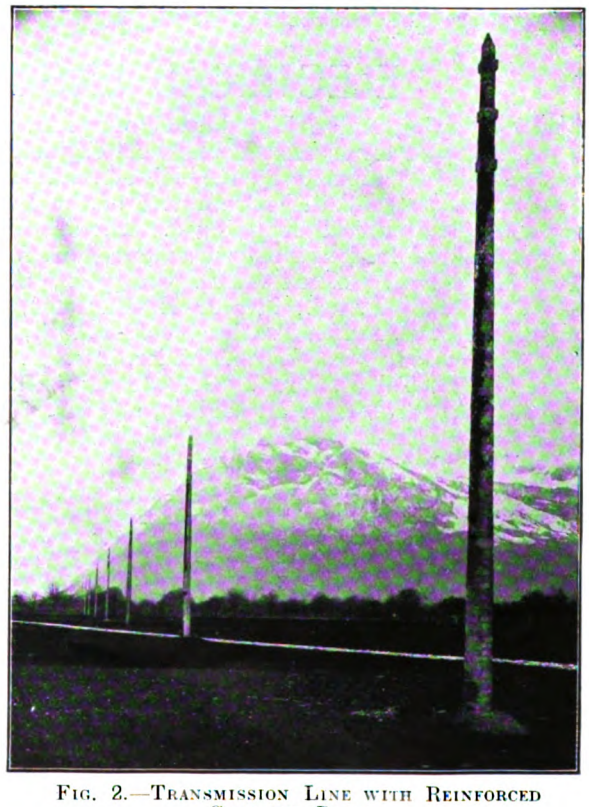

Fig. 2.—Transmission Line with Reinforced Concrete Poles.

Fig. 1, and the core is mounted between them so as to be capable of rotation. The trestles have toothed pinion wheels, which engage with a rack on the track, and are drawn gradually along in the direction of the machine. The concrete from the drum falls down a shoot upon a conveyer band or belt made of strong steel wire tightly plaited, which takes one wrap round the core, and is given its motion by passing over two wheels.

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By means of the two heavily weighted levers, the sliding carriage applies a pressure of about 5,000 lb. to the conveyer-belt, so that the concrete is wrapped upon the core under this pressure. A band of strong cloth webbing about 4 in. in width is laid on top of the belt. The concrete falls upon this webbing, and the webbing and the concrete are wrapped round the core in a continuous spiral. The edges of the webbing just overlap, so that the concrete layer and the webbing are continuous. The pressure on the conveyer-belt draws the longitudinal wire or rod reinforcements closer together. The guide rings holding the longitudinals in position are engaged by a wheel attachment, so that they slide along the rods as the core gradually passes towards and through the machine. Immediately the webbing and concrete issues beyond the conveyer-belt, wire or wires, as close together as may be desired, are fed from a spool. The webbing is drawn up over a bar above this spool of wire, so that the wires for the spiral binding may be fed upon and into the concrete. The rotation of the core draws the wire or wires from the spool so hard against the layer of concrete that they penetrate into it for some distance. The rotating core draws the band of webbing upon the surface of the concrete again, and a pressure roller on the end of a long spindle, which is screwed forward by hand, works on a sheet iron ring, and presses this webbing and the concrete hard against the core. The finished pole thus consists of a concrete pipe with a wall thickness of from one to two inches, with a reinforcement consisting of longitudinal rods tied together by a wire wound on spirally.

The electric motor that works the machine is mounted on the bottom frame, and the driving is by means of a worm wheel and several chain wheels. The machine can be adjusted to the necessary angle to the core if this is tapered. As soon as the core has been drawn through the machine completely wrapped with the spiral binding, it is picked up by a travelling crane overhead and slung on one side to enable the concrete to harden and mature. To ensure it gaining maximum hardness it is constantly wetted. The interior sheet metal core can be removed by being reduced in diameter by the screw attachment after about 12 hours, and the webbing may be removed after six days hardening. To complete a pole, all that requires to be done after it comes from the machine is merely to fix a stopper in the top and make a square necking or blocking for fixing the cross-arms that carry the insulators. The former is cast in a mould and dropped into the top of the post; the latter is moulded by hand. When a more finished appearance is required, the poles are given a wash of cement grout or rendering of cement and sand, the latter giving a stone-like appearance, and, if desired, neckings or mouldings may be run round the pole and any other ornamentation done by hand.

Reinforced concrete poles constructed in this manner are very suitable for use on tramways and also on power distribution lines. The makers give the following comparative estimates of first cost and 50 years' maintenance for reinforced concrete and other poles.

Tramway Poles, Height 29ft.

	Siegwart £ s. d.	Iron. £ s. d.	Wooden (impregnated.) £ s. d.
Price of pole	3 0 0	6 10 0	14 5
Erection	1 0 0	1 0 0	9 7
Painting or renewal ...	—	2 11 0	9 8 4
Total cost in 50 years..	£4 0 0	£10 1 0	£10 12 4

Poles for Power Distribution, Height 36ft. 6in.

	Siegwart. £ s. d.	Iron. £ s. d.	Wooden (impregnated) £ s. d.
Price of pole	4 0 0	9 0 0	19 3
Erection	1 4 0	2 0 0	9 7
Painting or renewal ...	—	2 11 6	12 5 0
Total cost in 50 years..	£5 4 0	£13 11 6	£13 13 10

Fig. 2 shows a line of Siegwart poles that has been erected in the country, where no special finish is required. This view, therefore, shows the poles just as they come from the machine, with the markings upon them left by the webbing. A type of pole which has been erected at Miggern, Switzerland, has a total height of 54 ft. above the ground. As this height is greater than the standard length of poles manufactured, it has been obtained by fixing an ordinary pole in a base which stands 16 ft. 5 in. above the ground, and embedded 6 ft. 6 in. in the ground, resting upon a foundation of rough stones and filled with stones to form a bearing for the pole proper.

The number of persons in the gang of men that have been employed to work the machine described above in the experimental stages has been eight, but eventually only seven men will be required. One labourer is engaged feeding the mixer for the concrete; two labourers and a foreman are engaged working the machine; two lads are engaged in placing the reinforcements on the core, and one man is required to remove the poles. Only one skilled man is thus required. The capacity of the machine is, roughly, about one pole an hour, though with smaller poles and pipes the time required is slightly less. The concrete, of course, is not a big item, and the metal is also of small amount, and costs very little.

ELECTRICAL ENGINEERING NOMENCLATURE

THE following is the first portion of a series of definitions of terms used in electrical engineering which have been prepared by the sub-Committee on Nomenclature of the British Committee of the International Electrotechnical Commission. The sub-Committee consists of the following gentlemen:—Mr. A. P. Trotter (chairman), Colonel R. E. Crompton, C.B., Mr. W. Duddell, F.R.S., Mr. J. E. Edgcome, Sir John Gavey, C.B., Dr. R. T. Glazebrook, F.R.S., Mr. Robert Hammond, Mr. H. W. Miller, Mr. F. H. Nalder, Mr. H. Talbot, Mr. L. G. Tate, Prof. S. P. Thompson, F.R.S., Mr. A. H. Walton, and Mr. C. H. Wordingham. Words printed in capitals in the definitions are themselves defined elsewhere.

Accumulator: An electric cell consisting of plates or of grids in an electrolyte, of such a character that the electrical energy supplied to it is converted into chemical energy (a process called "charging"). The chemical energy can be reconverted into electrical energy (a process called "discharging"). Sometimes called a Storage Cell or a Secondary Cell. Several accumulators connected together in one circuit are sometimes called a Secondary Battery.

Alternator: A machine for generating alternating current. The exciting current is generally supplied by a separate machine called an Exciter. (The word "dynamo" should be reserved for a continuous current generator.)

Alternating Current: An electric current which alternately reverses its direction around a circuit in a periodic manner. The time occupied by each pair of half waves is called a Period. Abbreviated "A.C."

Ammeter or Ampere Meter: An instrument which indicates directly, in amperes, the value of an electric current.

Ampere: The current which is produced by the electrical pressure of one volt applied to a conductor, the resistance of which is one ohm. The Practical unit of electric current. It is one-tenth of the centimetre-gramme-second (C.G.S.) unit.

Ampere-Hour: One ampere flowing for one hour, or its equivalent; such as 4 amperes flowing for 15 minutes, &c.

Ampere-Turn: A practical unit of magnetomotive force. The number of turns or windings of a coil multiplied by the current in amperes which flows through it.

Annunciator: An apparatus containing a series of signals for indicating which of several circuits is making the call.

Anode: (*a*) In an electrolytic cell, the conductor through the surface of which the current enters the liquid. (*b*) In a primary cell, the metal (usually zinc) through which the current enters the electrolyte. (*c*) The terminal by which the current enters a cell or other apparatus, such as a vacuum tube, &c.

Aperiodic: The motion of the moving part of a mechanism is said to be "aperiodic" when it does not overshoot the mark on taking up a new position. Must not be confused with "dead-beat." See also Damped.

Arc: A discharge, continuous or alternating, of electricity through a gas in which the material of one or both the electrodes is volatilised, and takes part in the conduction of the current accompanied by a brilliant light.

Armature: (Originally the pole pieces attached to a lodestone.) (*a*) Of a permanent magnet. An iron bar for completing the magnetic circuit; sometimes called a Keeper. (*b*) Of a simple electromagnetic mechanism. The iron part of the magnetic circuit which is not covered with wire; it is generally set in motion by an electromagnet. (*c*) Of a generator. That part of the machine which is acted upon inductively by the magnetic flux; and from which the induced current is transmitted to the terminals. (*d*) Of a motor. That part of the machine which receives the current, and is acted upon inductively by the magnetic flux. In continuous current machinery it usually rotates, in alternating current machinery it is sometimes stationary. See Stator and Rotor.

Armouring: Of a cable. A protective metallic covering of wires or tapes, usually of iron or steel (verb: to armour).

Arrester: An abbreviation. See Lightning Arrester.

Astatic: A system of magnets or coils is said to be astatic when the polarities of its parts are so adjusted that the polarity of the whole is zero, and no directive effect is exerted on the system of a uniform magnetic field.

Asynchronous: A term applied to an alternating current generator or motor, the speed of which has no fixed relation to the frequency of the current.

Auto-Transformer: A transformer in which part of the winding is common to both the primary and the secondary circuits; sometimes called a Compensator.

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Balancer: A dynamo, pair of dynamos, motor generator, or rotary converter, arranged to maintain the equality of pressure on the two sides of a three-wire system.

Bank: A number of similar pieces of apparatus grouped and connected to act together is sometimes called a bank. Thus lamps are banked in parallel, or in series, to form a resistance; and several transformers are banked to act as a single transformer.

Barretter: An instrument in which the current to be measured, generally alternating, flows through and heats a fine wire strip or filament, and causes a change in its resistance, which is taken as the measure of the current.

Battery: Two or more cells connected in one circuit.

Bifurcating Box: A box containing the joints between a two-core and two single core cables.

Blow (verb): When a fuse melts it is sometimes said to "blow," a term suggested, probably, from the result of the melting of a fusible plug in a steam boiler. The same expression is sometimes applied to the automatic opening of a circuit breaker.

Board of Trade: A British Government Department charged with the administration of, *inter alia*, the Electric Lighting and Power Acts, Railway and Tramway Acts, and of regulations made thereunder for the safety of the public, &c.

Board of Trade Unit: One Kilowatt-Hour. The expression "Unit" is officially used, and not the expression "Board of Trade Unit.

Bolometer: An instrument in which radiant energy to be measured causes an alteration of the resistance of a fine wire strip or filament.

Bond: (For tramway and railway rails.) A connector, usually of copper, used for electrically connecting the rails to each other or to a return conductor, in order to ensure good conductivity. (Verb: to bond.)

Boom: See Trolley Boom.

Booster: A dynamo, alternator, or transformer, interposed in a circuit for the purpose of increasing or decreasing the electromotive force acting in the circuit.

Braiding: A plaited covering of fibrous material or wire. (Verb: to braid.)

Branch Circuit: A circuit which derives its supply of current from points on another circuit.

B.T.U. or B.O.T.U.: See Board of Trade Unit. (Terms not recommended.)

British Thermal Unit: The quantity of heat required to raise a pound of water one degree from 60° F. to 61° F. Abbreviated "B.Th.U."

Brush: A conductor for collecting or delivering current from commutators or slip rings. Originally made of copper wires, afterwards of copper strips or gauze, or of carbon blocks.

Brush Discharge: A discharge having a feathery form and consisting of an intermittent partial discharge which takes place from a conductor when the potential difference exceeds a certain limit, but is not high enough to cause the formation of a true spark or arc. It is always accompanied by a hissing or crackling sound.

Brush Holder: The apparatus which holds the brushes.

Brush Rocker: The apparatus which enables the position of all the brushes carried by it to be altered simultaneously in either direction.

Buckling: Of accumulator plates. The distortion caused by uneven expansion.

Busy-Back: An electrical signal transmitted from one telephone exchange to another to indicate that the line wanted is in use.

Bus-Bar: Abbreviation for Omnibus-Bar. Conductors (generally on a switchboard and of comparatively large size) to which several mains or feeders are connected.

B.W.G.: Abbreviation for Birmingham Wire Gauge.

C.G.S.: Abbreviation for Centimetre-gramme-second.

Cable: For electrical purposes; a stranded conductor with or without protective covering.

Calibration: Of a measuring instrument. The determination of the value of the divisions of the scale of an instrument by comparison with a standard, or by some fresh determination.

Calorie: (*a*) The Calorie or Gramme-Calorie (also called the Small-Calorie) is the quantity of heat required to raise the temperature of one gramme of water one degree centigrade. (*b*) The Kilo-Calorie (also called the Great-Calorie) is one thousand calories, and is the quantity of heat required to raise the temperature of one kilogramme of water one degree centigrade.

Note.—The value of the calorie depends to some extent on the temperature at which the water is taken, and on the scale of the thermometer employed. The hydrogen thermometer is usually adopted as the standard, and the temperature selected is generally 15° C. or 20° C., or the mean 0° C.—100° C.

Candle Power: The luminous intensity, or illuminating power, of a source of light.

Candle Foot: See Foot Candle.

Capacity: (*a*) Of an accumulator. The quantity of electricity in ampere hours which may be taken from a cell at a given rate of discharge. (*b*) Of a Condenser. The quantity of electricity which must be imparted to a condenser, or to a conductor acting as a condenser, in order to raise its potential from zero to unity. (*c*) Of a Machine or of a Generating Station. This use of the word "capacity" is not recommended. The term Rating should be used.

Carcase: Of a dynamo, alternator, or motor. The assembled pole cores, pole pieces, and yoke or frame.

Cascade: (*a*) A series connection of two or more condensers. (*b*) A method of electrically connecting induction motors, whereby the induced part of one motor is connected electrically with the inducing part of the other. Also called Concatenation and Tandem.

Cathode: See Kathode.

Cell: (*a*) A source of electrical energy dependent on chemical action; complete in itself. (*b*) A compartment of a high pressure cellular switchboard. (*c*) A combustion chamber of a Dust or Refuse destructor.

Choking Coil: A coil with so great a self-induction that its impedence depends chiefly on the self-induction rather than upon the resistance.

Circuit: The conductors connected with a source of electrical supply are collectively called a circuit. When they form a closed path through which a current circulates there is a Closed Circuit. When the path is not closed and no current circulates there is an Open Circuit.

Circuit Breaker: A switch which is opened automatically when the current or the pressure exceeds (or falls below) a certain limit, or which can be "tripped" by hand.

Closed Circuit: See Circuit.

Coherer: (In wireless telegraphy.) A device employed at the receiving, and consisting essentially of an imperfect contact, or system of contacts, such that its resistance is altered on the reception of a signal.

Collecting Rail: See Conductor Rail.

Collector: A sliding piece which makes contact and collects the current from a fixed part of an electrical apparatus, or *vice versa*.

Collector Ring: A ring used for making a sliding connection between a fixed and a revolving part of an apparatus such as an alternator or a searchlight projector.

Commutator: An apparatus for reversing the direction of a current in any circuit. In a dynamo or motor that portion on which the brushes press and collect or deliver the current.

Compensator: See Auto-transformer.

Compound Wound: A generator or motor is said to be compound wound when the magnetic field is excited partly by series and partly by shunt coils, or independently excited coils.

Concatenation: See Cascade.

Concentric Cable: A cable consisting of two or more separate conductors arranged concentrically with insulation between them. Three conductors so arranged form a Triple Concentric Cable. The external conductor should be called "external," and not "outer," in order to avoid confusion with the outer conductors of a three-wire system.

Conductor Rail (Positive or Negative): A rail employed on electric railways for conducting current to or from the train. The terms Live Rail, Third Rail, Fourth Rail, Earth Rail, Collecting Rail, and Working Conductor are not recommended.

Conduit System: (*a*) For electric light and power distribution. A system of bare conductors carried on insulators in a conduit or culvert, generally of concrete. (*b*) For wiring. A system of metal or other pipes into which wires are drawn. (*c*) For traction. A system of bare conductors carried in a conduit, having an open slot through which a Plough makes contact between the conductor rails and the electrical equipment of the car. (*d*) For telegraphs and telephones. A group or collection of ways or passages called Ducts into which cables are drawn.

Consumers' Load Factor: The number obtained by dividing the actual consumption during a given period of time by what that consumption would have been had the maximum load reached during that period continued in use throughout the whole of that period.

Contactor: An electro-magnetic, electro-pneumatic, or automatic switch used for controlling heavy current circuits to motors, and which is itself controlled by a Master or Pilot Controller.

Continuous Current: An electric current in one direction and sensibly steady or free from pulsation. Abbreviated C.C. The term Direct Current is not recommended.

Controller: A compound or multiple switch containing the means for introducing resistances, or for connecting motors in series or in parallel. It has several steps or positions called Notches, and is intended for use on any notch for an appreciable period of time. It is to be distinguished, in this respect, from a Starting Switch. It is used for varying the speed or power of, as well as for starting, traction and other motors. A Master Controller, sometimes called a Pilot or Multiple Unit Controller, does not act directly on the current supplied to the motors, but works Contactors.

Converter: A revolving apparatus for converting alternating current into continuous current or *vice versa*; sometimes called a Rotary Converter. To be distinguished from a Transformer, Rectifier, or Motor Generator.

Core: (*a*) Of a magnetic circuit. That part which is within

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the winding. The part outside the winding, if any, is called the YOKE. (*b*) Of a transformer. The whole of the iron forming the magnetic circuit. (*c*) Of a cable. The conductor with its insulation or dielectric. Two, three, or more cores may be laid together to form a TWIN, THREE-CORE, or MULTICORE cable. (*d*) Of an arc lamp carbon. The longitudinal filling.

COULOMB: The PRACTICAL unit of electrical quantity. One coulomb is equivalent to one ampere flowing for one second; 3,600 coulombs equal one ampere-hour. The term AMPERE-HOUR is almost universally adopted; the coulomb is seldom used.

CUT-OUT: A device for protecting apparatus from damage by overload. The term cut-out comprises all the separate parts which, together with their mountings and base, form the complete device, and the term includes FUSES and CIRCUIT-BREAKERS.

CYCLE: A term not recommended as a synonym for PERIOD. See PERIOD, ALTERNATING CURRENT.

DAMPED: The motion of a piece of mechanism is said to be damped when any oscillations which may be started rapidly die away. If no oscillations can be produced, it is said to be APERIODIC. See DEAD-BEAT.

DASH-POT: An appliance for preventing sudden or oscillatory motion of any portion of an apparatus by the friction of air or of a liquid.

DEAD-BEAT: An instrument or other mechanism is said to be dead-beat when the oscillatory movement rapidly dies away. To be distinguished from APERIODIC.

DERIVED UNITS: See PRACTICAL UNITS.

DIELECTRIC: Any material which offers high resistance to the passage of an electric current.

DISCRIMINATING CUT-OUT: A cut-out, usually on a switchboard, for interrupting the circuit when the normal direction of the flow of energy is reversed.

DISTRIBUTING BOARD: A board carrying small bus-bars, used for connecting a number of circuits to a pair of mains. Sometimes called a DISTRIBUTION BOARD.

DISTRIBUTING MAINS: The conductors which intervene between the feeders and the service lines, and which are collectively called "distributing network," or "low-pressure network," or the NET-WORK.

DIVERSITY FACTOR: The number obtained by dividing the actual output of any works during a given period of time by what that output would have been had the works operated throughout the whole of that period at the maximum load reached during that period.

DRAW-IN BOX: A box used in connection with a draw-in system of mains. When complete, it contains no links, fuses, or switches, but in some cases permanent joints.

DRAW-IN SYSTEM: A system of laying mains in which the cables or wires are drawn into pipes or DUCTS after the latter have been laid or fixed in position, in such a manner that the cables or wires can be withdrawn at any time without disturbing the pipes or ducts. Draw-in boxes, manholes, or junction-boxes are usually provided, through which the cables or wires may be drawn in or withdrawn.

DIELECTRIC: Any material which permanently offers high resistance to the passage of electric current.

DROP (IN PRESSURE): A difference of potential between any two points in a conductor through which a current is flowing, the conductor itself not being the seat of any electromotive force.

DROP SIGNAL: See ANNUNCIATOR.

DUCTS: Pipes or blocks perforated with holes through which cables are drawn. Usually non-metallic and set in concrete. The holes themselves are sometimes called ducts.

DYNAMO: A continuous-current GENERATOR.

DYNAMOMETER: (*a*) An instrument for measuring forces. (*b*) An apparatus for measuring the torque exerted by a prime mover or motor. (*c*) An instrument for measuring electric currents depending on the measurement of the electro-magnetic forces between two or more cells. (Abbreviation for ELECTRO-DYNAMOMETER.)

EAR: In overhead tramway work. A grooved metal fitting rivetted over, soldered or otherwise attached to, a trolley wire for the purpose of: (*a*) Supporting the wire. (*b*) Altering the horizontal direction of a trolley wire, termed a "PULL OFF." (*c*) Anchoring a trolley wire.

EARTH: (*a*) An electrical connection with the earth, intentional or unintentional, is called an EARTH. (*b*) (Verb: to earth.) To connect any conductor with the general mass of the earth in such a manner as will ensure at all times an immediate and safe discharge of electrical energy. Board of Trade definition of "efficiently connected with earth." (*c*) Earth circuit. A circuit of which the earth forms a part.

EARTHED CIRCUIT: A circuit, one pole of which is earthed at one or more points.

EARTH RAIL: See CONDUCTOR RAIL.

EFFECTIVE VOLTS: A term not recommended. See VIRTUAL VOLTS.

E.H.P.: Contraction for ELECTRICAL HORSE POWER.

ELECTRODE: A conductor by which an electric current passes into or out of an electrolyte or other substance.

ELECTRO-DYNAMOMETER: See DYNAMOMETER.

ELECTROLYSIS: The passage of an electric current through an electrolyte.

ELECTROLYTE: Any substance which undergoes chemical decomposition by the direct action of an electric current passing through it.

ELECTROCUTION: A form of capital punishment for criminals by electric shock.

ELECTROMOTIVE FORCE: That which causes or tends to cause an electric current. Abbreviated "E.M.F." See POTENTIAL PRESSURE, TENSION, VOLTAGE.

EXCITER: A dynamo used for exciting the field magnets of another machine. See ALTERNATOR.

FARAD: The PRACTICAL unit of electrical capacity. It is inconveniently large, and, therefore, capacities are usually reckoned in MICROFARADS.

FACTOR OF SAFETY: The ratio of the "ultimate breaking stress" to the "maximum normal working stress."

FAULT: Any local defect in the insulation or continuity of a conductor which interferes with its use.

FEEDERS: Conductors for conveying electrical energy from the place where generated or transformed to FEEDING POINTS or sub-stations. Not used for supplying consumers directly, owing to the varying pressure along their length.

FEEDER BOX or PILLAR: (For tramways or railways.) A box or pillar containing switches, links, and sometimes fuses for connecting sections of trolley wire or conductor rail with feeders. (For electric lighting and power.) A box containing links and sometimes fuses for connecting feeders with distributing networks.

FEEDING-POINT: The point or junction of a FEEDER with the NETWORK.

FIELD, ELECTROSTATIC: Any region in which there are electric lines of force, as in the space between a positively-charged surface and a negatively-charged surface.

FIELD, ELECTRO-MAGNETIC. See FIELD, MAGNETIC.

FIELD-MAGNET: Any magnet or electromagnet employed for the purpose of providing a magnetic field. (It is incorrect to speak of the field magnets of a dynamo or motor as its "fields"; they should be called its "magnets," if the term "field magnets" is too long.)

FIELD, MAGNETIC: Any region in which there are magnetic lines of force, as in the space between the poles of a magnet or within a magnetising coil. The intensity of the field is usually expressed in C.G.S. measure as the number of lines per square centimetre. One line per square centimetre is called a GAUSS. See LINE.

FIGURE OF MERIT: (*a*) Of a galvanometer. The deflection in millimetres per micro-ampere at a scale distance of one metre. (*b*) The current in amperes required to produce a deflection of one millimetre at a scale distance of one metre. Sometimes expressed as the number of megohms through which one volt will give that deflection. The complete period of a swing is taken at 20 seconds unless otherwise stated. (*c*) Of a telegraph instrument. The minimum current necessary to work the instrument with absolute certainty.

FLASHING: (*a*) Any process of manufacture involving the temporary electrical superheating of a glow lamp filament. (*b*) The coating of glow lamp filaments with a layer of carbon by heating them electrically in a hydrocarbon vapour.

FLASHING OVER: The temporary formation of an arc from brush to brush on a commutator.

FLASH TEST: The momentary application of a high electrical pressure between two conductors insulated from each other.

FOOT CANDLE: The illumination produced by one candle-power falling perpendicularly on a surface at a distance of one foot.

FOURTH RAIL: See CONDUCTOR RAIL.

FREQUENCY: The number of complete periods per second of an alternating current. Symbol . The term PERIODICITY is not recommended.

FROG: In tramway overhead work. A fitting uniting two diverging trolley wires with a single wire (*a*) provided with a spring tongue or (*b*) pull-over tongue, or (*c*) of the fixed type.

FUSE: The actual wire or strip of metal in a cut-out which may be fused by an excessive current.

GAUGE: (*a*) A general term applied to various kinds of measuring instruments and to linear measurements. (*b*) The thickness of a plate, or the diameter of a wire, on the inch, millimetre, or on any arbitrary scale. (*c*) The distance between the rails of a railway or of a tramway. In the case of a railway it is the distance between the inner sides of the heads of the rails. In the case of a tramway it is the distance between the inside edges of the tread of the rails, *i.e.*, over and including the grooves.

GAUSS: A name given to the absolute electromagnetic unit of magnetic induction in the C.G.S. system.

GENERATOR: Any machine capable of transforming mechanical into electrical energy, e.g., a dynamo or alternator.

GLOW LAMP: A term recommended instead of INCANDESCENT LAMP in order to avoid confusion with the "INCANDESCENT GAS" mantle.

GRAMME CALORIE: See CALORIE.

GREAT CALORIE: See CALORIE.

GRID: In an accumulator. The framework supporting the active material.

GROUND: A term used in America, having practically the same meaning as earth. See EARTH.

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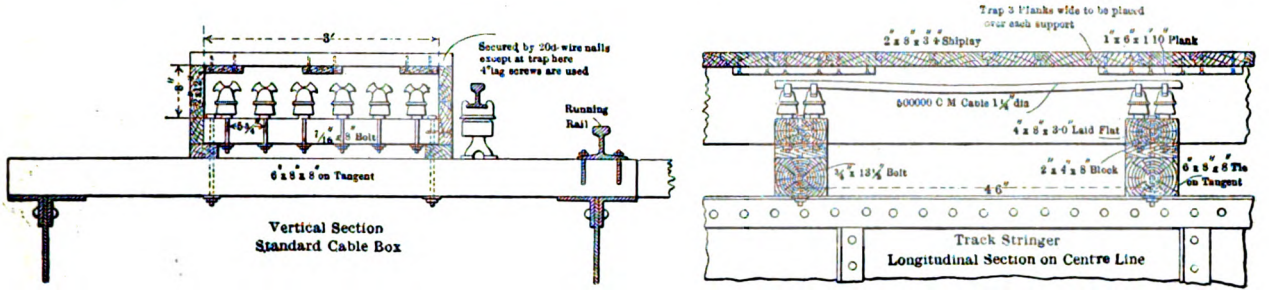
ELEVATED RAILWAY CONSTRUCTION IN AMERICA

Extensions to the Chicago South Side Elevated Railway

A DESCRIPTION was given recently in the *Street Railway Journal* of some extensions to the system of the Chicago South Side Elevated Railroad, including what is known as the Kenwood branch, which was opened last September, and the stockyards extension. The former line is partly earth embankment with retaining walls of a sufficient height to give 12 to 13 ft. clearance under the road bridges, but with a short length of steel structure at one end terminating in an overhead storage yard with a capacity for about 50 cars.

The stockyards branch, on the other hand, is entirely a steel structure. Because of the local difficulties, there are wide variations in the details of the structure, and hardly any two spans are alike. As nearly as possible, however, a standard form of deck plate girder construction was followed. The standard span on tangents is 40 ft., with double-column bents and short spans of 20 ft. over braced towers, put in between every fourth span, of greater dimensions. Each track is carried independently by two longitudinal girders stiffened with diagonal cross-bracing, top and bottom, and cross-frames in the centre of each span. The longitudinal girders are riveted to short cross-girders built on top of each column, and these cross-girders are connected together with angle ties and braces. Fig. 2 shows the details of a typical bent and longitudinal girder. A unique feature of the construction is the method of assembling the longitudinal girders so that they form a continuous bearing for the ties over the cross-girders of the bents. The longitudinal girders are notched out from 6 in. to 7 in. at each end just under the top flange angles, and are stiffened here by short pieces of angle iron riveted under the flange angles. The top flange of the cross-girder fits in this notch, and carries most of the load, a double row of rivets being provided, as usual, to secure the end stiffening angles of the longitudinals to the cross-girders.

Expansion joints are provided at approximately every 200 ft. The details of one of these are shown in Fig. 2. The longitudinal girders rest on brackets attached to the cross-girders, and are confined laterally, but are free to move longitudinally. These brackets are made up of two pieces of 15 in., 45 lb.



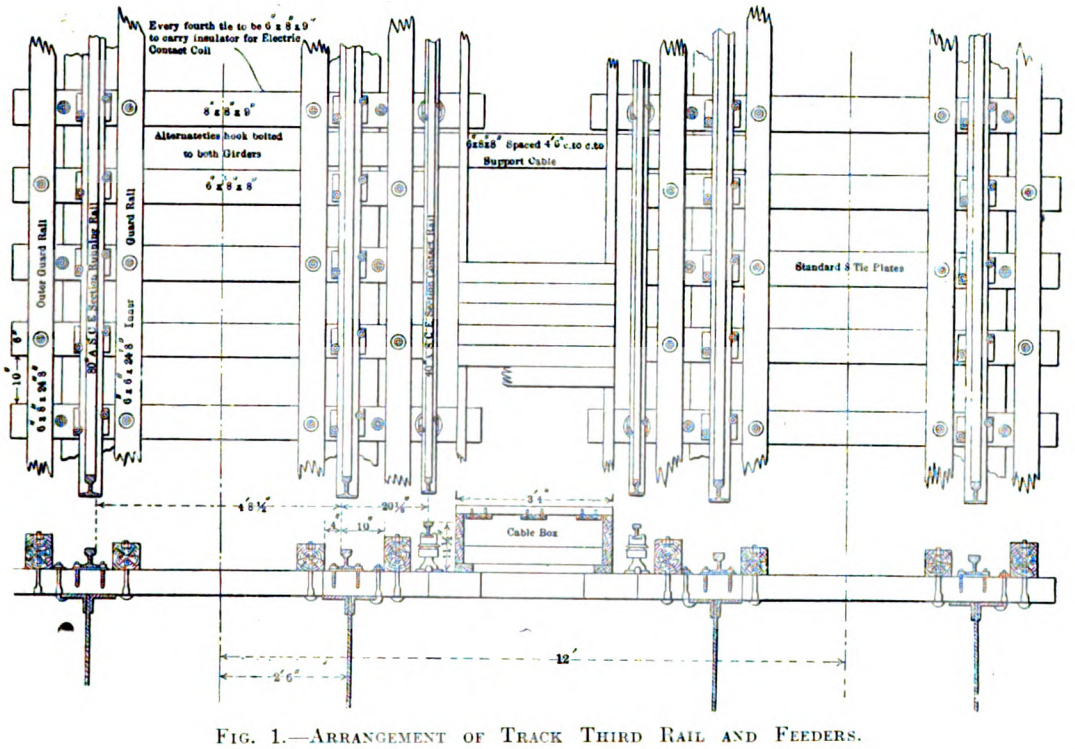


FIG. 1.—ARRANGEMENT OF TRACK THIRD RAIL AND FEEDERS.

The columns of the structure are made up of four Z bars, 3½ in. × 3½ in. × ⅜ in. × 6 in, and one ⅜-in. × 10-in. web-plate. The Z bars are continuous from the base plate up to the top flange of the cross-girder, but the narrow web-plate is carried up only to the springing line of the bracket angles, where it is butt jointed to the web-plate forming the cross-girders. The foundation base consists of a bed-plate, 26 in. × 26 in. × ⅞ in., two side-plates, 18 in. × 26 in. × ⅜ in., and corner angles, 6 in. × 6 in. × ¾ in. The two foundation bolts are carried up through the bed-plate, and are enclosed by crimped plates, ½ in. × 15 in. high, rivetted to the web of the column. The bolt-washers rest on the top edge of these plates.

The foundations for the structure varied according to local conditions, but in general they were built with five steps, the top course being 36in. × 36 in. The steelwork was designed to support on each track trains of cars weighing 80,000 lbs. each, 46 ft. 4 in. long over all, 32 ft. 10 in. long between truck centres, with a truck wheel base of 6 ft. 1 in.

The track is arranged as shown in Fig. 1. The sleepers or

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ties are 6 in. × 8 in. × 8 ft. of sawed yellow pine laid on the top flanges of the longitudinal girders, which are 12½ in. wide. They are spaced 18 ins. apart, and every fourth tie is cut to 9-ft. length to provide support for the third rail insulators. The alternate long and short ties are secured to the girder flanges by ¾-in. × 7¾-in. hook bolts having flats washers and projecting nuts. The outer guard rail is a 6-in. × 8-in. timber cut in lengths of 24 ft. 8 in., and laid on edge 10 in. out from the gauge line of the rail. It is secured by ¾-in. bolts to the alternate ties, which are not hook bolted to the structure. The washers are cupped and counter-sunk. The inner guard rail is a 6-in. × 6-in. timber cut in the same lengths and placed 4 in. inside of the gauge line of the rail. It is bolted to alternate ties, which are hook bolted to the structure. The running rails are 80-lb. American standard section laid to standard 4 ft. 8½ in. gauge on 8 in. tie-plates throughout. They are fastened to the ties with two 5-in. screw-spikes, and are connected by continuous rail-joints.

The third rail on the double-track section, where the feeders are run in a cable box, as shown in Fig. 1, are of 40-lb. American standard section, supported on insulators mounted on every fourth tie, or at 6-ft. intervals. On a single-track loop at stockyards no provision has been made for feeders, and an 80-lb. third rail has been put in. A new form of vitrified clay insulator base has been used on this work instead of an iron base. These are secured to the long ties by four lag screws or wood screws. The third rail is located with its centre line 20⅛ in. out from the gauge line of the adjacent running rail, and with its top 11½ in. above the top of the tie. On double track they are placed inside, next to the cable box.

The cable box, which is covered throughout, forms a convenient and safe runway along the structure between the tracks. It is supported on 6-in. × 8-in. × 8-ft. ties laid across the inside girders between track ties every 4 ft. 6 in. The sides are 2-in. × 12-in. planks, and the top is made of 2-in. × 8-in. × 3-ft. 4-in. ship lap planks; the under side is open. On each cross-tie support are 2-in. × 4-in. × 8-in. blocks, which raise the cable insulator beams up from the cross-ties. These beams are 4 in. × 8 in., and carry 11 insulators in two rows staggered at intervals of 5¾ in. The insulators are designed to carry each a 500,000-circ. mil cable, 1¼ in. in diameter. Over each cable support is a trap door in the top planking consisting of three planks secured with 1-in. × 6-in. battens, which is fastened down with lag screws. This can be quickly removed for inspection, repairs, or when new cable is to be strung.

On curves the superstructure, as described above, varies somewhat. The outer running rail is elevated by bevelled shims cut in four sizes according to the radius of the curve where used. For curves over 700-ft. radius, the elevation is ⅞ in.

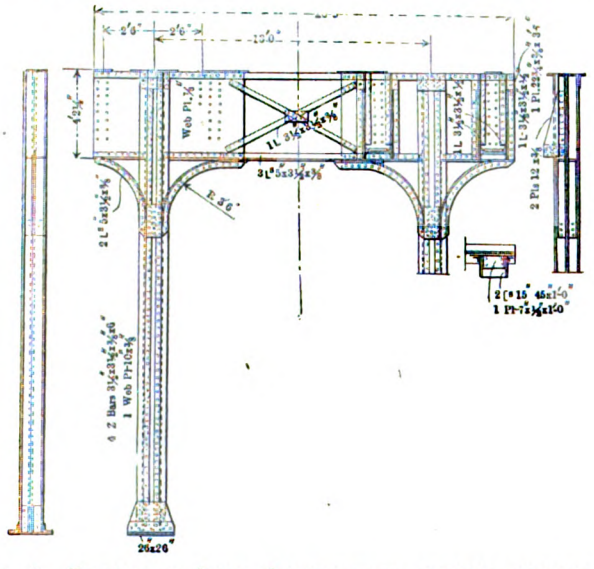

FIG. 2.—DETAILS OF STEEL CONSTRUCTION SHOWING EXPANSION JOINT.

between 500 and 700 ft., 1⅞ in. between 300 ft. and 500 ft., 3 in. and less than 300 ft. 4½ in. Extra steel guard rails are used on the inside of all curves. All special work is of a heavy pattern, and switch-points are protected by a safety guard rail. Rail braces are used on the sharpest curves. The sharpest curve on the double-track section is 150 ft. radius, but on the single-track loop the turns are made with a 109-ft. radius.

The 80-lb. third rail, which is being laid on the loop, is cut to 33-ft. lengths, and is spliced with malleable iron fish-plates, having four bolt holes. Each joint is bonded with two 500,000 circ. mil Crown bonds 15 in. long, which are pin-driven in the webs. The 40-lb. third rail used on the remainder of the line is cut to 30-ft. lengths, and is spliced with rolled fish-

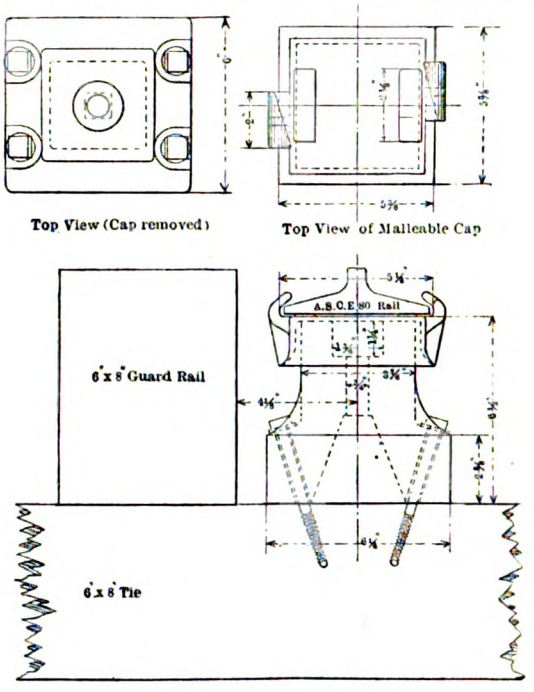

FIG. 3.—DETAILS OF THIRD RAIL INSULATOR.

plates. Two compressed terminal No. 0000 bonds from 2½ in. to 4 in. long are put in the webs at each joint. The track rails are bonded with No. 0000 compressed terminal bonds under the continuous joints.

The power-house is at Fortieth and State Streets, and the distribution of current is accomplished with only small transmission loss. One 1,500,000 circ. mil aluminium feeder cable has been laid from the power-house to the stockyards loop, and in addition one 1,000,000 circ. mil cable has been laid as far as the Union Avenue yard. Third-rail feeders are tapped into these cables about 1,800 ft. apart. The elevated structure has been carefully bonded for return current, and each of the track rails is bonded to the structure at intervals of about 400 ft. These bonds to the structure are staggered, so that with the four rails there is a bond about every 100 ft. No cross-bonding between rails has been put in. All bonds of every kind when applied have been coated with plastic amalgam.

City of London Engineer's Report.—In his annual report, the City Engineer (Mr. F. Sumner) states that the lighting of most of the main thoroughfares of the City by arc lamps was continued throughout 1907. The number of the older type electric lamps in use at the end of the year, at a cost of £26 each, was 400, a decrease of 39 being mainly accounted for by the substitution of new and cheaper flame arcs. The lamps were lighted on nine days during the year when fog or unusual darkness occurred, and the total additional cost was £43 12s. 11d. The number of defective electric lamps observed during the year was 99. Particulars with regard to the City subways show that the City of London Electric Light Co. has mains measuring 1 mile 1,481 yards, and the Charing Cross, West End & City Electricity Supply Co. 1 mile 1,721 yards in the subways, which also contain G.P.O. telegraph and telephone cables measuring 2 miles 1,145 yards, and a number of the department's pneumatic tubes. On the question of overhead wires, the City Engineer expresses the opinion that the Corporation, in its next General Powers Bill, should insert a clause making it obligatory upon persons who require to erect wires to give prior notice of their intention so to do, and at the same time submit proper plans. At present, he points out, any persons can fix wires (provided they comply with the Act) so long as they notify the Corporation within one month of their having done so. As a result, hundreds of wires have been erected in the City without any notice at all having been given, and it is only due to very careful supervision that new lines are detected. The overhead wires in the City continue to increase. During the year the number of private owners of lines was 133, and of companies 22. Both added considerably to their number during the twelve months, and the total stands at about 733,200 spans crossing public thoroughfares, compared with 731,500 in 1906, and 260,000 in 1899.

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ELECTROMETALLURGY AND ELECTROCHEMISTRY

ACCORDING to T. Geilenkirchen in *Stahl und Eisen* (1908), **28**, 873, one of the most remarkable features of the Héroult process is the way in which sulphur can be eliminated from the charge. Tests of the product made from 1,000 successive charges in a Héroult furnace showed that the content of sulphur varied from 0·001 to 0·036 per cent. Of these tests 743 showed a percentage below 0·01 and 958, a percentage below 0·015. The author considers that two causes at least contribute to this elimination; firstly, manganese and iron sulphides are both of them soluble in the metal and in the slag, they therefore distribute themselves in furnaces between the metal and the slag, and when equilibrium is reached the final proportions depend upon their relative solubilities. Now at the higher temperature of the Héroult furnace the solubility of these sulphides in the slag is increased to a much greater extent than their solubility in the metal. In the second place, and this he considers is the more important, there is the powerful reducing action of the calcium carbide produced in the furnace. In the first place this effects the reduction of metallic oxides contained in the slag, the reduced metal being returned to the bath. The reduction of the sulphides by conversion into calcium sulphide is shown by the following equation :—

$$2CaO+3FeS+CaC_2=2CO+3CaS+3Fe;$$

The sulphide equilibrium is thus disturbed, consequently more sulphide enters into the slag from the bath, and this goes on progressively until finally almost complete desulphurisation is effected. From this it follows that a carefully worked charge from the higher furnace will never retain any appreciable proportion of sulphur, however high the original sulphur content may have been. Furthermore, the desulphurising action progresses independently of, and without altering, the proportions of the other constituents contained in the iron. For example, Thomas steel, when poured into the electric furnace to be finished, undergoes no change in its composition except that entailed in the removal of the sulphur; or if the foundry iron of low content in carbon, manganese, and silicon is being dealt with, and such an iron can hardly be obtained without having an excessive amount of sulphur, the Héroult furnace is *par excellence*, the furnace for refining inferior iron of this nature, independently of the amount of sulphur it may contain.

In the *Journal du Four Electrique et de l'Electrolyse* of July 15th, there is an interesting article upon the starting of the 750 kilowatt Keller electric furnaces at Unieux. The furnaces are capable of casting 8,000 kilograms of steel. The group of 750 kilowatt furnaces are run by a Westinghouse alternator which is worked by a steam compound engine of the Dujardin type, the boiler being on the Belleville system. The furnaces are placed near the Martin steel furnaces, so that the steel can readily be transferred from there to the electric furnaces. The Keller furnace is of the electrode type, the current passing from one electrode to the other. Each pole is composed of two electrodes in parallel, consequently there are four electrodes to each furnace, and the heating hearth is made to correspond with each of the four electrodes. Every electrode is worked by separate hydraulic machinery, so that the position of any one of them can be altered at will without effecting the others. The chief difference in the arrangement of the electrodes in the Keller furnace to that of the Héroult is that the electrodes do not dip into the slag, the arc striking above the molten mass, whereas with the Héroult they are beneath it. In order to regulate the tension, the electrodes of the same pole are simultaneously lowered. If there is any inequality between the tension of the opposite electrodes they can be independently moved, and the movement of the electrodes as they are all separate, is a very easy operation. The current intensity between the poles is also regulated by separately moving the electrodes. The current enters the furnace at the top of the electrodes, and is brought in by means of copper leads. The poles are so arranged in the four circuits so as to give the minimum of induction. The steel is produced in the Martin furnaces, and from there is poured directly into the electric furnace. The liquid steel is then refined, the time necessary for refining varying with the quality of the original steel, and also of the steel to be produced. At the end of the operation, the quantity of phosphorus+sulphur is less than 0·01 per cent. The installation at Unieux was started on April 22nd of this year, and the works have a capacity of 10 tons. Only four men are required to work a plant capable of producing 8 tons, so that the operating costs are light. At Unieux, 50,000 tons of fuel are employed to produce 6,500 tons of steel. About 10 tons of fuel are required to produce 1 ton of steel; this includes the amount required to raise steam and for the furnace operations. The article is illustrated with blocks showing the furnace in operation, and also with a general view of the works.

ELECTRICAL SCIENCE

British and American

Resistance of Silicon at Various Temperatures.—The results of an investigation of the effect of temperature upon the resistance of metallic silicon through a range of 600 degrees are given by F. G. Wick in the *Physical Review* for July. The material was in the form of rods about 3 millimetres diameter, and of various lengths from 3 to 27 cm. long. The rods were connected into an electrical circuit by means of iron wires fused into the ends of the rods by the oxy-hydrogen flame. On each rod, in turn, near either end, two independent copper-constantan thermo-junctions were bound, and the rod was passed into a porcelain tube heated by iron wire wound evenly over it. The position of the rod in the tube was adjusted so that the thermo-junctions showed the same temperature, and the resistance of the silicon was then measured by comparing the voltage drop between its ends with the drop between the terminals of a known resistance in series with the silicon. For temperatures below zero, the rod with its connections, was immersed in carbon dioxide and ether, and finally in liquid air. The experiments were carried out on four different silicon rods. The results show a lack of uniformity in the resistance of the different specimens, and also in the effect of temperature on resistance. This appears to indicate that the electrical properties of metallic silicon are very sensitive to changes in purity, physical constitution, crystalline structure, and, perhaps, other conditions. The average value of the specific resistance is $58,000\times10^{-6}$ ohm. per centimetre cube. The resistance temperature-coefficient was in all specimens negative from $-200°$ to $+200°$ C., but above the latter temperature was negative for some specimens and positive for others. The author has examined into the possibility of utilising silicon as an agent for electrical heating, but the extreme brittleness of the substance has prevented success in this application.

Continental

Thermoelectric Detectors.—In connection with Tissot's recent descriptions of "thermoelectric" detectors, E. Branly points out, in the *Comptes Rendus* for July 13th, that for years before Tissot he used combinations containing tellurium as detectors in wireless telegraphy. Such combinations included tellurium-steel, tellurium-silver, tellurium-gold, and a combination of tellurium with mercury and steel. The more usual arrangement was a tripod of tellurium or some telluride on a polished steel plate or disc. The circuit consisted of a telephone, a cell giving 0·1 volt, and the tripod and disc. That the effect is not thermoelectric was proved by the fact that the tripod may also be provided with steel feet without losing its efficacy, but tellurium is both more sensitive and more regular in its action. Comparing such detectors with the electrolytic type, Branly remarks that though the latter are the more sensitive, he prefers the tellurium detector for use in the laboratory. The first employment of tellurium for wireless purposes dates back to 1891, when Branly used selenium and tellurium filings for his coherer or "radio-conductor."

Wireless Telemechanics.—Telemechanics, or the control of mechanism at a distance without ordinary methods of transmission, is still in a very undeveloped stage, chiefly owing to the danger of the mechanism getting started or stopped accidentally by some disturbing impulse. Edouard Branly has been working for some years at perfecting the methods. Some time ago he described a method of guarding the telemechanism against accidental spark-waves. But since the advent of commercial wireless telegraphy, the real danger has lain in the interference by wave-trains of considerable duration. In the *Comptes Rendus* for July 20th, Branly describes an apparatus designed to obviate this danger also. The control is divided into five recurrent periods, to each of which is assigned a separate function. Unless each function is carried out in the succession appointed, the mechanism stops. The periods are governed by the motion of a rod having three soft iron sections, which are sucked into three different solenoids. The first period is used for starting, but if the start is false (of which a bell warns the operator automatically), the second period may be used for stopping. Otherwise, it is left unused.

Electric Double Refraction in Nitrobenzene.—A. Cotton and H. Mouton describe some further remarkable optical properties of nitrobenzene, shown when immersed in an electric or magnetic field. The particulars are given in the *Comptes Rendus* for July 20th. The difference in the refractive indices for the ordinary and extraordinary rays varies in a magnetic field in

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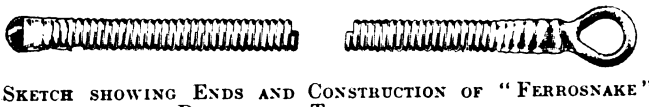
the same sense as it does in quartz, but more rapidly. The variation is quite regular throughout the visible spectrum. The electric double refraction is very great, and the authors go so far as to say that it is 97 times as great as it is in carbon bisulphide. As regards the visible spectrum, the dispersion of the magnetic double refraction is the same as the electric double refraction. The authors go on to consider the bearing of these observations on the theory of the Faraday and Kerr effects, and conclude that we have to do with a true orientation of the molecules of the liquid themselves. The effects are of the same kind in other bodies belonging to the aromatic series, but not nearly so large.

A NEW DRAWING IN "TAPE"

THE Armorduct Manufacturing Co., Ltd., have just introduced a new appliance which should prove of great use to wiring contractors in the shape of an improved form of draw in "tape" for drawing in conductors into conduit tubes. The apparatus has been given the name of the "Ferrosnake," and is constructed in an entirely novel way. Difficulties are frequently experienced in the drawing-in of electrical conductors, by reason of the sticking of the draw-in tape employed. To meet this difficulty the "Watch" tape replaced the drawing-in wire, but the ordinary "Watch" tape is exceedingly brittle and liable to kink, is expensive and mechanically weak. It was to meet these objections that the present appliance was



SKETCH SHOWING ENDS AND CONSTRUCTION OF "FERROSNAKE" DRAWING IN TAPE, FULL SIZE.

designed. The general appearance of the "Ferrosnake" is seen in the accompanying illustration, which shows the ends full size and to scale. Galvanised steel wire is used for its construction formed into a tight coiled spring, which is of enormous strength, while it can be bent in all directions like a flexible shaft. Its nature is, however, such that it cannot possibly kink, tear, stick, twist, or knot while being pushed through a tube, and an important feature is that if it meets a projection in the conduit or conduit fittings, a slight twist at its extreme end will spring it free. The diameter is about 5/32 inch, and it is supplied in three lengths, 35, 70, and 100 ft.

Proposed London Central Council.—Among the objects of a proposed new central council for London, the creation of which will be urged upon the Prime Minister after the reassembling of Parliament in October, is an arrangement whereby all electrical and similar undertakings shall fall ultimately into its possession. The idea is said to be to make the present County of London one borough with a municipal council of 250 members, presided over by a Lord Mayor.

Tramway Accidents.—On Thursday a car belonging to the Stalybridge, Hyde, Mossley, and Dukinfield Joint Tramways Board jumped the points at Stanley Square, Stalybridge, and crashed into a surgery, knocking down the front part of the entrance. The damage to the car was not serious, and none of the passengers were hurt.

A double-deck tramcar on the Mexbrough and Swinton system got out of control of the driver on Thursday when near Rawmarsh. The car ran away on Warren Hill, leaving the rails at the bottom, breaking through a wall, and dropping into a garden about 10 ft. below. There were about 60 miners on the car, but the most serious injury was a broken collar bone. This particular system is at present being converted from the surface contact to the overhead trolley system, but the conversion has not reached the point where the accident took place.

The British Association.—Arrangements are well advanced for the holding of the 78th annual meeting of the British Association in Dublin from September 2nd to September 9th next, under the presidency of Prof. Francis Darwin, F.R.S. We give below the officials of Sections A and G in the proceedings, of which most of the electrical interest is concentrated. Section A.—*Mathematical and Physical Science:* President—Dr. W. N. Shaw, F.R.S.; Vice-Presidents—Prof. A. E. H. Love, F.R.S.; Right Hon. the Earl of Berkeley, F.R.S., Mr. F. Purser, Prof. W. S. Burnside, Prof. H. H. Turner, F.R.S., and Prof. W. F. Barrett, F.R.S. Secretaries—Prof. A. W. Porter (Recorder); Prof. E. T. Whittaker, F.R.S., Mr. W. Geoffrey Duffield, Dr. L. N. G. Filson, Mr. E. Gold, Prof. J. A. M'Clelland. Section G.—*Engineering:* President—Mr. Dugald Clerk, F.R.S., M.Inst.C.E.; Vice-Presidents—Prof. Silvanus P. Thompson, F.R.S., Sir Howard Grubb, F.R.S., Sir Charles Douglas Fox; Secretaries—Mr. W. A. Price (Recorder), Prof. E. G. Coker, Mr. H. E. Wimperis, B.A., Prof. W. E. Lilly.

CATALOGUES AND PAMPHLETS RECEIVED

ELECTROLYTIC VALVE APPARATUS.—Messrs. Siemens Brothers & Co., Ltd., have issued a supplement to their catalogue of electromedical apparatus. This supplement describes the Siemens patent electrolytic valve apparatus for rectifying alternating current, and outfits are listed and illustrated for its application to X-ray and high-frequency work, charging of accumulators, electro-plating baths, and mercury vapour lamps. The reliability of the apparatus is safeguarded by the employment of a patent testing switch by means of which the condition of the valve apparatus may be determined at any time. The apparatus should be found useful by those who, up to the present, have been precluded from employing in an efficient manner processes requiring continuous current owing to their electric supply being an alternating one. The coils included in the X-ray outfits are specially constructed for use with the Wenhelt interrupter, and a high degree of efficiency is claimed for the combination.

CABLES AND WIRES.—Messrs. Johnson & Phillips, Ltd., of Charlton, have issued a new edition of their catalogue of "Vulcanised Indiarubber-Covered Cables and Wires." This is very complete and well-arranged, and contains particulars of a large number of varieties of material, both in accordance with the standards of the Cable Makers' Association and of "non-associated grades," including also Paterson's fireproof cables.

SPECIAL CASTINGS.—We have received a booklet, written by Mr. Charles Barker, describing the Borshardt casting process, which we understand is in extensive use in France for producing a metal of great homogeneity and thoroughly malleable, without any process subsequent to the actual casting. The main features of the process are: The adoption of a special furnace, which is patented, producing an excessive heat, of a uniform temperature of about 2.000° throughout, the introduction during the fusion of the metal of chemical products into the metallic mass in order to refine it and give the necessary qualities to the metal, and the use of a special coating in order to reduce in a considerable manner the wear and tear of the melting pots or crucibles, and to keep up and preserve the interior sides of the furnace, which reduces the current repairs to a low basis, and thereby procuring a low cost of production.

GAS ENGINES.—A new gas engine and suction plant catalogue has been issued by Messrs. Kynoch, Ltd., of Birmingham. Particular attention has been paid in the design of the Kynoch gas engines to points enabling very steady running to be obtained, and in the larger engines, cylinders of excessive size with their attendant disadvantages are avoided by a tandem arrangement. In engines from 80 h.p. upwards the pistons are cooled by a "trombone" device, and the exhaust valves are water cooled on the pump system. Particulars and illustrations of engines from 5 to 580 B.H.P. are given, all of the horizontal type, with brief descriptive particulars of the Kynoch suction gas plant, followed by abridged specifications. The usefulness of the catalogue is enhanced by full tables of shipping weights and measurements.

Erratum.—By a clerical error on page 176 of our last issue we referred to Mr. R. Borlase Matthews as Chairman to the proposed electrical league instead of Honorary Secretary.

Commutating Poles for Continuous-Current Traction Motors.—In general the application of commutating poles to small traction motors of from 30 to 35 h.p., as used on the ordinary 500- to 600-volt tramway systems offers no particular advantages. In certain cases, however, where wide variations in speed are required, the use of commutating pole motors with speed control by varying the main field may be advisable. An article in *Elektrische Kraftbetriebe und Bahnen* describes some experiments made on the tramway line between Mainz and Wiesbaden with two cars of exactly the same pattern with the exception that the motors of one car were fitted with commutating poles. About four miles of the line between Mainz and Wiesbaden is on a private way, and on this portion of the line the speed of the cars could be increased with advantage to over 30 miles per hour. The same cars must be capable of running economically at the slow speed usual in towns. Experiments proved that whereas the speed of the car equipped with commutating pole motors could be economically varied by field regulation (and, of course, series parallel working) between the limits of 31 and 13 miles per hour, the limits in the case of the other car were 31 and 18 miles per hour. This latter speed would be too high for ordinary road use. The experiments also showed that the alteration from series to parallel running could be performed easier in the case of the former car. The bow could be withdrawn from the line and the rheostatic brakes applied without injurious sparking occurring at the commutators of the commutating pole motors when running at the maximum speed of 31 miles per hour.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published July 30th, 1908

A full list of these was published in our last issue. The following are abstracts of the more important specifications.

1907 Patents

16,431. **The "Stearn" Multiple Metal-Filament Lamp.** C. H. Stearn and C. F. Topham. This lamp, which was described and illustrated in Electrical Engineering, Vol. III., page 651, consists of a number of lamp units, each of which is a single loop lamp. A number of these lamp units are arranged in series on a common base, and arrangements are made so that should one filament burn out, a carbon or other resistance is put in as a shunt across the burnt-out filament, thus keeping the lamp, as a whole, alight and permitting the ready detection and replacement of burnt-out lamp unit. Instead of substituting a resistance for a burnt-out unit another lamp, normally short-circuited, may be put in circuit and the burnt-out unit short-circuited. Four claims, seven figures.

17,815. **Joints between Metal Filaments and Leading-in Wires.** A. C. Hyde. The leading-in wires of electric lamps may be of copper, iron, nickel, or platinum. To produce a conducting joint between the leading-in wire and the tungsten or other filament, the filament is first secured to the wire with a paste made from a metallic powder and a gelatinous metallic oxide. Copper, tungsten, or nickel powder may be used with a precipitated oxide of either copper or nickel. To reduce the paste and sinter the joint together the leading-in wire is connected to one terminal of the secondary of a 1,000-volt transformer. An electrode connected to the other terminal is brought near the joint. The arc formed reduces the oxide and a good metallic joint is obtained. The operation must be performed in an atmosphere of hydrogen. A jet of hydrogen may be used instead of the arc. Two claims, one figure.

1908 Patents

10,121. **Speed Regulation of Single-phase Commutator Motors.** Allgemeine Elektricitäts Gesellschaft. This invention relates to the speed regulation of that type of single-phase motor in which the working winding, which is supplied direct from the secondary of the main transformer, is in series with the auto-transformer which feeds the exciting winding. In this method of control the secondary of the main transformer and the primary of the exciter transformer are so interconnected that the number of turns in the primary winding of the exciter transformer is decreased and the transformer ratio thus increased at the same time as the potential of the secondary of the main transformer is lowered. Thus at speeds higher than the synchronous speeds it is possible to lower the impressed motor voltage, and thus reduce the core loss and improve the commutation. Two claims, one figure.

11,534. **Manufacture of Metal Filaments.** Siemens & Halske Aktiengesellschaft. A process for removing from metal filaments the carbon which remains from the binding agent. The filament to be treated is connected with a source of supply and placed in the receiver of an air-pump, which also contains a dish holding glacial acetic acid. After a sufficient vacuum has been produced, the glacial acetic acid evaporates, and if now the filament is caused to glow the carbon is rapidly removed. Two claims.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of the more important of these patents will appear in our next issue.

1907 Patents

11,070, British Thomson-Houston Co. (*Allegemeine Elektricitats Ges.*). Motor-controlling switchgear.
15,834, La Cour. Starting and controlling induction motors on a single-phase supply.
16,252, Rojcsik. Means for electrically operating tramway points.
16,372, McPhail. Insulation of cables, generators, or motors.
16,461, Varley. Make and break contacts.
16,503, Deutsche Gasgluhlicht Akt.-Ges. Method of attaching tungsten filaments in glow lamps.
16,600, Schreiber. Electrically-propelled vehicle.
17,584, Harding. Switches for electric bells.
18,022, British Thomson-Houston Co. (*General Electric Co.*). Controlling devices for electric circuits.
15,753, Cole. Means for working electric signs.
18,762, Mackenzie. Indicating and recording apparatus.
19,113, Pendlebury, Pendlebury, & Pendlebury. Conduits for electric wiring.
20,619, Escaré & Damey. Lamp holder.
21,174, Siemens Bros. Dynamo Works, Ltd. (*Siemens-Schuckertwerke Ges.*). Switches, relays, and measuring instruments.
21,699, Denieport. Magnetos for explosion engines.
23,043, Timar & Von Dreger. Arc lamps.
23,322, Boucher & Mitchell. Electric switches.
23,880, Felten & Guilleaume Lahmeyerwerke Akt.-Ges. Means for generating direct current.
24,231, British Thomson-Houston Co. (*General Electric Co.*). Systems of electric distribution.
24,387, Russell & Milligan. Apparatus for recording signals in mines.
26,144, Eastwood. Lifting magnets.
26,404, Siemens Bros. Dynamo Works, Ltd. (*Siemens Schuckertwerke Ges.*). Speed-controlling apparatus for electric motors.
26,797, Siemens Bros. Dynamo Works, Ltd., & Bolton. Starting switch sets for polyphase motors.
27,764, Gibbons. Helm signal telemotor apparatus.

1908 Patents

877, Siemens Bros. Dynamo Works, Ltd., & Clift. Automatic stopping devices for electric lifts or hoists.
1,799, Bassano. Means for controlling the electric motors of gramophones.
2,340, Malley. Vulcanising apparatus.
2,404, Le Pontois. Magneto generators.
3,159, Frey. Link-suspension device for incandescent bodies.
5,950, Barton & Sons, Ltd., Barton, & Harper. Means of coupling electrical conduits.
6,051, Siemens & Halske Akt.-Ges. Process for hardening tantalum.
6,229, Digby. Arc lamps for theatre stages.
6,453, Jirotka. Production of ozone.
7,107, Eisemann. Sparking plugs.
7,494, Fessenden. Wireless signalling.
8,471, Verity's, Ltd., & Smith. Electric heating apparatus.
8,769, Blum. Sparking-plug.
9,289, Aron. Multiple tariff electricity meters.
11,134, Steckel & Thomson. Electrical induction clutches.

Complete Specifications open to Public Inspection before Acceptance.

1908 Patents

4,030, Tidnam. Telegraph pole.
9,638, Siemens-Schuckertwerke Ges. Three-phase commutator machines.
12,682. Allgemeine Elektricitäts-Ges. Arc lamps.
12,720, Soc. Française d'Incandescence par la Gaz (*Système* Auer). Manufacture of incandescent electric lamp filaments.
13,134, Usine Genevoise de Degrossissage D'Or. Electrolytic cells for separating metals or alloys.
13,772, Bénard. Electrically-controlled valve for gas.
14,610, Berlinger. Portable vulcanisers.
14,850, E. Goosens Pope & Co. Manufacture of plastic masses of oxide of tungsten.
14,897, Breslauer. Method of compounding alternating-current generators.

Application for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of July 29th, 1908.

24,572 of 1904. De Dion Bouton (1907), Ltd., seek leave to amend the specification numbered as above, granted to Albert de Dion and G. Bouton, for "Electric igniters for internal combustion engines," for the purpose of more clearly defining the invention.

Expiring Patents

The following patents expire during the current week, after a life of fourteen years :—

15,129 of August 8th, 1894. **Evacuation of Lamp Bulbs.** A. Malignani. A process for producing a vacuum in lamp bulbs and consisting in first producing a 2 mm. vacuum by means of a vacuum pump, after which the filament is raised to incandescence. The gases given off by the filament are caused to unite with other gases produced by warming sulphur, or arsenic previously introduced into an extension of the bulb. A solid or liquid precipitate is formed in the extension.

15,276 of August 10th, 1894. **Electrolytic Cells.** M. Kiliani, W. Rathenau, and the Elektrochemische Werke Ges. An acid- and alkali-proof diaphragm vessel consisting of a permeable membrane held between latticework frames made of acid-proof material.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	—	10½—11	
Do. 4½% Cum. Pref.	10	4½	4½%*	9⅝—10⅜	
Do. 6% Cum. Second Pref.	10	6	6%*	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%*	100—103	
Bromley (Kent) E.L.& Power Co.,Ltd.	5	5⅛	—	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%*	94—97	
Brompton & Kensington E. S. Co.,Ld.	5	10	—	7—8	
Do. 7% Cum. Pref.	5	7	7%*	6⅞—7⅜	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%*	98—101	
Ch. Cross. W. E. & City E. S. Co.	5	5	—	3½—4	−¼
Do. 4½% Cum. Pref.	5	4½	4½%*	4—4½	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%*	3⅝—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	—	3—3⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	5/-*	9½—10½ xd	-¼
Do. 6% Cum. Pref.	10	6	6%*	12—13 xd	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%*	3⅜—4¼	
County of London Elect. Sup. Co. Ltd.	10	5	—	7¼—8¼ xd	-¼
Do. 6% Cum. Pref.	10	6	6%*	10½—10⅞ xd	-¼
Do. 4½% Deb. Red	Stock	4½	4½%*	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%*	98—101	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%*	60—67	-1
Folkestone Elec. Supply Co., Ltd.	5	5¼	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%*	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%*	96—99 xd	-2
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6⅛	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%*	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	—	8—9	
Do. 4% Deb. Red	Stock	4	4%*	94—97 xd	-2
Kens. & N'tng Hill E.L. Cos. Db.Rd.	Stock	4	4%*	97—101	
London Electric Supply Corporation	3	2½	2/6	¾—1⅛	
Do. 6% Pref.	5	6	6*	4½—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	88—92	
Metropolitan Elec. Supply Co., Ltd.	5	6⅝	—	4½—5 xd	-⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—4⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%*	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%*	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	5	2/6*	5¼—5⅛	-⅛
Do. £2 Paid	5	8	4·85d.*	2¼—2⅜	
Do. 5% Pref. (fully paid)	5	5	2/6*	⅝—¾	
Do. £2 Paid	5	5	4·85d.*	2⅛—2⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	12—13	
Oxford Electric Co., Ltd.	5	7	—	5⅜—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld	5	10	5/-	7¼—8¼ xd	-¼
Do. 7% Non-Cum. Pref.	5	7	7%	6⅞—7¼ xd	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%*	68—72 xd	-2
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅞	
Do. 7% Cum. Pref.	1	7	—	1—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%*	100—103	+1
Urban Elec. Supply Co., Ltd.	5	5	—	½—1½	
Do. 5% Cum. Pref.	5	5	5%*	1⅜—2⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%*	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5/-	7½—8½ xd	-¼
Do. 4½% Cum. Pref.	5	4½	4½%*	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%*	90—92	
Central London	Stock	3	3%*	69—71	
Do. 4% Preferred	Stock	4	4%*	87—89	
Do. Deferred	Stock	2	—	53—56	
Do. 4% Debentures	Stock	4	4%*	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%*	81—84	
City and South London Cons.	Stock	4½	—	32½—33½ xd	-1
Do. 4% Perp. Deb.	Stock	4	4%*	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114 xd	-2
Do. 5% Perp. Pref. 1895	Stock	5	—	109—112 xd	-3
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110 xd	-3
Great Northern & City Pref. "A"	10	11½d.	—	⅜—1¼	
Gt. Northern, Piccadilly & Brompton	10	4	—	7¼—7⅝	
Do. 4% Perp. Deb.	Stock	4	4%*	90—92	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	4	—	36½—37½	+1½
Do. 3½% Preference	Stock	3½	—	86—89	
Do. 3½% "A" Pref.	Stock	3½	—	76—79	
Do. 3½% Convertible Pref.	Stock	3½	—	73—76	
Metropolitan District	Stock	—	—	11½—12½	+½
Do. 6% Perp. Deb.	Stock	6	6%*	115—120	
Do. 4% Deb.	Stock	4	4%*	71—75	
Do. Perp. Extension Pref. (5%)	Stock	—	—	21—26	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	45—49 xd	-1
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	—	39—43	-1
Whitechapel and Bow 4% Deb.	Stock	4	4%*	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	—	86—91	+1
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅝—1⅞	
Do. 6% Cum. Pref.	10	6	—	4¼—4⅜	
Do. 5% Perp. Deb.	Stock	5	5%*	95—98	
Do. 4½% 2nd Deb.	Stock	4½	4½%*	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%*	97—100	

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	6/-	12—13 xd	-¼
Do. 6% Pref.	10	6	6/-	12¼—13¼ xd	-¼
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%*	3¼—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%*	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%*	91—93	
London Street Tramways Co.	4	4/6	2/-	⅞—1¼ xd	-⅛
London United Trs., Ld., Cm. Pf.	10	5	—	6½—7¼	-¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%*	79—84	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%*	1¼—1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%*	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	80—92	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅝	
Do. 5% Cum. Pref.	1	5	—	⅝—¾	
Do. 4½% Deb. Red	Stock	4½	4½%*	93—96	
Provincial Tramways Co. Ltd.	10	4	3/-*	4⅜—5⅛	
Do. 6% Cum. Pref.	10	6	6%*	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	7½d	¾—1 xd	
Do. 4% Deb. Red.	Stock	4	4%*	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%*	75—80	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	3¼—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%*	83—86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	15/-*	56—59 xd	-1
Do. 6% Pref. Crd.	Stock	6	30/-*	102—103½ xd	-½
Do. Def. Ord.	Stock	1	—	15¼—15½	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%*	83—86	
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3¼	
Do. 10% Cum. Pref.	5	10	10%*	8—9	
Do. 4½% Debs.	50	4½	4½%*	100—103	
Direct United States Cable Co. Ltd.	20	4¼	4/-*	13¼—13⅝	-¼
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%*	98—100	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	—	100—102	
Do. do. (Mauritius Sub.)	25	4	—	100—102	
Eastern Ext. Australasia & China	10	7	2/6*	12½—13	-⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%*	99⅜—101¼ xd	-1½
Eastern Telegraph Co.	Stock	7	14%*	133—136	+1
Do. 3½% Pref.	Stock	3½	3½%*	83½—85½	
Do. 4% Mort. Deb.	Stock	4	4%*	101—103	
G. N. Tel. Co. (Copenhagen)	10	20	5/-*	27—29	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%*	106—108 xd	-3
Do. Deferred	Stock	6	6%*	115—117 xd	-2½
Do. 6% Cum. 1st Pref.	10	6	6%*	10—12 xd	-½
Do. 6% Cum. 2nd Pref.	10	6	6%*	9½—11½ xd	-½
Do. 5% 3rd Pref.	5	5	2/6	5⅜—5⅞ xd	-⅛
Do. 3½% Deb. Red	Stock	3½	3½%*	98—100	+½
Do. 4% Deb. Red.	Stock	4	4%*	102—104	+1½
Western Telegraph Co., Ltd.	10	7	3/-*	13⅜—14½	+⅛
Do. 4% Deb.	Stock	4	4%*	99½—101½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	-1/16
Do. 6% Cum. Pref.	1	1 2½d.	1/4½d.	1⅛—1⅜	-3/16
Babcock & Wilcox, Ord.	1	20	—	3¼—3⅜	
Do. 6% Pref.	1	6	—	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	3/-	6¼—6⅝	
Do. 6% Cum. Pref.	5	6	—	6—6½ xd	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%*	102—105	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%*	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	1⅞—1⅛	
Do. 4% Mort. Deb. Red.	Stock	4	4%*	43—48	
Brush Electrical Engineering Co.	2	—	—	0—½	
Do. 6% Pref.	2	—	—	⅞—1⅛	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%*	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%*	53—58	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10½	
Do. 5% Cum. Pref.	5	5	5%*	5⅛—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%*	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—⅝	
Crompton & Co., Ltd.	3	5	3/-	1½—1¾ xd	-⅛
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%*	90—93	
Dick, Kerr & Co., Ltd.	1	10	—	1⅛—1⅜	
Do. 6% Cum. Pref.	1	6	6%*	1—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½%*	99—102	
Edison & Swan United "A." £3 paid	5	2/6	—	½—¾	
Do. do. (fully paid)	5	4/2	—	1⅛—1⅞ xd	⅛
Do. 4% Deb. Red.	Stock	4	4%*	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%*	85—87	
Electric Construction Co., Ltd.	2	—	—	¼—⅜	
Do. 7% Cum. Pref.	2	—	2/9⅔	1⅜—1½ xd	-⅛
Do. 4% 1st Mort. Deb.	Stock	4	4%*	66—71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7⅛—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%*	84—87	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	—	10¾—11½	
Do. 4½% Cum. Pref.	5	4½	4½%*	5—5½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%*	106—108	
I. R. & G. P. Co., Ltd.	10	10	5/-*	15½—16½	
Do. 4% Deb. Red.	100	4	4%*	98—100	
Tel. Const. & Maintenance Co.	12	17½	12/-*	31—33	
Do. 4% Deb. Bds. Red.	100	4	4%*	100—102	
Willans & Robinson, Ord. Shres.	1	5	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	6	6%*	3—3⅜	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%*	72—76	-½

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LOCAL NOTES

ABERDEEN: *Agreement with Tramway Co.*—The renewal of the agreement between the Corporation and the Aberdeen Suburban Tramways Co. for a supply of electricity to the latter is still under discussion, and it is possible that a conference will be held very shortly to settle the points in dispute.

AUSTRALIA. *Sydney: Tramway Strike.*—A *Reuter* telegram states that the Chief Commissioner of the Railways addressed a mass meeting of the strikers on Wednesday last week, and as a result 500 men asked to be reinstated.

Adelaide: Tramways.—The annual report of the Engineer to the Municipal Tramways Trust, Mr. W. G. T. Goodman, has been issued. Dealing with the preliminary work of the Trust, the engineer points out that he sub-divided the work into 45 contracts, 31 of which related to the main construction work. He is now engaged on the preparation of the plans and specifications for the power station buildings and equipment, the remainder of the rolling-stock, and the overhead transmission lines. The two most important contracts that have been let are for the construction of the permanent way to Messrs. Smith & Timms, and for the overhead construction work to the British Insulated & Helsby Cables, Ltd. The next question to be faced is the organisation of the traffic staff, and Mr. Goodman states that his object will be to take over the present horse-car employees as far as possible. He is, however, preparing a special report upon this part of the work.

Hawthorn (Victoria): Electric Lighting.—Mr. W. Corin is to prepare a report with regard to an electrical installation.

BECKENHAM: *Supply of Electricity Bill.*—The Electricity Committee have received a copy of a circular which is being sent around to municipalities by the Town Clerk of the Shoreditch Borough Council, proposing a deputation to the Board of Trade urging the re-introduction of the Supply of Electricity Bill. The Committee recommend the appointment of two of their members to join this deputation.

BELFAST: *Harbour Tramways.*—The harbour tramway is now complete, and an experimental run was made over it last week from County Down terminus to the end of Queen's Road. The Board of Trade has been notified that the line is ready for inspection.

BIRMINGHAM: *Tramway Extension.*—A ratepayers' meeting has been held with regard to the proposal to urge the Corporation to extend their tramway system into Stechford, and a resolution was passed asking the Yardley Rural District Council to open up negotiations with Birmingham with this object in view.

BIRKENHEAD: *Tramway Finance.*—The report of Mr. W. Wyld, the Borough Electrical Engineer and Tramways Manager, for the year ended March 31st, 1908, shows a total income of £55,936, and working expenses £54,972. After meeting capital charges, however, there is a net deficiency of £914, which has been largely brought about by the increase in cost of fuel, in maintenance of rolling stock, and in capital charges, which in all amounts to £2,445. The report makes mention of the fact that there were no fatal accidents, nor any of a serious nature during the year.

BRIGHTON: *Power Supply.*—The London, Brighton, and South Coast Railway Co. having proposed to introduce electric power into their Brighton works, have agreed with the Corporation Electricity Supply Committee to take current upon terms which now await the sanction of the Council. The general conditions of the agreement are that the railway company will take a supply for five years, which will be disconnected between 5.30 p.m. and 8 a.m. during December and January, the terms of payment being a fixed charge of £750 per annum, *plus* 0·56d. per unit. There is a clause in the agreement that in the event of an increase in the price of coal above 16s. per ton, a proportionate increase in price will be paid by the company for the energy. Mr. J. Christie, the Borough Electrical Engineer, reports that the company are fixing motors of a total capacity of 1,500 h.p., which will be run in such a way as to give a continuous load on the electricity works during the day-time of from 400 to 500 h.p. It is estimated that the consumption will be from 500,000 to 750,000 units per annum, and that the revenue will be from £2,000 to £2,500. The cost of laying mains to connect the works with the North Road sub-station is £3,363. Mr. Christie strongly recommends the acceptance of the agreement, which also has the support of Mr. Arthur Wright, the consulting engineer.

BRISTOL: *Electricity Accounts.*—At the meeting of the Corporation on Tuesday last week, Alderman Pearson, the Chairman of the Electric Lighting Committee, presented the accounts of the electricity undertaking, which we gave in our last issue. He said he had to report that the general growth of the undertaking had been satisfactory as to amounts, although not quite so satisfactory as to profits. They had an increase of nearly £7,500 in income and about £2,040 in profits. Their customers were about 80 short as compared with the increase of the previous year, whilst the lamp connections also had not been so good, there being 16,900 in 1907 and 11,600 in the year just ended. Similarly, the horse-power added to the motor load had only been 1,300 against 1,833 last year. There had been a most satisfactory increase in output, however, which enabled them to considerably reduce the cost to the consumer. One of the main reasons for the profits having shrunk was a very material increase in the sinking fund charges, which had grown by £2,200. In addition, they had a very ridiculous charge put upon them in respect of the wages of workmen employed on capital duties, because they happened to be permanently employed. After a short discussion the Electricity Commitee's report was adopted.

CROYDON: *Electric Supply Charges.*—The following reductions in the charges for current have been agreed to by the Corporation, to take effect, as regards the tramways, from the June quarter, and as regarding public and private lighting from the September quarter, 1908:—(*a*) flat rate at 5d. to be reduced to 4½d.; (*b*) heating, cooking, and basement lighting, flat rate at 2½d., heating and cooking to be reduced to 1½d.; (*c*) public lighting, the price per lamp per annum for arc lighting to be reduced £1 per lamp; (*d*) power with time switch during evening load at 3d. and 1½d. to be reduced to 3d. and 1d.; (*e*) traction, first 1,000,000 units at 2d., excess at 1½d.

DARTFORD: *Light Railways.*—The accounts for 1907-8 show a balance of £1,472, after meeting interest and sinking fund, &c. The number of passengers carried was 2,055,033, and the car miles run 317,127. The number of Board of Trade units taken from the Council's electricity works by the lessees of the lines, Messrs. J. G. White & Co., was 428,600.

DUBLIN: *Tram Fares.*—A letter has been addressed to the Town Clerk, pointing out that under Section 68 of the Corporations Tramway Act of 1904, the Corporation only have the right of fixing tram fares annually, and that this having been done at the commencement of the present financial year, the inauguration of a system of halfpenny fares is illegal. The letter in question, which has been written on behalf of a number of ratepayers, contends that the Corporation must at once revert to the fares fixed at the commencement of the financial year, otherwise the Ratepayers' Association will put the matter before counsel with a view to taking such proceedings as may be advised.

DUNDEE: *Albert Institute Lighting.*—The supply of electrical energy for the lighting of the Albert Institute is now taken entirely from the Corporation mains, the independent plant having been dismantled. Mr. H. Richardson, City Electrical Engineer, has acted as adviser for the new installation. The lighting includes three 10 ampere "Excello" arcs of 2,700 c.p. each, and four 25 c.p. tantalum lamps. It is estimated that a saving of £130 per annum will be made under the new arrangement.

DUNFERMLINE: *Transfer of Provisional Order.*—An agreement has been drawn up between the Town Council and the Fife Electric Power Co. for the transfer of the Council's electric lighting order. The agreement gives the Council the option of re-purchasing the undertaking at the expiration of 30 years, or every subsequent period of seven years. In the event of such purchase taking place the Council is to pay the company £5 for every consumer supplied. Sir Alexander Kennedy is named in the agreement as the arbitrator between the company and the Council upon all matters arising out of the agreement.

DUNSTABLE: *Provisional Order.*—Messrs. Foote & Milne have notified the Council of their intention to apply to the Board of Trade for an electric lighting provisional order for the district.

EDINBURGH: *Electric Lighting Surplus.*—At the meeting of the Corporation last week the Electric Lighting Committee's recommendation to transfer £9,794 of the surplus electric lighting profits to the relief of the rates was carried.

FRANCE: *Electric Traction.*—The Chamber of Deputies have approved the construction of three railway lines which will complete the Midi Railway system in the Departments of Gers, Hautes and Basses Pyrénées and the Landes. The first of the lines, from Auch to Lannemezan, will be of normal gauge and cover a distance of 70 kilometres. The second line, 52 kilometres long, is to be of metre gauge and will connect Castelnau-Magnoac with Tarbes, passing by Trie, Cabanac, Aubarède, and Pouyastruc, through a series of valleys to the main line from Toulouse to Bayonne, which it will join at Marcadieu. The third line will be constructed from Arreau to Saint-Lary-Vielle-Aure, to prolong the existing line from Lannemezan to Arreau. This will be of normal gauge and about 11 kilometres long. These lines, which are to be run by electrical traction, will receive their power from the hydro-electrical works at Eget. The waters of the Oule are to be stored by means of a dam erected in the Aure Valley, and will pass through a canal, 5,800 metres long, to the Eget Plateau, whence they will be forced through conduits to the power-generating works near Tramezaygues.

GUERNSEY: *Telephone Anniversary.*—The tenth anniversary of the opening of the State telephone service was celebrated last week. The number of stations now connected to the system is 1,698, which is equal to one for every 23·8 persons. The capital expended upon the system to date is £51,560.

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HESTON AND ISLEWORTH: *Condition of Tramway Track.*—The District Council has appointed representatives to attend a conference of Local Authorities, which is being convened by the Hampton District Council to take into consideration the condition of the tramway track with a view to united action being taken against the London United Tramways Company.

ILFORD: *Electricity Accounts.*—The financial result of the electricity undertaking for the year ended March 31st, 1908, is a deficit of £375. The total revenue amounted to £27,637, and the expenditure to £17,891. Of the amount carried to net revenue account, sinking fund absorbed £4,364, and interest on mortgage debt £5,124, whilst the payment to the Tramways Committee as instalment and interest on machinery used for generation of electricity charged to tramways capital account amounted to £557. The capital expenditure at the end of the year was £154,601. The number of units sold was 3,046,728, and the average price obtained was 1·90d. per unit. The percentage of gross profit, namely, £9,671, to average capital was 6·37. There are now 3,045 against 2,836 for the previous year. The maximum load was 1,604 kw. against 1,675 kw., and the load factor was 21·68 per cent. compared with 20·7 per cent. The total working costs amounted to 1·17d. per unit, an increase of 0·04d. over the previous year.

LONDON: *Greenwich: Treatment of Sewer Gas.*—In a report upon Major Cardew's experiment of deodorising sewer gases by means of an ozone generating apparatus, suspended in each manhole, and supplied with energy from the street mains, the Public Health Committee state that although the apparatus might deal with the normal flow of sewer gas, they doubt whether it would treat effectively the gas coming from the sewers at high pressure. Further experiments would be costly, and of uncertain advantage, and they had decided that no further expense should be incurred in the matter. Major Cardew estimated the cost of a single installation, including cables and street work, at £30, and the upkeep, provided not less than 20 apparatus were installed, at £3 per installation per annum.

Hammersmith: Electricity Accounts.—In submitting the accounts of the electricity department for the year ended March 31st, 1908, the Borough Accountant states that the aggregate amount of capital borrowed at that date was £279,951, and net amount expended £290,221. Of the above total capital indebtedness, an amount of £49,298 had been redeemed at termination of financial year, in addition to an amount of £153 charged in the accounts as a reserve for redemption of capital overdraft. This redemption represents 17·6 per cent. upon the amount of loans taken up, and the amount of unpaid borrowed capital at end of year was, therefore, £230,653. Of this total capital outlay the amount redeemed during the year was £10,389, or 3·58 per cent. The revenue account shows a substantial increase over the previous year. The gross income has been £40,428, whereas at corresponding date last year it was £37,302. The total number of units sold for private purposes during the year was 4,406,671, and the revenue obtained therefrom averaged 1·85d. per unit. During the previous year the total units sold was 3,657,610, and the average revenue obtained was 2·01d. per unit. The percentage of increase shown by the units sold over the previous year was 20·4. The actual increase in income derived from private lighting supply has been £3,501, and from public lighting supply £152. The revenue from meter rents has been £191, an increase of £17 when compared with last year, whilst revenue derived from miscellaneous receipts has reached £1,340. The working expenditure for the year has been £21,896, and the gross surplus £18,531. This gross profit represents a percentage of 6·4 upon amount of capital expended upon the undertaking. Last year the gross profit was 5·6 per cent. upon amount of capital expended, and in the previous year the corresponding gross profit amounted to 6·13 per cent. After meeting charges of interest, &c., and temporary overdraft on capital account, and writing off a sum of £153 for irrecoverables, the net profit made for the year was £13. The corresponding sum last year was £14. During the past year a further amount of £3,000 has been contributed by the undertaking in relief of Borough rate. The total contribution to date thus made from its accumulated revenues has been £7,000. The reserve fund of £2,500 formed pursuant to resolution of the Council of June 17th, 1903, has been added to by a similar amount placed to its credit during the year. The reserve fund thus stands at £5,000.

Islington: Sinking Fund Charges.—The Finance Committee of the Borough Council have considered a suggestion by the London County Council that a special reserve fund be set apart in order to provide that loan repayments in respect of machinery, plant, mains, &c., shall have been completed at the expiration of the usual life of such equipment, viz., at an earlier period than the 42 years, which is the period the loans were originally granted for. The Committee think, however, that a departure from the present system of repayment is not desirable.

Marylebone: Electricity Accounts.—The financial statement of the second year of the electricity undertaking shows that the gross income was £161,492, compared with £158,459 for the previous year. Of this working expenses, management, &c., absorbed £50,920, and special expenses brought the total charges on revenue account to £57,659. The costs per unit sold averaged 1·389d. compared with 1·45d. for the previous year. Notwithstanding the higher price of coal during the latter part of the year, generation costs were reduced from 0·77d. to 0·731d. The average price charged for current to private consumers worked out (including meter rents) at 4·38d., compared with 4·7d., the average for the previous year, and 5·15d. for the year ended March, 1906. The net increase in the number of units sold was 629,175. There is a deficiency on the year's working of £3,136. The shortage, say the committee, is mainly due to the lower average price now obtained. The large increase on the sales of current for power purposes and for other cheaper classes of supply, together with the increase in the number of consumers now obtaining a lower average price under the maximum demand system have, combined, resulted in a temporary deficiency between income and expenditure. The committee feel assured, however, that the lower charges now made for the supplies referred to are creating a fresh market for the development of the undertaking, and that the tariff generally is perfectly sound. The balance in hand at March 31st, 1907, was £29,325, out of which the deficiency will be met, leaving a credit balance at March 31st last of £26,189.

Stepney: G.B. Surface-Contact System.—At the meeting of the Borough Council on Thursday the report of the Works Committee recommending the Council not to give its consent to the overhead system in the Mile End Road was adopted. Mr. H. H. Gordon gave notice to bring forward at a future meeting the following resolution :—"That this Council views with feelings of great dissatisfaction and alarm the proposals of the London County Council to continue the experiment of electric traction in the main road of the borough, the results of which show, as the Highways Committee themselves state, that it will not be practicable to continue the use of the system consistently with the safety of the public using the roads, and the efficient working of the tramway under the circumstances prevailing on the road, and that copies of the resolution be sent to the Board of Trade, the local members of Parliament, and local members on the L.C.C." He said that apparently without any fresh information the London County Council had in the early hours that morning reversed the recommendation contained in the Highways Committee's report.

St. Pancras: The Patents Act.—The Parliamentary and General Purposes Committee have reported that the Electricity and Public Lighting Committee have called attention to the new Patents Act, which makes it compulsory for all patented goods intended for sale in this country to be manufactured here. It is stated that as a result many foreign firms have rented premises in the metropolis for manufacturing purposes, and it is suggested that the Council should advertise in British and foreign papers pointing out the facilities offered in St. Pancras in the way of cheap electric power for setting up factories.

LOUGHBOROUGH: *Electricity Accounts Deficit.*—At the monthly meeting of the Town Council on Wednesday last week it was stated that the balance-sheet of the electricity undertaking for the year ended March 31st, 1908, had turned out more unsatisfactory than had been expected, and a sub-committee had been appointed to go thoroughly into the accounts. When this had been done the annual statement would be presented to the Council.

MADEIRA: *Telephone System.*—A British Consular report states that the question of providing a telephone system in Madeira is still being argued for and against. The question appears to be whether the system shall remain a Government one or not, and the expenses have to be looked into and considered most carefully. The general opinion, however, is that whatever plan be adopted it would well repay the outlay.

Electric Light.—This still continues in the hands of one company. It has been rumoured that a British company was to take over the whole plant and erect a new installation.

MAIDSTONE: *Engineer's Remuneration.*—The Electricity Committee recommend that, as from March 25th, 1908, Mr. E. E. Hoadley, the electrical engineer, be paid a salary and commission calculated as follows :—When the total cost per unit (excluding capital charges) shall be one and one-eighth pence, the salary shall be £300 per annum, and for each £100 saved to the committee through the reduction in cost per unit sold a bonus of 20 per cent. per annum. In all cases the salary for the financial year ending in March shall be calculated on the cost of the preceding financial year. This arrangement was to be subject to the following clauses :—(*a*) The usual coal clause; (*b*) if the committee at any time should decide to buy meters or other capital goods out of revenue, they shall adopt the procedure recommended by the Local Government Board, viz., keep the amounts so spent as a separate account which shall be extinguished each year out of the profits. The recommendation was adopted at the last meeting of the Corporation.

MONTEVIDEO: *Tramway Extension.*—A cable advice has been received that a further 20 miles of single track have been opened upon the electric tramway service, making a total of 75 miles of single track in operation by electric traction out of a total of 80 miles.

MORECAMBE: *Purchase of Tramways.*—A special meeting of the Town Council was held on Wednesday to consider the question of purchasing the undertaking of the Morecambe Tramways Co. It was reported that the Corporation valuers had valued the system at £7,661, whilst the company's valuers put

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the value at £15,952, with further sums for plant, &c. The Tramways Committee have rejected the company's figure, and the Council was asked to sanction an application to the Board of Trade for the appointment of an arbitrator. This recommendation was approved.

PORTISHEAD: *Provisional Order.*—The Western Electrical Co. have notified the Council of their intention to apply to the Board of Trade for a Provisional Order authorising the supply of electricity within the urban district. It may be pointed out that the company obtained an order a few years ago, but it was revoked by the Board of Trade.

REDDITCH: *Electricity Accounts.*—At the last meeting of the Urban District Council the Chairman of the Electricity Committee reported that the balance-sheet of the electricity undertaking, in common with all other electric supply undertakings, had been severely affected by the high price of coal, coupled with serious trade depression. At the same time, although the balance-sheet was unfavourable, they had just received an order for the supply of energy for power purposes which placed the undertaking practically in the same position as it was before they lost a considerable amount of trade through several firms leaving the town.

RODLEY: *Electricity Supply.*—The Leeds Corporation Electricity Department have under consideration the supply of electricity in this district.

ROSSENDALE: *Electric Supply.*—An important conference has just been held at Rawtenstall of representatives of the boroughs of Bacup, Haslingden, and Rawtenstall, called by Mr. Hooper, of the Local Government Board, to secure, if possible, arrangements whereby three boroughs might be most suitably and economically supplied with electric current, instead of having three separate schemes. Rawtenstall agreed to accept the offer of Bacup to forego its right of supplying its own tramways with electricity, and allow Rawtenstall to supply them; and that in consideration of this, should Bacup want current for lighting purposes, the fact of their taking electricity for the tramways should be taken into account in fixing the price. The Inspector was unable to bring about an understanding between Haslingden and Rawtenstall, a Haslingden representative stating, at the close of an acrimonious discussion, that so far as Haslingden is concerned, they were not prepared to go any further in the matter.

SOUTHALL-NORWOOD: *Electric Supply.*—The Urban District Council has decided to inform the Metropolitan Electric Lighting Company, that the Council cannot accept their proposals for public lighting, but is willing to consider any offer the company may make to purchase the Order and powers of the Council without conditions.

SUNBURY: *Electric Lighting Provisional Order.*—The Urban District Council has received notice of the Electric Light & Traction Co.'s intention to apply for a Provisional Order to supply current in the Council's district.

TASMANIA. *Launceston: Electric Tramways.*—The plans for the electric tramway system have been approved by the City Council, and the work has been commenced.

TEWKESBURY: *Electric Lighting.*—The Hereford Town Council has agreed to allow its Surveyor to act as advisory engineer to the company about to be formed under the Tewkesbury Electric Lighting Order, but at the next meeting a resolution will be moved that this decision be reconsidered.

WEST BROMWICH: *Tramway Accounts.*—The Borough Treasurer's abstract of the accounts for the year ended March 31st, 1908, shows that the amount received as rent up to date from the South Staffordshire Tramway Co. was £6,979, and from the Birmingham and Midland Tramways Co. £1,627. There was a deficit on the tramways undertaking on March 31st of £1,092.

WEST HAM: *Tramway Profits.*—The Borough Treasurer, in his report upon the accounts of the Corporation tramways for the year to March 31st, states that the revenue account shows a total expenditure of £76,717, and income of £120,013. After providing for capital charges the sum of £5,378 is carried to the relief of rates.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

DARTFORD.—A Local Government Board inquiry has been held into the application of the Urban District Council for sanction to borrow £2,880 for an extension of condensing plant at the electricity station for an additional feeder cable and for house-service cable, which, it is estimated, will be required during the next three years.

ECCLES.—Mr. H. R. Hooper held an inquiry at Eccles on July 28th into the Council's application to borrow £16,278 for the purposes of electrical extensions.

EDMONTON.—The Guardians invite tenders for an electric-lighting plant at the Nurses' Home, Upper Edmonton. Particulars from Messrs. May & Hawes, Caxton House, Westminster (fee £1, returnable), and tenders to the Clerk, White Hart Lane, Lower Tottenham, by August 26th.

GILLINGHAM.—Mr. H. R. Hooper held a Local Government Board inquiry last week into an application for sanction for further capital in connection with the electricity undertaking. The proceedings were private.

LEYTON.—At the last meeting of the Urban District Council sanction was received from the Local Government Board to the borrowing of £895 for providing additional plant at the generating station.

MANCHESTER.—The Electricity Committee invite tenders for the supply, delivery, and erection of (1) storage battery at the Stuart Street station, and (2) low-pressure pipe-work, including exhaust steam air-pump discharge and circulating water-pipes and two atmospheric exhaust valves at Dickinson Street station. Specifications from Mr. F. E. Hughes, Secretary to the Electricity Department (fee, £2 2s. for each specification), and further particulars from the City Electrical Engineer, Mr. S. L. Pearce. Tenders to the Chairman of the Electricity Committee by August 12th.

METROPOLITAN ASYLUMS BOARD.—Tenders are invited for the installation of a storage battery, motor-driven booster, switchboard, and connections at the training ship *Exmouth*, Grays, Essex. Particulars from the offices of the Board (fee £2, returnable), and tenders to the Clerk by September 1st.

SURBITON.—At the last meeting of the District Council, the Parliamentary Committee reported that there was every reason to expect at an early date the Local Government Board's sanction to the proposed loan for electric light extensions. The Committee recommended that immediately on receipt of the sanction tenders should be invited and submitted to a special Council meeting. The matter was referred back to the Committee for further consideration.

WATFORD.—Tenders are invited for a surface condenser complete with steam-driven pumps. Particulars from the Electrical Engineer (fee £1, returnable), and tenders to the Town Clerk by September 1st.

Miscellaneous

CHILE.—*Commercial Intelligence* states that the management of the State Railways of Chile has advertised for bids for the construction of an electric plant at San Eugenio, comprising the building and the machinery for the production of motor force in the shops and the lighting of the stations, with a capacity of 900 kilowatts, divided into three units of 300 each. No proposals will be considered that are not made upon the form that will be found in duplicate on the leaf of specifications furnished free of charge by the engineer of the technical office, upon a deposit of 60 pesos with the central cashier of the service. The work must be executed in conformity with these specifications. At the time of receiving the specifications the interested party or his representatives will sign the volume kept for this purposes in the central office, giving their name and the domicile of the house they represent. The management reserves the right to reject all proposals, to accept any part of any of them, or to accept the one most convenient, even though it is not the lowest. The proposals will be opened in the presence of the interested parties on Monday, November 2nd, 1908, at 3 p.m., in the office of the Director-General of the State Railways, Santiago, Chile.

DONCASTER.—The Rural District Council have instructed Messrs. D. Balfour & Son, of Newcastle-on-Tyne and London, to prepare plans for an additional pumping station for the sewerage of Bentley-with-Arksey and Rostholme. The work includes the laying of the necessary sewers and the construction of a storage tank, engine-house, including electric motors and pumps.

INDIA.—It is stated that a detailed scheme for the conversion of the Nilgiri Railway to electric traction, and for the lighting of Ootacamund, Coonoor, and Wellington is recommended.

NEW ZEALAND.—The Board of Trade correspondent at Auckland (Mr. A. J. Denniston) writes that, according to the local Press, the Auckland Harbour Board are calling for tenders for the supply of 16 electric cranes. Tenders by October 1st to Messrs. W. & A. McArthur, Ltd., of 18-19 Silk Street, London, E.C., at whose offices copies of the specifications and diagrams may be seen.

NORWICH.—Tenders are invited for a sewage screening and electrical lifting gear for the Corporation. Full particulars from the City Engineer, Mr. A. E. Collins, Guild Hall, Norwich, and tenders to the Chairman of the Sewage Committee by September 21st.

RAWTENSTALL.—Tenders are invited for the supply and delivery of sixteen tramcars; also for station lighting, wiring, and motor-testing instruments, &c. Full particulars from Messrs. Lacey, Sillar & Leigh, 2 Queen Anne's Gate, Westminster, and 78 King Street, Manchester, and tenders to the Town Clerk by August 15th.

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SOUTH AFRICA.—The conversion to electric traction of the railway line between Cape Town and Wynberg is contemplated.

Parliamentary sanction is being sought for an electric tramway service in Boksburg.

TWICKENHAM.—Tenders are to be invited for electric fittings for the Infectious Diseases Hospital.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—New warehouse and alterations to warehouse (£1,900) in Aldgate for L. & N.W. Railway Co. Architects, Joseph & Smithem, 85 Queen Street, E.C.

E.C.—Buildings in Clerkenwell for Sir W. P. Hartley, Green Walk, Tower Bridge Road, E.C.

Alterations, Training College, Moorfields (£1,067). Builders, J. Grover & Son, New North Road, N.

Additions to Training College, Graystoke Place (£608). Builders, E. Laurance & Son, Wharf Road, City Road, E.C.

Alterations, &c., business premises, Fort Street (£880). Architects, Gordon, Wilson & Co., 667 Fulham Road, S.W.

N.—Schools, Islington (£8,675). Builders, W. Johnson & Co., Wandsworth Common, S.W.

N.W.—School in St. Pancras (120 places). Architect, T. J. Bailey, Education Department, L.C.C.

New offices for Zoological Society. P. C. Mitchell, Secretary, 3 Hanover Square, W.

S.E.—Alterations, Dulwich Fire Station (£885). Builders, G. & C. Bowyer, Upper Norwood.

Additions to school, Sydenham (£400). Architect, T. J. Bailey, Education Department, L.C.C.

Alteration of premises, Woolwich (£450). Builders, Johnson & Co., Wandsworth Common, S.W.

S.W.—Alterations, Chelsea Fire Station (£613). Builders, J. & C. Bowyer, Upper Norwood.

Alterations, school, Bermondsey (£9,466). Builders, W. Johnson & Co., Wandsworth Common, S.W.

Additions to Battersea Polytechnic (£5,183). Joseph Harwood, Secretary, Battersea Park Road, S.W.

New fire station, Waterloo Road (£11,000). Builder, H. L. Holloway, Church Street, Deptford, S.E.

Additions to school, Battersea (£10,688). Builders, W. Johnson & Co., Wandsworth Common, S.W.

W.—School in Hammersmith (80 places). Architect, T. J. Bailey, Education Department, L.C.C.

Additions and alterations, Paddington Workhouse. Architect, F. J. Smith, Parliament Mansions, Victoria Street, S.W.

Additions to Paddington Technical Institute (£10,700). Architect, T. J. Bailey, Education Department, L.C.C.

Alterations, 131 Regent Street. Parkinson and Son, Fisher Street, Southampton Row, W.C.

W.C.—Adapting 13 Southampton Row for occupation by Pope & Bradley, tailors, 87 Theobalds Road, W.C.

Alterations and repairs to premises *Illustrated London News*, Milford Lane, after fire.

PROVINCES.

BATTLE.—Partial rebuilding (after fire) of Lord Brassey's mansion.

BECKENHAM.—Four shops and houses. Architect, J. Farrer, 2 Coleman Street, E.C.

BRIGHTON.—Additions, London Road Congregational Church (£1,000). Architect, E. J. Hamilton, 2 New Road, Brighton.

BRISTOL.—Extensions of business premises in Castle Street. Architects, La Trobe & Weston, 44 Corn Street, Bristol.

BROMLEY.—Re-erection of Mason's Hill School. S. E. Osborne, secretary to managers, 1 Exmouth Road, Bromley.

BURSLEM.—Additions to Wedgwood Institute (£5,000). F. Bettany, surveyor, Town Council.

CARSHALTON.—Houses. Builder, A. B. Cook, Wallington, Surrey.

Alterations to Southern Hospital. Engineer, W. T. Hatch, Metropolitan Asylums Board, Embankment, E.C.

CHELTENHAM.—New municipal offices (£10,000). Borough Surveyor, J. S. Pickering.

CROYDON.—Seventeen houses. Architect, D. L. Gooch, 54 Gresham Street, E.C.

Eighteen houses. Architect, Stanley Peach, 28 Victoria Street, S.W.

Ten houses and shops. Architects, Pepler and Allen, 3 George Street, Croydon.

HANWELL.—Additions to asylum (£2,000). W. E. Riley, superintending architect, L.C.C.

HOUNSLOW.—Infants' school and house (£4,000). Builder, W. Lacey, Staines Road, Hounslow.

KETTERING.—Additions and alterations (£3,500), Police Station. C. S. Morris, County Surveyor, Northampton.

KINGSTON (Surrey).—Workmen's Club. Builder, F. Hawkey, 81 Brighton Road, Surbiton.

NEWPORT.—Additions to schools (£3,500). Architect, C. F. Ward, c/o Education Committee.

NOTTINGHAM.—Memorial Hall (£1,500). Builders, W. Maule & Co., 190 Mansfield Road, Nottingham.

ROWLEY REGIS (Staffs.).—Public libraries (£5,000). Architects, Wills & Anderson, 4 and 5 Adam Street, Adelphi, W.C.

SALFORD.—Alterations County Courts. H.M. Office of Works, Storey's Gate, S.W.

SUTTON.—Reconstruction of Belmont Asylum. Clerk, Fulham Guardians, 120 Fulham Palace Road, S.W.

WOODFORD (Essex).—Additions to asylum. W. E. Riley, superintending architect, L.C.C.

UXBRIDGE.—Partial rebuilding of Yeading Hospital. C. Woodbridge, Clerk, Joint Hospital Board.

Alterations to Council Chamber. Architect, W. L. Eves, 54 High Street, Uxbridge.

WALTHAMSTOW.—Central library (£8,773). Architect, J. Williams Dunford, 109c Queen Victoria Street, E.C.; builders, Brand, Pettit & Co., South Tottenham.

WINDSOR.—New block of barracks. Director of Barrack Construction, 80 Pall Mall, S.W.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The New South Wales Postmaster-General's department has accepted the tender of the British Insulated & Helsby Cables, Ltd., for 14¼ tons of hard drawn copper wire (300 lb. to the mile) at £70 18s. per ton, and 4 cwt. of copper binding tape (200 lb. to the mile) at £4 2s. per cwt. The tender of Messrs. Siemens Bros. Dynamo Works, Ltd., for 3,500 best white porcelain insulators at 6½d. each has also been accepted.

The Victorian Postmaster-General's Department has accepted the tender of Mr. R. P. Hunderford, of Sydney, for 11 sections of a common battery switchboard, and 3,000 subscribers' telephone and other apparatus at £19,303.

BIRMINGHAM.—The Tramways Committee have accepted the tender of Mr. E. Crowder for the erection of a tramway depôt in Miller Street at £7,877.

The tender of the General Electric Co., Ltd., has been accepted for an induced draught plant at £350.

CANADA (ONTARIO).—Twenty-seven tenders have been received, many from the United States and Europe, for the construction of the transmission line from Niagara to Toronto. The Special Commission which has the matter in hand is now considering these tenders.

CHIPPING NORTON.—The D.P. Battery Company, Ltd., have secured the contract for the supply of a battery of their L 15 type cells for the above central station.

COTTESLOE (WEST AUSTRALIA).—The D.P. Battery Company, Ltd., have received an order for the renewal with their W.L. 9-type, of the above battery.

CROYDON.—The Corporation has accepted the tender of Babcock & Wilcox, Ltd., at £530, for mechanical stokers; also the tender of Casperd & Co. at £151 for installing electric light in the Scarbrook Road swimming bath.

HASLINGDON.—The Board of Guardians has accepted the offer of the Corporation for a supply of electrical energy at 3d. per unit.

HULL.—With regard to the supply of new transformers for factory sub-stations, Mr. H. Bell, the Electrical Engineer, has reported that as the department already has thirty-four such machines made by Messrs. Thomas Parker, Ltd., of Wolverhampton, which were of special design and were working quite satisfactorily, it would be wise for the Committee to order similar machines in the present instances. Messrs. Thomas Parker had signified their willingness to supply the additional transformers and switchgear at the same rates as under a previous contract, and this recommendation was adopted.

ILFORD.—The Urban District Council has accepted the following tenders:—Cole, Marchent & Morley, Ltd., surface condensing plant and cooling tower, £1,954; John Spencer, Ltd., steam and feed pipes, boiler feed pump, &c., £529; The Walsall Electrical Co., Ltd., extensions and alterations to main switchboard, £418.

LONDON: *Stepney.*—The tender of the Fulham Steel Works Co. for the framework of the Blythe Wharf generating station has been accepted at £15,609.

Fulham.—The Electricity and Lighting Committee of the Borough Council has accepted the following quotations for a crane and grab and electric motor to be provided for clearing the river sump at the electricity works, at a total estimated cost of £178 (which amount includes £20 for foundations, fixing

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machinery, &c.) :—Lewis & Lewis, crane, £64; Priestman, grab, £59: The British Thomson-Houston Co., electric motor, £55.

Hammersmith.—The Council have renewed the contract of the Main Colliery Co. for the supply of Graigola and Victoria coal at 15s. 1d. per ton for twelve months, and have accepted the quotation of Cory Brothers & Co. of free burning coal from Pentre Colliery, Rhondda Valley, at 14s. 11½d. per ton for twelve months. For static transformers the following tenders have been received :—100 kw., British Electric Transformer Co. (accepted), £112; Johnson & Phillips, £101 5s.; Siemens Bros., £106: Brush Electrical Engineering Co., £127; 200 kw.: British Electric Transformer Co. (accepted), £175; Johnson & Phillips, £148; Siemens Bros., £140; Brush Electrical Engineering Co., £203. Only the British Electric Transformer Co., Ltd., was able to quote in accordance with Council's present machines, viz., air-cooled transformers. He could see no advantage in departing from the present practice.

Hampstead.—The Board of Guardians has accepted the tender of E. R. Smith, Hampstead, at £18 5s., for making the necessary alteration for reducing the voltage of electric current at the workhouse from 210 to 105, it having been decided that in future metallic filament lamps be used.

Islington.—The Council received eleven tenders for the erection of a cooling tower, and accepted that of the Midland Engineering Co., Ltd., Birmingham, at £2,170.

Marylebone.—The Borough Council received the following tenders for electric light fittings at premises in Somerset Street :—Donnison, Sillem & Co. (accepted), £26; W. Mossop & Co., £28; Roger Dawson & Co., £35; Rashleigh, Phipps & Co., £41.

The following tenders have been received for the supply of half-a-mile of 0·15 sq. in. T.C.C. paper-insulated, lead-covered, jute served and compound cable :—W. T. Henley's Telegraph Works Co., Ltd. (accepted), £287 10s.; British Insulated & Helsby Cables, Ltd., £287 10s.; Siemens Bros., Ltd., £287 10s.; W. T. Glover & Co., Ltd., £287 10s.; St. Helen's Cable Co., Ltd., £295; Callender's Cable & Construction Co., Ltd., £295.

The tender of Siemens Bros. & Co., Ltd., was accepted at £69 10s. for the supply of four circuit-breakers. Five firms sent in tenders, and that accepted was the lowest.

St. Pancras.—The Council at their last meeting accepted the following tenders for the supply of coal to the electricity department: J. H. Beattie & Co., 11,000 tons Bolsover (Mansfield) best nutty slack coal, at 12s. 4d. per ton (King's Road generating station); Brentnall & Cleland, 10,000 tons Desford steam coal (Regent's Park Station) at 14s. 8d. per ton, and 1,000 tons at the same price to King's Road; Facer & Co., Ltd., 600 tons Bwllfa coal at £1 1s. 6d. per ton (Regent's Park Station). The Electricity Committee recommended the recission of the bye-law with regard to trades union rates of labour, in order to accept a tender by Messrs. Beattie at 11s. 6d. per ton instead of 12s. 4d., the company having agreed to pay a minimum wage of 30s. per week to carters. The recommendation was not agreed to.

For additions to the low-tension switchboard at King's Road generating station the following tenders were received: Johnson & Phillips, Ltd. (accepted), £112; Spagnolette, Ltd., £113; Whipp & Bourne, £116; Electric & Ordinance Co., Ltd., £119; Bertram Thomas, £126; Walsall Electric Co., £126; British Thomson-Houston Co., Ltd., £131; British Westinghouse Co., £135; Cowans, Ltd., £151; Switchgear Co., £156 10s.; Edison & Swan United Electric Lighting Co., Ltd., £162; Siemens Bros. & Co., £176; E.M.F. Manufacturing Co., Ltd., £205; A. W. Penrose & Co., Ltd., £224; Electric Construction Co., £225.

LOWESTOFT.—The tender of Messrs. Mann, Egerton, & Co., for the electric wiring and fitting of the Central Boys' and Central Girls' School and the St. Andrew's Schools has been accepted.

TOTTENHAM.—Messrs. Venner & Co. have received an order for 120 "C" type time switches for the street lighting of Tottenham from the North Metropolitan Electric Power Supply Co.

WEST HAM.—The Electric Lighting and Tramways Committee has decided to accept the tender of Ferranti, Ltd., at £247 13s., for the supply of switchgear for a turbo. The tender was the lowest received.

COMPANIES' MEETINGS AND REPORTS

ANGLO-AMERICAN TELEGRAPH CO.—At the annual meeting on Friday the report and accounts given in our last issue were adopted. With regard to the net reduction in the receipts of £6,650, the chairman, Mr. Francis Bevan, said the directors did not in any way regard this as due to the effect of wireless telegraphy. The Wireless Telegraph Co. may have taken a little business from them at Montreal, but it was so little that he did not think it really had much effect upon the company's receipts. The real reason, in the directors' opinion, was set out in the report. During the last two years the company had had no trouble from trawlers on the west coast of Ireland, which was probably due to the fact that their cables at the shore end were now so strong that trawlers could not inflict the injury upon them which they used to.

BAKER STREET & WATERLOO RAILWAY CO.—The report for the half-year ending June 30th, 1908, states that the capital expenditure during the half-year amounted to £784. The gross receipts amounted to £85,528, being an increase of £20,077, or 31·64 per cent., on the receipts for the corresponding half of 1907. The working expenses amounted to £45,452, an increase of £3,324, or 7·89 per cent. After providing for interest and rents, and for dividend at the rate of 4 per cent. per annum on the preference shares, and crediting to net revenue account £2,142 5s. 8d. receivable from the Underground Electric Railways Co. of London, Ltd., under their guarantee agreement, there remains a balance of £9,854 10s. 6d. available for dividend on the ordinary shares, and the directors recommend that a dividend at the rate of ¾ per cent. per annum be declared on the ordinary shares, and an additional dividend at the rate of 2¼ per cent. per annum (making 3 per cent. per annum in all) on the ordinary shares other than those held by the Underground Co. or their nominees. The number of passengers carried was 12,940,801, being an increase of 3,003,806 over those carried during the corresponding period of 1907. The meeting is on the 11th inst.

BRITISH THOMSON-HOUSTON CO.—At the annual meeting last week the report and accounts given in our last issue were adopted. Mr. H. Nauheim, who presided, said the company's position was distinctly better than last year, although business at the present moment was not particularly brisk. They had been able to further reduce their indebtedness by a considerable sum, and had begun the redemption of their debentures.

CENTRAL LONDON RAILWAY CO.—The report for the half-year ending June 30th, 1908, shows that the capital expended during the half-year was £52,288. The chief items are for the additional generating plant at the power house, and the extension of the line from Shepherd's Bush to Wood Lane. Compared with the corresponding period in 1907 there has been an increase of £8,761 in the revenue receipts, and of £185 in the working expenses. The balance carried to net revenue is £83,526. After providing for interest on the debenture stock and other payments, there remains a balance of £74,125. The directors recommend the declaration of the following dividends :—On the undivided ordinary stock at the rate of 3 per cent. per annum for the half-year; on the preferred ordinary stock at the rate of 4 per cent. per annum for the half year. Dividend on the deferred ordinary stock not being payable until the result of the year's business is ascertained, the balance remaining of £54,671 is carried forward to next half-year. The number of passengers carried was 19,901,750, compared with 20,260,871 in the corresponding half-year of 1907. The Franco-British Exhibition at Shepherd's Bush was officially opened on May 14th last, and on that day the company's trains were worked over the new line sanctioned by Parliament last year, utilising also the new station at Wood Lane opposite the entrance to the Exhibition. This extension of the system adds half-a-mile to the length of railway worked. A very substantial increase in the company's business has resulted, and as tram-cars and omnibuses now run between Hammersmith and Willesden, passing the entrance to the new station, there is every prospect that an increasing traffic will be permanently carried to and from this new centre. The system of through booking between stations on the Central London Railway and those on the Baker Street and Waterloo, the Charing Cross Euston and Hampstead, the Great Northern Piccadilly and Brompton, the City and South London, the Great Northern and City, and the Metropolitan Railways, established last year, has steadily developed: about 25,000 passengers per day are exchanged with the other companies, minimising and partially replacing the loss on the short-distance traffic diverted by the motor omnibuses. The average receipt per passenger for the half-year is 1·97d., as compared with 1·85d. in the half-year ending June, 1907. The cost per passenger is 1·08d., as compared with 1·06d. in the corresponding period. The meeting is to-day.

CHARING CROSS, EUSTON & HAMPSTEAD RAILWAY CO.—The report for the half-year ending June 30th, 1908, shows gross receipts of £88,885, and working expenses £56,492, and after providing for interests and rents, there remains a balance of £852 on the net revenue account to be carried to next half-year. Since the opening of the railway the following passengers have been carried: June 30th, 1907 (eight days), 421,466: December 31st, 1907, 9,881,357: June 30th, 1908, 12,152,639. The meeting is on August 11th.

CITY OF LONDON ELECTRIC LIGHTING CO.—The report for the half-year to June 30th, 1908, states that the number of consumers is 12,485, compared with 12,295 on June 30th, 1907,

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the number of kilowatts connected on these respective dates being 34,445 and 30,009. On July 1st, 1908, in addition to the above connections, there were orders in hand for a further 1,357 kw. The gross revenue amounted to £143,006, being an increase of £1,693 over that of the first six months of 1907. The net revenue for the half-year was £76,678, to which is added £20,473 brought forward. The number of units sold during the half-year was 12,430,827, as compared with 11,856,427 during the corresponding period of 1907, showing an increase of 574,400 units, chiefly in the supply for power purposes, the lighting supply having been adversely affected by the bright weather experienced in the second quarter of the year. Dealing with the power Bills before Parliament, the report states that numerous amendments have been made in the companies' Bills as originally deposited, and, the Committee having decided to allow all three Bills to proceed as modified, they have been passed by the House of Lords, and will in due course be introduced into the House of Commons. It is to be hoped that a final settlement, satisfactory to all parties, may be arrived at during the present session of Parliament so as to put an end to the heavy expenditure and work thrown on the London companies during the past few years in connection with Parliamentary proceedings. The directors have declared the following dividends, less income tax, viz., 6s. per share on the company's preference shares, 5s. per share on the company's ordinary shares.

DIRECT UNITED STATES CABLE CO.—At the annual general meeting on Wednesday last week, the report and accounts, given in our last issue, were adopted. The chairman, Mr. E. M. Underdown, K.C., said that the revenue had fallen by £5,688 compared with the corresponding period of 1907, when the great activity that characterised the Atlantic business for some time was already beginning to slacken. This was followed by serious financial difficulties in America, the effects of which were still apparent. With regard to the damage done to cables by trawler vessels off the coast of Ireland, he did not think much injury had been done to the company's cables, but the matter was, nevertheless, of much importance to them. The Inter-Departmental Committee appointed by the Postmaster-General was now considering the matter, and there was no doubt that measures would be taken as far as practicable to secure their cables from damage in this way.

DUBLIN UNITED TRAMWAYS.—The half-yearly meeting was held last week in Dublin, when the report and accounts, given in our last issue, were adopted. The Chairman, Mr. W. M. Murphy, said that the half-year, owing to the International Exhibition, was one of exceptional prosperity for the tramway company. The falling off of passengers' receipts amounted to £3,115, compared with the corresponding half-year of 1907, which included the first two months of the exhibition traffic last year. Compared, however, with the receipts of the first half-year of 1906, there was the substantial addition of £5,043, from which it would be seen that the continuous increase under normal conditions in the gross earning powers of the tramways showed no signs of exhaustion. For the first time there was a check to the expansion of the parcel traffic, which showed the small falling off of £29, but this was also attributable to the fact that some of the parcel traffic last year was due to the exhibition. The general expenses had increased by £2,849, more than half of which was due to the increased generating expenses, owing to the high price of coal. The increase of £378 in general charges was accounted for by the expenses they had been compelled to incur in protecting the company's interests in Parliament in relation to the Central Ireland Electric Power Bill. Out of the large profits made in the second half of 1907, they were enabled to appropriate £10,000 towards the reconstruction of the Southern District Tramways between Blackrock and Ailesbury Road. On that work a sum of £5,250 was expended during the past half-year, and there remained on June 30th a balance of £4,749 towards its completion, which was estimated to cost about £14,000. When that work was finished they would have an entirely new tramway between Haddington Road and Temple Hill, Blackrock. They had already appropriated to the reconstruction of that line, all out of current revenue, the large sum of £20,500. It would be desirable before long that they should put their capital account in order, and the directors were considering the best way of raising a comparatively small amount of additional capital during the current half-year.

EAST LONDON RAILWAY CO.—The half-yearly meeting was held on Wednesday last week, Lord Claud Hamilton presiding. With regard to the question of electrification, referred to in the directors' report (given in our issue of July 23rd), the chairman stated that the report by Messrs. Jones and Firth, the electrical engineers to the Metropolitan and Great Eastern Railway Companies respectively, had been referred to the general managers of the six lessee companies for detailed consideration. The matter was a very difficult one, but the spirit in which it had been taken up by the lessee companies was encouraging. With regard to the cost, he stated that the total equipment of the line, including entrance into Liverpool Street and New Cross stations, and the supply of electrical energy, came out under one scheme at £59,600, and under an alternative scheme at £79,600. A further report was in the course of preparation giving an estimated cost without entrance into Liverpool Street station, as the officers of the Great Eastern Railway were of the opinion that it might jeopardise the safety of the public and the servants of the company to work electric trains over the very complicated and intricate system of permanent way leading into Liverpool Street.

ELECTRIC & GENERAL INVESTMENTS CO.—At the annual meeting on Wednesday last week, the report and accounts given in our issue of July 23rd were adopted. Mr. J. B. Braithwaite, the chairman, who presided, remarked that the business of the Company was a financial one specially connected with electrical investments, but as the past year had been one in which little or no finance of that character had taken place, the opportunities for carrying on a profitable business had been greatly curtailed, and they had had to rely almost entirely on their income from investments.

GREAT NORTHERN & CITY RAILWAY CO.—The directors' report shows that the total revenue receipts for the six months ending June 30th last amounted to £46,476, and the cost of working to £23,286, being at the rate of 50·10 per cent. Inclusive of the balance brought forward from December 31st last, and after providing for interest on debenture stock and other charges, and setting aside £500 to renewal fund, there remains a balance of £419, which your directors recommend be carried forward to next account. The number of passengers for the six months under review, including season ticket holders, was 6,875,602, as against 8,269,455 for the corresponding period last year. The heavy falling off in the number of passengers is attributable to the increasing competition of the London County Council's electrified tramways, by which the company is seriously affected.

GREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY CO.—The report for the half-year ending June 30th, 1908, states that the Bill promoted by the company, which was approved by the shareholders at the last half-yearly meeting, has passed into law, and under the provisions thereof 35,704 ordinary shares have been converted into preference shares as on and from July 1st, 1908, entitled, out of the profits of the company in each half-year, to a fixed preferential dividend at the rate of 4 per cent. per annum guaranteed by the Underground Electric Railways Co. of London, Ltd. The gross receipts amounted to £147,763, being an increase of £41,193, or 38·65 per cent., on the receipts for the corresponding half of 1970. The working expenses amount to £74,980, being a decrease of £810, or 1·07 per cent. After providing for interest and rents and for dividend at the rate of 4 per cent. per annum on the preference shares, there remains a balance of £22,475 available for dividend on the ordinary shares, and the directors recommend that a dividend at the rate of ¾ per cent. per annum be declared on the amount paid up on the ordinary shares, leaving a balance of £4,886 14s. 9d. to be carried to next half-year's account. The number of passengers carried was 17,446,477, an increase of 5,492,718 over the corresponding period of 1907. The meeting is on August 11th.

LANCASHIRE & YORKSHIRE RAILWAY CO.—The gross revenue for the June half-year shows a decrease of £57,152 and the gross working expenses an increase of £33,960, resulting in a balance on revenue account of £1,068,449, as compared with £1,159,561 in the corresponding half-year. There is an increase of £5,338 in the charges for interest on loans and debenture stock, £2,658 of which is caused by the conversion of the West Lancashire Railway debenture interest stock into Lancashire and Yorkshire debenture stock, in accordance with the provisions of the Act of Parliament of 1897, with a consequent decrease of that amount in the West Lancashire rent charge, and an increase of £6,418 in general interest and bankers' interest. The net revenue balance available for distribution is £785,020, as compared with £877,432 in the corresponding half-year. The balance, after meeting the charge for interest on guaranteed and preference stocks, amounts to £304,225, which is available for dividend on the ordinary stock, out of which the directors recommend a dividend of 3 per cent. per annum, and to carry forward a balance of £22,133 to the next account, as against 4 per cent. per annum for the corresponding period with a balance forward of £21,679. The amount of capital expended during the half-year for general purposes has been £201,292 against £235,907 authorised by the shareholders at the last half-yearly meeting. At the ensuing meeting the directors will ask for authority to expend £177,922 on capital account for general purposes during the current half-year. The reduction in net revenue available for dividend has been entirely brought about by the very unsatisfactory state of trade. Commencing in January last, the fall in imports and exports throughout the country has been month by month very considerable; in addition to which, notwithstanding that every effort has been made in the direction of economy, the expenses show an increase, largely under the head of coal, but there will be some relief so far as this item of expenditure is concerned during the current half-year. At the meeting yesterday the report and accounts were adopted.

LANCASHIRE ELECTRIC POWER CO.—A special meeting was held in London on Wednesday last week to confirm the

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resolution passed at the ordinary general meeting, appointing Mr. H. F. Parshall chairman of the company at a salary of £1,000 per annum, and a commission of 10 per cent. on all profits above £20,000, calculated before charging interest on the debenture stock and income bonds, and also appointing as directors Sir R. A. Hampson, Mr. J. Young, and Mr. J. L. Rushton. The resolution also increased the capital of the company by the creation of income bonds for £100,000. The resolution was carried.

LIVERPOOL OVERHEAD RAILWAY CO.—The report for the half-year to June 30th, 1908, shows gross revenue receipts amounting to £37,868, and working expenses to £30,511. The number of passengers carried during the half-year was 5,367,286, compared with 5,423,595 in the corresponding half-year of 1907. The falling off in the traffic is attributed to the shrinkage in trade and the considerable number of steamers laid up. After deducting interest on mortgage debentures, and on calls paid in advance, viz., 4,329, there remain, with the balance brought forward from December 31st, 1907, the sum of £7,206 available for dividend. Out of this balance the directors recommend a dividend of 5 per cent. per annum on the (1892) preference shares (less income tax), leaving a balance of £4,206 16s. 9d. to be carried forward to next half-year. The meeting is on the 11th inst.

METROPOLITAN DISTRICT RAILWAY CO.—The report for the half-year ended June 30th, 1908, states that the expenditure on capital account during the half-year has been £59,499. The gross receipts amount to £247,900, being an increase of £27,272 on the receipts for the corresponding half of 1907. The working expenses amount to £154,829, being an increase of £10,893. After providing for rent charges, interest on debenture stock, and other charges, the net revenue account shows a deficit of £8,951. To this deficit must be added the sum of £10,937, being the company's proportion of net revenue arising from the City lines joint undertaking, which, although included in the net revenue account, is not available for payment of debenture interest, being specially appropriated to the payment of dividend on the 4 per cent. guaranteed stock. With the above-mentioned addition, the deficiency for the half-year chargeable to capital under the company's statutory powers is £19,889, as compared with £28,191 in the corresponding half of 1907. The dividend payable on the 4 per cent. guaranteed stock is at the rate of £1 15s. per cent. per annum. The number of passengers carried during the half year was 29,626,586, an increase of 4,199,761 over the corresponding period of 1907. The bill, which was approved at the last half-yearly meeting, has now become law. It is proposed to issue £550,000 of the authorised £750,000 prior lien debenture stock during the current half-year, bearing interest at the rate of 4 per cent. per annum, and redeemable at the price of 105 per cent. on or at any time after December 31st, 1920, and, out of the proceeds of the issue, the existing charges on the company's surplus lands, amounting to £478,175, will be paid off. The meeting is on the 12th inst.

METROPOLITAN RAILWAY CO.—At the half-yearly meeting on Thursday, the report and accounts given in our last issue were adopted. Sir Charles McLaren, Bart., M.P., who presided, said that there had been a very large diminution in receipts from first-class passengers, which, however, had been more than made good by the satisfactory increase in the third-class traffic. They had again suffered from the effects of omnibus, tube, and tramway competition, but he was happy to say that as far as the two former were concerned, the directors believed they had now reached the period when the maximum loss from that competition had been ascertained. A satisfactory feature of the half-year's working was that the average receipts per passenger had increased from 1·599d. to 1·465d. At present they were carrying a large number of passengers at fares which were not remunerative, but they had been forced to do this by the action of their competitors.

Royal Assent.—Royal assent was given to the following, amongst other Bills, on Saturday:—Telegraph (Construction) Act; Ayr Corporation Tramways Order Confirmation Act; Electric Lighting Orders Confirmation (No. 1) Act; Electric Lighting Order Confirmation (No. 2) Act; Electric Lighting Order Confirmation (No. 3) Act; Lanarkshire Tramways Order Confirmation Act; Paisley District Tramways Order Confirmation Act; Tramways Order Confirmation (No. 2) Act; North-East London Railway Act; King's College London (Transfer) Act; Bristol Tramways Act; Leicester Corporation Act; Doncaster Corporation Act; Metropolitan District Railway Act; Leeds Corporation Act; South Wales Electrical Power Distribution Co. Act; Wishaw Burgh Electricity, &c., Act; Wolverhampton Corporation Act; Finchley Urban District Council Act; London County Council (Tramways and Improvements) Act; Macclesfield and District Tramways (Abandonment) Act; Metropolitan Electric Tramways Act; Blackburn Corporation Act; Keighley Corporation Act; Gt. Northern, Piccadilly, & Brompton Railway Act; London United Tramways Act; Nottinghamshire and Derbyshire Tramways Act; Central Ireland Electric Power Act; Ravensthorpe Urban District Council Act.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire-bars, net c.i.f. port of arrival, quoted on Tuesday night, was £61 5s. to £61 15s. per ton (last week, £60 10s. to £61 per ton).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Dolter Electric Traction, Ltd., is to be wound up voluntarily. Mr. W. S. Ogle, 90 Cannon Street, London, is liquidator.

COMPANY MORTGAGES, &c.

ICAN DIRECT TELEGRAPH CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date, and not required to be registered under Section 14 of the Companies Act, 1900, has been filed pursuaant to Section 12 of the Companies Act, 1907. Particulars—Debentures, dated February 23rd, and March 22nd, 1895, on which £28,200 is outstanding.

ANGLO-ARGENTINE TRAMWAYS CO.—A statement of the total amount outstanding on July 1st, in respect of mortgages and charges created prior to the date and not required to be registered under Section 14 of the Companies Act, 1900, has been filed pursuant to Section 12 of the Companies Act, 1907. Particulars—Indenture dated August 13th, 1888, securing £266,600 debenture stock, charged on company's concessions, tramways, stations, and property.

CENTRAL ELECTRIC SUPPLY CO.—A charge under the Land Transfer Acts, 1875 to 1897, dated June 15th, 1908, to secure £50,000 further stock and a premium of £5,000 thereon (supplemental to a trust deed, dated July 2nd, 1901, securing £250,000), has been registered. Property charged—Certain land in Marylebone. Trustees—Right Hon. A. Lyttelton, K.C., 3 Paper Buildings, Temple, E.C., and William Hayes Fisher, 13 Buckingham Palace Gardens, S.W.

A. C. COSSOR.—Particulars of £3,500 debentures, created by resolution of July 9th, 1908, have been filed pursuant to Section 10 (3) of the Companaies Act, 1907. Property charged—The company's assets, present and future, including uncalled capital. There are no trustees.

NAIROBI ELECTRIC POWER & LIGHTING CO.—Particulars have been filed of £4,000 6 per cent first mortgage debentures created by a resolution on April 8th, 1908. Property charged The company's undertaking and property, present and future, including uncalled capital, but excluding £1,500 deposited in the joint names of the Crown Agents for the Colonies with the National Bank of India, Ltd.; capital uncalled on 10,000 preference and 6,000 ordinary shares, and a contract, dated July 20th, 1906, and all interest therein and power conferred thereby, save so far as the company shall hereafter, with the consent of H.M. Commissioners for the East Africa Protectorate, subject the same to such charge. No trustees. An issue of £600 debentures, part of above series, has also been registered.

ORIENTAL TELEPHONE & ELECTRIC CO.—A memorandum of satisfaction has been filed to the extent of £1,545 of a trust deed dated June 28th, 1905, securing £100,000 debenture stock.

SANDYCROFT FOUNDRY CO.—Particulars have been filed of £20,000 6 per cent. debentures created by a resolution on April 16th, 1908. Property charged, the company's undertaking, present and future, including uncalled capital. There are no trustees.

UNITY MOTOR ELECTRICAL & GENERAL ENGINEERING CO.—Particulars of £1,000 5 per cent. debentures, created by resolution of July 4th, 1908, have been filed pursuant to Section 10 (3) of the Companies Act, 1907. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees. Issue on same date of £325 debentures, part of above series, also registered.

VICKERS SONS & MAXIM.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Section 14 of the Companies Act, 1900, has been filed pursuant to Section 12 of the Companies Act, 1907. Particulars—Trust deed, dated November 16th, 1897, securing £1,250,000 debenture stock, charged on freeholds, leaseholds, and other assets of the company, including uncalled capital.

Congress on Electrical Units and Standards.—The President of the Board of Trade has appointed the Lord Rayleigh, P.C., O.M., Professor J. J. Thomson, F.R.S., Dr. R. T. Glazebrook, F.R.S., Sir John Gavey, K.C.B., and Mr. A. P. Trotter to be the British Delegates to the International Conference on Electrical Units and Standards which is to assemble in London on October 12th. Mr. W. Duddell, F.R.S., and Mr. M. J. Collins (Board of Trade) will act as Secretaries to the British Delegates, and Mr. F. E. Smith and Mr. C. W. S. Crawley as Assistant Secretaries. We gave particulars of the objects and scope of the Congress in ELECTRICAL ENGINEERING, Vol. III., p. 894.

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NEW COMPANIES

BALCHIN, SCHULZ & CO.—This company was registered on July 13th, with a capital of £10,000 in £1 shares (7,500 5 per cent. cumulative preference), to adopt an agreement between H. A. Balchin, G. F. Schulz, and C. H. Hayward of the first part, H. A. Woodman and F. Coomber of the second part, and the company of the third part, for the acquisition of the businesses (1) carried on by the said H A. Balchin, G. F. Schulz, and C. H. Hayward as "Balchin, Schulz, and Co.," at Lennox House, Norfolk Street, W.C., and (2) carried on by the said H. A. Woodman and F. Coomber, as "Armitage & Co.," at 27a Gloucester Street, Queen Square, W.C., and to carry on the business of electrical and mechanical engineers, founders, manufacturers of agricultural implements and other machinery, &c. The subscribers are: H. A. Balchin, G. F. Schulz, C. H. Hayward, H. A. Woodman, and F. Coomber. Private company. The number of directors is not to be less than three, nor more than seven; the first are H. A. Balchin, G. F. Schulz, C. H. Hayward, H. A. Woodman, and E. Coomber (all permanent, subject to holding 200 shares each). Qualification of ordinary directors, 100 shares. Registered office, Lennox House, Norfolk Street, Strand, W.C.

DEY TIME REGISTERS.—This company was registered on July 13th, with a capital of £50,000 in £1 shares (15,000 6 per cent. cumulative preference), to take over the business carried on at Liverpool, London, Glasgow, Paris, Brussels, or elsewhere, as patentees, inventors, and manufacturers of and dealers in time recorders, tell-tale and other clocks and watches, time stamps, horological instruments, slips, sheets, cards, discs, crates, boxes, and cases, and other articles and mechanism, as "Howard Bros.," and to adopt an agreement with F. M. Howard, W. R. Howard, E. S. Howard, and W. T. Jolliffe, and to carry on the said business and that of electrical engineers and contractors, suppliers of electricity, synchronisers of clocks and timepieces, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic, and other apparatus, &c. The subscribers are: F. M. Howard, W. R. Howard, E. S. Howard, and W. T. Jolliffe. Private company The number of directors is not to be less than three, nor more than seven; the first are: F. M. Howard and E. S. Howard (joint managing directors), and W. R. Howard (all permanent, subject to holding 1,000 shares). Qualification of ordinary directors, 100 shares. Remuneration of joint managing directors, £500 each per annum, and 5 per cent. of the surplus profits in excess of £6,000; of the other directors, £200 per annum. Registered offices, 40 Paradise Street, Liverpool.

ELECTRICAL REGULATORS & ECONOMISERS.—This company was registered on July 13th, with a capital of £2,000 in £1 shares, to acquire and turn to account certain patent rights granted or to be granted to H. S. Martin, of Liverpool, relating to improvements in electric resistance, to make experiments in and exhibitions of applied electricity, magnetism, or similar agencies, &c. The subscribers are: C. T. Wood, E. H. W Butterworth, R. M. Grierson, and H. S. Martin. Private company. Table "A" mainly applies. Registered office, 51 North John Street, Liverpool.

PARIS ACCUMULATOR CO.—This company was registered on July 14th with a capital of £3,000 in £1 shares to acquire the business of an accumulator manufacturer and assembler, carried on by S. Leuchters, trading as the "Paris Accumulator Co." at 14 Park Cross Street, Leeds, and to carry on the same and the business of manufacturers in motor-cabs, motor-cycles, &c. Private company with two subscribers, viz., S. Leuchters, 14 Park Cross Street, Leeds, accumulator expert; and W. Wainwright, 61 Lodge Lane, Beeston Hill, Leeds, pork butcher, each signing for one share. The first directors are S. Leuchters (permanent managing director and chairman) and W. Wainwright. Qualification, 100 shares. Remuneration of S. Leuchters, £250 per annum. Table "A" mainly applies. Registered office, 14 Park Cross Street, Leeds.

URUGUAY EAST COAST RAILWAY CO.—This company was registered on July 14th, with a capital of £125,000 in £1 shares, to acquire from the Government of the Republic of Uruguay a concession for working an existing line of railway from Olmos Junction to La Sierra, and for constructing, equipping, and working extensions thereof from La Sierra to Maldonada, and to Rocha and elsewhere, and to adopt an agreement with the Uruguay Great Eastern Railway Co., Ltd. The subscribers are: G. Grinnell-Milne, G. Hannaford, A. L. Secretan, F. A. Kentfield, R. A. Woirley, T. Merrylees, A. Frewin. The number of directors is not to be less than three, nor more than six; the first are G. Grinnell-Milne (representing the holders of first charge debentures), G. Hannaford (representing holders of income debenture stock), and A. Frewin (representing the shareholders). Qualification of director representing shareholders, 400 shares. Remuneration, £2,000 per annum, dividend. The directors shall, in accordance with the said agreement, create a series of 5 per cent. first charge debentures not exceeding in the first instance £315,000 in nominal value, which limit may be increased by £5,000 for every kilometre of railway hereafter constructed under the new concession referred to in the said agreement in excess of 63 kilometres, and shall also create £184,900 income debenture stock with interest at 4 per cent. payable during the first three years from issue only out of the net revenue of the company. Registered office, Salisbury House, London Wall, E.C.

MISCELLANEOUS CITY NOTES

ARMSTRONG, WHITWORTH & CO.—An extraordinary general meeting has been called for the 7th inst., at Newcastle, for the purpose of considering, and, if thought fit, passing a resolution authorising the raising or borrowing at interest, for the purposes of the company, a sum not exceeding £1,000,000.

BAKER STREET & WATERLOO RAILWAY CO.—A dividend of 4 per cent. per annum is recommended upon the preference shares and ¾ per cent. per annum on the ordinary shares. The holders of ordinary shares other than the Underground Co. will receive an additional dividend of 2¼ per cent. per annum (making 3 per cent. per annum in all) out of moneys payable by the Underground Electric Railways Co. of London under the guarantee agreement.

CHARING CROSS, EUSTON & HAMPSTEAD RAILWAY CO.—Subject to final audit the accounts for the June half-year show net revenue sufficient to pay interest on the total authorised debenture stock. The carry forward is £832.

CHARING CROSS, WEST END, & CITY ELECTRICITY SUPPLY CO.—The directors have declared an interim dividend at the rate of 5 per cent. per annum on the ordinary shares of the West End undertaking, and increased the carry forward in the case of the West End undertaking to £4,748, and in the case of the City undertaking to £4,591. The figures for the half-year ended June 30th, 1908, as compared with the corresponding period of last year (excluding the bulk supply from one undertaking to the other) are:—

West End: Units sold (1907) 5,098,880, (1908) 5,509,773; Revenue (1907) £65,093, (1908) £68,237. *City:* Units sold (1907) 4,234,589, (1908) 4,792,333; Revenue (1907) £46,372, (1908) £50,114.

GREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY CO.—The directors recommend the payment of interest at the rate of 4 per cent. per annum on 35,704 shares, which have been converted from ordinary into preference shares, in addition to a dividend of ¾ per cent. per annum on the ordinary share capital. The carry forward is £4,886.

W. T. HENLEY'S TELEGRAPH WORKS CO.—An interim dividend of 10 per cent. per annum for the half-year to June 30th has been declared upon the ordinary shares.

KENSINGTON & KNIGHTSBRIDGE ELECTRIC LIGHTING CO.—A dividend of 8 per cent. per annum (4s. per share) less income tax has been declared upon the ordinary shares for the last half-year.

LIVERPOOL DISTRICT LIGHTING CO.—An interim dividend at the rate of 5 per cent. per annum for the June half-year is recommended.

METROPOLITAN ELECTRIC SUPPLY CO.—An interim dividend of 5 per cent. per annum (2s. 6d. per share) has been declared upon the ordinary shares for the past half-year.

METROPOLITAN DISTRICT RAILWAY CO.—A dividend on the 4 per cent. guaranteed stock for the past six months has been recommended at the rate of 1¾ per cent. per annum.

THOMAS PARKER.—An extraordinary general meeting was held in Wolverhampton on Wednesday last, when the following resolution was passed and confirmed at a subsequent extraordinary general meeting:—"That it is desirable to make further provision for the reconstruction of the company, and accordingly that the draft agreement submitted to this meeting and expressed to be made between the company and its liquidator of the one part, and the proposed new or reconstructed company, namely, the Rees Roturbo Manufacturing Co., Ltd., of the other part, whereby provision is made for the transfer of the undertaking of this company to such new company on the terms therein set forth, and the draft Memorandum and Articles of Association of such proposed new company also submitted to this meeting, be and the same are hereby respectively approved; and that this company be wound up voluntarily, and that Mr. William Arthur Nelson, Incorporated Accountant, of Lich Gate, Wolverhampton, be and he is hereby appointed liquidator thereof, and that such liquidater be and he is hereby authorised and empowered to enter into an agreement with the new company, when formed, in the terms of the said draft and to carry such agreement into effect with such, if any, modifications as he may think fit to assent to, and that for the purposes aforesaid the said liquidator may exercise all or any of the powers, authorities, and discretions capable of being conferred on him under sections 160 and 161 of the Companies Act, 1862."

WALSALL ELECTRICAL CO. In the Chancery Division last week, Mr. Justice Swinfen Eady sanctioned the reduction of the capital of this company by £4,380.

WESTMINSTER ELECTRIC SUPPLY CORPORATION.—An interim dividend for the June half-year at the rate of 10 per cent. per annum, less tax, is recommended.

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ELECTRICAL ENGINEERING

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SUMMARY

A strike of about 100 boiler-hands took place at the works of the Paris electricity supply companies, at eight o'clock last Thursday, causing an interruption of the supply for about 70 minutes, after which the men resumed work (Page 238.)

An inquest was held on Tuesday into the death of a boy, five years old, who had strayed on to the Metropolitan Railway line near Notting Hill, and was found with his wrist upon the positive rail, and his body upon the running rail. (Page 238.)

A single-phase goods locomotive has recently been taken into use on the Windsor, Essex and Lake Shore Railway in Canada. (Page 238.)

The following books are reviewed in this issue:—"Radio-telegraphy," by C. C. F. Monckton; "Electrometallurgy," by J. B. C. Kershaw; "Elementary Manual on Mechanics," by A. Jamieson; "Switchboard Measuring Instruments for Continuous and Polyphase Systems," by J. C. Connan; "The Deinhardt-Schloman Series of Technical Dictionaries in Six Languages, Vol. III."; "The Calculus for Engineers and Physicists," by R. H. Smith; "First Stage Steam," by J. W. Hayward; "Telephones, Their Construction, Installation, Wiring, Operation, and Maintenance," by W. H. Ratcliffe and H. C. Cushing; "Electric Bells and All About Them," by S. R. Bottone; "Questions and Answers in Electrical Engineering," by A. E. Moore and F. Shaw; "The Electron." (Page 239.)

An illustrated article on the functions of flywheels in electrical generating plants shows that flywheels are used to reduce variations in speed arising from uneven turning movement in prime movers, and rapid fluctuations of the external load, and to improve the parallel running of alternators by preventing correspondence between the free oscillation period of the alternators, and the cyclic irregularity of turning movement of the engines, which would set up resonance. The quantitative elements required for practical design are given. The applications of flywheels to converting sets, and to winding and rolling machinery are briefly discussed. (Page 241.)

An article by E. Goolding deals with the question of rail creeping, more particularly as regards the conductor rail on electric railways. The results of a series of observations on the North-Eastern Railway are given, and the influence of a number of causes is discussed. (Page 244.)

An article by Mr. L. H. Walter considers the relative merits of a number of systems of wireless telephony, which have been suggested and used, both as regards the methods of arranging the microphone in the sending apparatus to control the oscillations, and

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the most suitable forms of detector for this class of work. (Page 247.)

The Locarno-Bignasco railway in the Maggia Valley, Switzerland, is of interest as one of the latest examples of Swiss single-phase lines. The overhead conductor is supplied at 5,000 volts over most of the line, but a pressure of 800 volts is used in the urban sections. The cars are provided with two independent collectors. That for the high-voltage system is of the Oerlikon curved bar pattern, while a bow collector is in use on the 800-volt sections. The motor coaches are each equipped with four 40-h.p. motors of the Oerlikon single-phase commutator type, supplied in the usual way with auto-transformers, of which two are carried on each car. (Page 249.)

An electrical equipment which replaces steam driving is at work in the Rubislaw granite quarries near Aberdeen. Current is taken from the mains of the Aberdeen Corporation and the applications of electrical power include ten cranes, a system of aërial ropeways, pumps, air-compressors, and the driving of stone-breaking, crushing and screening plant. (Page 251.)

The reports of H.M. Inspectors of Mines for the various districts contain a good deal of information regarding the use of electricity in mines. In addition to the comparative statistics as to the use of electric and other coal-cutting machinery, which we have already summarised, accounts are given of all the principal accidents attributed during the year under review to electrical causes, both fatal and non-fatal. It is pointed out how many of these could have been avoided by a closer observance of the Home Office special rules regarding electricity in mines. (Page 253.)

Among the papers read at the recent meeting of the Institution of Mechanical Engineers at Bristol was one by Mr. S. O. Cowper-Coles in which, after a short historical introduction, he described the centrifugal electrolytic process for the direct production of copper tubes, sheets and wire. (Page 255.)

The Ottawa branch of the Royal Mint has a very complete and modern system of electric driving. Rolling mills, cutting machines, and coining presses are geared direct to motors and the smaller machines are driven in groups from shafting. The Mint has its own sub-station, in which the two-phase alternating current supplied is transformed into low-pressure alternating for the lighting events and into continuous current for the power circuits. (Page 256.)

Under Electrometallurgy and Electrochemistry attention is drawn to the recent advances in electrochemistry as applied to metal depositions. One of the great difficulties met with has been, especially in the case of gold plating, the corrosion of the anodes. Anodes of carborundum are now suggested, and it is stated that they are practically unacted upon when employed even in such corrosive electrolytes as strong hydrochloric acid. (Page 257.)

Under Electrical Science, in the British and American Section, are notes on a new form of selenium cell and on a battery designed to yield very constant small currents. In the papers abstracted in the Continental Section, Tissot replies to Branly's criticism of his thermoelectric detectors; Gripenberg gives instructions how to deposit selenium by sublimation; and Almy investigates sparking potentials in microscopic spark gaps. (Page 258.)

The patents published last week, of which we give abstracts on a later page, include two relating to conduit systems of house wiring. The Auer Company patent the use of wire made of nickel and copper, either mechanically combined or in an alloy, for the leading-in wires of tungsten lamps. A new arrangement of field switch connections is described by the British Thomson-Houston Co., in which the field and adjustable resistance is first connected as a shunt to the field itself and then as a shunt to a fixed resistance in series with the field, and Siemens Brothers Dynamo Works have patented a speed controlling device for hoisting motors which releases a check brake when too high a speed is reached. Siemens & Halske patent the use of silicon in higher proportions than 1 per cent. for hardening tantalum without materially impairing the ductility of the latter metal, and Hermann Aron has a very broad patent for a multiple maximum demand indicator combined with a multiple tariff meter. A specification by the British Thomson-Houston Co. deals with the neutralisation of the inductive action on telephone and telegraph wires on single-phase railways. (Page 258.)

An agreement has been come to with the Admiralty by the Aberdeen Corporation for a supply of electrical energy to the proposed wireless telegraph station at Stoneywood, the terms being £350 per annum for five years, plus 3½d. per unit.—The agreement with the London, Brighton and South Coast Railway for a supply to their Brighton works was confirmed at the last meeting of the Corporation.—There was a gross revenue of £115,318 upon the Glasgow Corporation tramways for the year to May 31st. The net balance, after deducting capital charges, is £51,061. No less than £50,000 has been writen off for depreciation.—A deputation from the Manchester Tramways Committee is to visit the Continent to investigate the possibilities of trolley omnibuses for the outlying districts. During the past twelve months the sum of £15,000 was paid by the Manchester Tramways Committee as compensation for tramway accidents.—The "rateable value" basis of charging for electric supply has been adopted at Nuneaton.—An application has been made to the Oxford Corporation by the Electric Vehicles Development Co. for permission to run electric omnibuses.—The Salford tramway accounts for the year to March 31st show a gross profit of £96,761. The contribution in aid of the rates amounts to £18,000.—The first portion of the overhead trolley line erected in place of the Dolter surface contact system between Rawmarsh and Mexborough, has been opened for traffic.—A new 1,000-h.p. set has been added at the Leith electricity works. (Page 261.)

Extensions to the Aberdeen Electricity Works are to be carried out at a cost of £16,000.—Local Government Board inquiries have been held at Derby (£7,500), St. Anne's-on-Sea (£3,500), Southampton (£3,000), and Whitehaven (£1,700).—The London County Council require low-tension cables, high- and low-tension switchgear, and six 500-kw. and one 150-kw. motor generators.—A surface-condensing plant is required at Reigate. (Pages 264–266.)

At the half-yearly meeting of the Baker Street and Waterloo Railway Co., on Monday, Sir George Gibb made special reference to the exchange of passengers between London tube railways, and stated that in co-operation of working lay the best hope for the prosperity of urban railways.—Sir Henry Oakley, presiding at the half-yearly meeting of the Central London Railway on Thursday, mentioned that during the first six weeks of the Franco-British Exhibition they had carried 676,000 more passengers than in the corresponding period of last year.—The report of Edmundsons Electricity Corporation for the year ended March 31st, 1908, shows a net profit of £2,610, which is increased to £20,417 with the balance brought forward from the previous year. Mr. P. D. Tuckett, the chairman of the company, at the meeting on Thursday, said that the reduction in trading profits was accounted for by a smaller turnover and by the fact that the local authority losses had been charged against profit instead of reserve as formerly.—At the meetings of the Great Northern & City Railway Co. and the North London Railway Co., complaints were made of the effect of tramway competition. (Pages 267–269.)

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The annual reports of H.M. Inspectors of Mines, extracts from which we publish on a later page, throw interesting light on the conditions under which electrical working is carried on. In a previous issue we gave some statistics regarding the use of electrical coal cutting machinery, and our article this week relates to investigations of accidents connected in one way or another with the electrical plant generally. One cannot help being struck with the small number of such accidents, considering the extent of the applications of electricity in mining, but examining the circumstances from another point of view, it is apparent that a large proportion of the comparatively few accidents that did occur would have been prevented by a closer observance of the special rules of the Home Office issued for this particular purpose. That these rules are valuable in preventing risks that might otherwise be present, is vouched for by more than one inspector. On the other hand, pure carelessness has been responsible for a number of accidents, while there have also been some cases in which what might at first sight appear to be carelessness might more accurately be ascribed to ignorance of the danger caused by lack of familiarity with the application of electricity. Improvement may be anticipated in this direction, however, for one inspector emphasises how quickly persons in charge of electrical machinery have been able to grasp its details and its dangers, and have learned to handle it with absolute safety. Taken all round the record is highly creditable, and when reading the collected accounts of such few electrical accidents which have occurred in the hundreds of collieries where electricity plays a part, one must not forget the other side of the account—namely, the number of cases in which possible risk of accident has been avoided by these improved methods of working.

It is to be hoped that one result of the closer *entente cordiale* between Great Britain and France may be the realisation, by our friends on the other side of the Channel, of the true difference between effective organisation and organised officialism. An example of the difference is afforded by the failure of the electric light over a large part of Paris for over an hour last Thursday. The new company that has taken over the concessions of the Paris electricity supply companies, and has been granted an extension of the monopoly, has had to pay a high price for these favours—so high a price, in fact, that the cost of electricity in Paris is destined to remain for many years far higher than the cost in London. A long and complicated agreement has been drawn up, in which the interests of the workmen and employees are safeguarded. This agreement has also provided for a standing committee, upon which the Municipal Council is strongly represented, to see that all the various conditions and restrictions are observed, and the cost to the consumer of the "red tape" with which the electricity supply business is bound up is probably an appreciable percentage of the price he pays for electrical energy. Yet the simple organisation necessary to guard against the results of a strike of stokers has been disregarded, although there was a serious enough warning about eighteen months ago, when the whole electricity supply in Paris was suspended for 29 hours through a similar cause. If the boiler hands in any one of the electricity works in London struck work, there would be enough volunteers to take their place before the steam pressure had dropped sufficiently to necessitate a cessation of supply. In Paris, in spite of—or perhaps because of—the municipal control, things are very different, and the decision of a few men to cease work upon an arbitrary order of a Trades Union secretary is sufficient to do irretrievable damage to the electricity supply industry. It is stated that the whole trouble was due to 100 stokers striking work, and yet it appears that these 100 stokers, in spite of their wilful neglect of discipline, and their obvious violation of the terms upon which they are engaged, are still in the service of the electric lighting companies. Had a similar strike occurred in the various London electricity works, the probable course would have been that telephone messages would have been sent to the various police stations and men off duty would have been sent as volunteer stokers, while men on duty would have been told off to protect them. While these were coming, there would have been a sufficient number of hands in the station to keep the pressure up. Moreover, we cannot but think that here an arbitrary strike of this sort would have been punishable as a criminal offence in view of the serious public danger consequent upon a total extinction of the lights. In addition to the public inconvenience caused by the Paris strike, there is no doubt that this second attack will have done great damage to the electrical industry in France generally. The public has begun to lose confidence in an illuminant which to all appearances is dependent on keeping a number of workmen and employés in good humour, and the continuity of which can be broken by the irresponsible action of a hundred dissatisfied stokers. Already there is a tendency in Paris to revert to gas lighting, and motor-users are getting nervous also. As is well known, a loss of consumers has its effect not only on the supply companies but on every branch of the electrical industry, for it means a diminution in the output of machinery, lamps, and all the numerous accessories, and a drop in the volume of contracting work. In their own interests, the electrical community in Paris should not take this blow "lying down," and no step should be spared to bring the offenders to justice. Even a socialistic people can surely realise that a general loss of this nature reacts on the workmen themselves, and that the action of this band of stokers may eventually result in throwing thousands of other hands out of work. Punishment not only of the strike leaders, but also of the strikers, should be brought about if there is any means of effecting this.

Telegraph Traffic.—There are a few more announcements to make this week in regard to interruptions and repairs of telegraphic communication. The opening of the new cable between Sevastopol and Varna in Bulgaria took place on the 2nd inst. The cable between Kotonon and Grand Bassam, interrupted on July 20th last, was again restored to working order on the 4th inst. On the following day a break occurred in the cable connecting Kwandang and Menado, in consequence of which telegrams will be transmitted *viâ* Yab to the latter place and those for other places *viâ* Penang-Singapore or Saigon. The Indo-European Telegraph Co. have suffered an interruption to their land-line between Djoulfa and Tabriz, which took place on the 6th inst., but was repaired on the following day, and again interrupted on the 8th inst. The cable betwen Cadiz and Tangier, which has been inoperative since June 3rd last, was put into working order once more on the 8th inst. The cable between Trinidad and Demerara, British Guiana, once more succumbed on the 31st ult., but was repaired on the 9th inst. by the company's own repairing steamer.

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STRIKE AT THE PARIS ELECTRICITY WORKS

LAST Thursday the stokers at practically all the Paris electricity supply works repeated on a smaller scale their strike of last year. On this occasion it appears that, instead of a regular strike, a cessation of work for two hours was ordered, and the actual interruption of supply lasted 70 minutes. This was, however, sufficiently serious, as the time chosen for stopping work was 8 p.m., when the theatres and music-halls are giving their performances, and the business at the cafés is at its briskest, and also when the traffic in the central streets is considerable.

The workmen's syndicate and the companies are still at issue over a number of minor details relating chiefly to contributions to superannuation and widows' funds, &c., and the syndicate has, moreover, not been definitely recognised by two of the companies. No definite grievance or hardship has been alleged by the workmen themselves, however, and some of the Paris correspondents regard the incident as a "joke" on the part of the secretary of the electric light workers' trade union, a man named Pataud. According to some accounts, the Confédération Generale de Travail, the general Labour Council, had expressed a doubt whether Pataud's organisation of his union was effective, and he thereupon issued strike notices in order to demonstrate this. These notices were issued to all the men employed by the electricity companies, and some 100 stokers obeyed the mandate, striking work but remaining at their posts presumably to intimidate others from taking their places.

It appears that some sort of action has now been taken by the managers of the electricity works to prevent a recurrence of this incident, for the reports of an interview between them and M. Clemenceau (the Premier and Minister of the Interior), state that they expressed their confidence that their organisation was now sufficient for this without outside assistance. Nevertheless, M. Clemenceau has given orders for a detachment of Army Engineers, sufficient to take the places of the men in the electricity works, to be posted in Paris.

A Paris correspondent informs us that the Edison Company has been successful in an action brought against them by the administration of the Comédie Française for damages owing to the fact that the theatre was unable to give performances on March 8th and 9th last year, the date of the former strike. The defence was *force majeure* and that the company was guilty of no negligence as the strike was impossible to foresee.

Electric Traction in Lancashire.—The *Pall Mall Gazette* states that the Midland and London & North-Western Railway Companies propose converting some portions of their lines in Lancashire and the Midlands to electric traction. The Lancashire & Yorkshire Company, it is stated, also intend constructing additional electric railways in Lancashire.

Fatal Accident on Metropolitan Railway. An inquest was held on Tuesday at the Kensington Coroner's Court upon the five-year-old son of a labourer living in North Kensington, who was found lying dead upon the positive rail of the Metropolitan Railway on Saturday. It appears that the child was staying at a relative's house at Acklam-road, Kensington, which backs on to the line, and was thought to be in the garden, but had apparently climbed the low wall of the garden and got on to the railway. The driver of a train from Westbourne Park to Notting Hill stated that on Saturday morning when approaching Portobello-road Bridge, he saw smoke coming from the opposite line and noticed a child on the rails with its wrist on the positive rail and its body on the running rail. He stopped his train, and, taking a rubber mat, removed the body with it. The positive rail at this spot is protected by the usual wooden board. The landlord of the house said that the wall at the bottom of the garden was only 3 ft. high, and the coroner expressed the opinion that he ought to have warned his tenants of the danger of such a low wall in close proximity to the electric railway. The landlord gave an undertaking to rebuild the wall, and the jury, in returning a verdict of accidental death, stated that high railings should be placed at the backs of all the gardens at the spot in question. No amount of protection of conductor rails will prevent accidents like this, and it is quite probable that the child would have been run over and killed by a train even if the line had been working by steam.

A SINGLE-PHASE GOODS LOCOMOTIVE

A DESCRIPTION is given in the *Electric Railway Journal* of a single-phase locomotive which has recently been completed for the Windsor, Essex, and Lake Shore Railway of Canada for use for such purposes as ballast and goods trains, and also for dealing with extra excursion passenger traffic. The locomotive is 35 tons in weight and of the following general dimensions:—Length, 37 ft.; width, 8 ft.; distance between centres of trucks, 20 ft. 3 in. In designing this locomotive special attention was paid to having motors, wheels, gears, and axles interchangeable with those on the motor-cars. The latter are equipped with two Westinghouse 100-h.p. motors in parallel, while in the locomotive there are four motors of the same type, the two motors on each truck being in series and the two sets in parallel. The weight of each motor is about 4,900 lb. The body is arranged with sliding doors, and has plenty of space which can be used for luggage. A driver's cab is provided at each end. The frame is mounted on two trucks with 36-in. wheels. The distance between centres of wheels is 6 ft. 6 in. The axles are 6 in. in diameter, and are the same as used on the interurban cars of the company. There is one motor on each axle. The weight of the truck with wheels and without motors is 9,750 lb. The locomotive is provided with the unit switch system of control of the ordinary Westinghouse type. A 104-volt tapping is taken from the main transformer for the circuit supplying the lights, the compressor motor and the motor generator for charging the batteries used on the control circuit. As the controller was originally arranged, the first step allowed of the closing of a sequence of the first four of the unit switches. This was, however, found to give more rapid acceleration than was convenient for shunting and such purpose, so an auxiliary control switch was added in each of the cabs in series, with one of the interlocking wires, so that the sequence of switches could be interrupted as soon as the second unit switch closed. The first voltage step was thus made 296 volts instead of 413 volts, the remaining four controller positions actuate the remainder of the unit switches, and apply progressive voltage steps up to 620 volts to the motors. All of the electrical apparatus, except the car motors, are placed inside the locomotive. The storage battery, motor generator, reverses, preventive coils, and the switch group are secured to a structure made of 4 in. × 4 in. angle iron placed in one corner of the locomotive. It was intended to use 1,100 volts in Windsor and 6,600 volts over the rest of the line, and the car equipment was so planned that a change to the lower voltage may be made without altering the equipment. The auto-transformer, which is oil-cooled and of 200-kw. capacity, is placed in a diagonally opposite corner from the switch group. The line switch is placed immediately above the auto-transformer, and is just below the pantograph collector. All the control wiring is in iron armoured conduit. All the control apparatus of the car, which includes the switch group, reverser, line switch, and pantograph, is electro-pneumatically operated. The air compressor, which is driven by a single-phase motor, is placed between the switch group and one of the sliding doors on the side.

So far the locomotive has only been used to pull gravel trains, and up to the present not more than six loaded flat cars have been hauled at one time. From the ease with which these cars are handled, it is probable that twelve flat cars loaded with gravel will make a fair load for the machine. The motors are geared to run the locomotive at a maximum speed of about 35 m.p.h., but it is found to run about 40 m.p.h. on level tangents.

Lowering Gear for Arc Lamps.—We have received from the London Electric Firm of Croydon particulars of some alterations to street arc lamp-posts which they have carried out to the order of Mr. Brydges, electrical engineer to the Corporation of Eastbourne. It appears that until recently all the arc lamps in the town were arranged with some form of lowering gear, except four standards of the "lyre" pattern. These have now been altered by the addition of an ingenious lowering arrangement. The contact and suspension device is fixed in the hood of the carrier. A cross-arm is fitted right through the hood, and a wire rope, working over pulleys, unlocks the suspension device, draws the lamp out horizontally clear of the pole, and then lowers it vertically. A single sustaining winch, fitted in the base of the pole (operated in the same direction all the while) performs the whole of these operations, and conversely re-hoisting and taking the weight of the lamp off the rope. The contact-suspension device is positive in action and does not depend on the operation of springs, levers, balls, clutches, or other similar contrivances, and, being on the concentric principle, does not require to be manœuvred to ensure correct polarity.

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REVIEWS OF BOOKS

Radio-Telegraphy. By C. C. F. Monckton. 263 pp. 5½ in. by 8¼ in. 173 illustrations. (London: Archibald Constable & Co.) 6s.

This book suggests a pupa breaking through its mathematical covering and showing itself as a fully developed insect. It also brings home to us that a new kind of electrical engineer has been quietly growing up in our midst without our recognising the fact.

The traction man knows plenty of telegraph men and enough of their work to take an intelligent interest in it; the telephone man has friends among the station engineers, and knows what the electrochemist is about—more or less. But how many of us know the wireless man? He has kept to his own class, for patent reasons probably, but he is here none the less; for wireless is no longer a mere mathematical theory, but has risen to the ranks of engineering.

In saying this there is no wish to minimise the work of the mathematical men of science. Wireless is due to them, and to them alone. The fact that it has commercial value, and that the public perhaps put that value too high, has given the means of carrying out the work, but the credit is theirs. None but the mathematician could deal with it at the start, and well has he risen to the occasion, but the ordinary engineer is taking his share now. The latter, as we said, is still a man apart, brought up to look at things from a different side to the ordinary man. The wireless man lives in a static world. A current, to him, is "something that happens when you charge a body"; that the same phenomenon occurs when you close a battery or dynamo circuit is interesting perhaps, but of minor importance. He will doubtless lose this feeling somewhat when he mixes with other engineers, but, on the other hand, let us hope that they will learn from him to regard displacement currents and the like as real live things; just as real commonplace facts as volts and amperes. They will then benefit as much as he, if not more. Mr. Monckton has the advantage of having been an electrical engineer, and an experienced one, before he specialised in wireless telegraphy. He is able, therefore, to take a broader view than the ordinary "wireless man," and his book ranks as a first-class engineering treatise. It deals with the whole matter without any mathematics at all, which is rather a *tour de force*. Some of his preliminary matter in the first 60 pp. he would perhaps have left out had he realised how much ordinary men know; some of it he might have expanded, had he realised how little. It is rather a pity that the author was brought up on tubes of force, and has not given them up yet. Though useful in their place, they are so bad for explanation, and convey such a very inadequate idea of facts to the average man. A few hydraulic or pneumatic analogies would have given a much clearer conception, and one feels that the author was quite able and willing to supply them had he known they would have appealed better to his readers, for he makes full and excellent use of the vibrating string when explaining waves and resonance.

We would advise the engineer who starts with a prejudice against wireless to begin at Chapter X., on measurements. When he finds that he is going to deal with average currents of two or three amperes going to line—just common amperes measured on an ammeter—and having a maximum value of some hundreds, he will realise that he is getting towards something he can appreciate. Mere volts, however big, he has but little respect for; but big volts "with the amperes behind them" are worth talking about. It will also appeal to him when he finds the whole problem of wireless expressed in his own language; given so many horse-power put in at one end, how to transmit it to the other with least loss: though he will, we fear, consider the efficiency of transmission somewhat low.

The different forms of aërial, earthed or insulated, close- or loose-coupled; the various receivers and other instruments, and little working difficulties, such as dawn and sunset troubles, are all now things in every-day work, and are described and explained by Mr. Monckton with no more reverence than a traction man uses to trolley pole.

The book closes with chapters on Lodge, Telefunken, and Poulsen experimental stations, field telegraphs and radio-telephony.

Printing and illustrations are alike excellent.

Electrometallurgy. By John B. C. Kershaw. 303 pp. 5½ in. by 8¼ in. 61 illustrations. (London: Archibald Constable and Co.) 6s.

The greatly increased interest which is being taken in electrochemistry and electrometallurgy is evidenced by the large amount of literature upon the subject which is being published. The book before us upon electrometallurgy commences with an historical survey, and in this section various definitions as to what electrometallurgy is, and as to how the electric current acts in refining are given. It would have been as well to leave out the definitions, as they convey nothing to one who does not know, and are so very inadequate to those who do know. We might point out that Davy did not commence to experiment with the electric current in 1806; he began at least five years earlier, but took up the subject again in 1806. It is extraordinary that so far back as 1851 Charles Watt took out a patent for electrochemical and electrometallurgical processes, in which he described how many processes might be carried out which only recently have been perfected, if we can ever call a process perfect, such, for example, as the production of the alkali metals, chlorine, hypochlorites, chlorates, and the refining of metals. In Watt's days it was out of the question to work any of these processes, because there was no possibility of obtaining suitable electrical energy. Although to-day the bulk of the copper, for geographical and geological reasons, is refined electrochemically in America, it must not be forgotten that it was Elkington in 1869 in this country who first erected a copper refining plant. In fact, so carefully was the process worked out that even to-day, when thousands of tons are being weekly refined by electrical methods, the process only differs in minor details to the initial one.

The descriptive part of the book commences with the production of aluminium. The rise of this industry is indeed remarkable. In 1886 the first attempts to obtain the metal by electrometallurgical methods were commenced by the brothers Cowles, and the process was worked both in this country and in America upon a considerable scale. It consisted in the reduction of alumina in a resistance furnace by means of carbon, but although it worked very well for the production of aluminium alloys, it could not be used for the manufacture of pure aluminium. It is extraordinary that just as the chemical processes for the manufacture of aluminium by reduction of aluminium chloride with sodium had reached its zenith, and the price of the metal had dropped to about 2s. 6d. per pound, it was forced out by the advent of a satisfactory electrochemical process. The methods of Héroult in France and Hall in America, which are essentially the same, were first introduced in 1888, and by 1890 compelled the hitherto successful works which employed the chemical process to shut down. Since then the production of aluminium has shown a steady increase, although the price has fluctuated considerably. We

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are not likely, however, to see any very great rise in the price of this commodity in the near future, owing to the number of new undertakings which have been or are about to be started. In connection with aluminium, the use of this substance in "thermit" is referred to, and an interesting photograph of the repair to the stern of a steamer is shown.

Beside purely electrometallurgical processes, the manufacture of glass and quartz by means of the electric furnace are also described. Quartz vessels are manufactured by the Thermal Syndicate at Wallsend-on-Tyne, so the author tells us. Is the author not aware that in London the Silica Syndicate, Ltd., produce transparent silica ware as distinct from the rather rough and non-transparent product of the Thermal Syndicate? It should, however, be pointed out that both forms have their particular uses.

The book will, we think, be found useful to those who wish for a general idea as to the position of the electrometallurgical industries. It is not written for those who are well up in the subject, because the author in his preface says that his "aim has been to give a brief and clear account . . . in language that can be understood by those whose acquaintance with chemical or electrical science may be but slight." A remark like this rather disarms criticism, but we are inclined to doubt the wisdom of writing books of this class for such a *clientèle*.

Elementary Manual on Applied Mechanics. By Andrew Jamieson. Eighth Edition. 455 pp. 4¾ in. by 7½ in. (London: Charles Griffin & Co.) 3s. 6d.

A REVISED and enlarged edition of this well-known text-book on applied mechanics. The additions include some notes on the terms and definitions of words used in measuring pressures; and a series of definitions emphasising the distinctions between solids, liquids, and gases, and between perfect, viscous, and elastic fluids. The chapter on measuring tools and gauges has been thoroughly revised, and now includes a detailed explanation of the uses of Limit Gauges and of Berridge's Tangentometer. The C.G.S. system units of measurement and their definitions, and the definitions of the practical electrical units have been added to an Appendix. The Examination Papers incorporated in the book now include the 1907 papers for Stage I. of the Board of Education; the City and Guilds of London, Ordinary Grade, Part I., 1907 papers on Mechanical Engineering; and the Entrance or Students' Examinations of the Institution of Civil Engineers in Elementary Mechanics for 1907 and February, 1908. The numerical answers to most of the questions are given. The contents of the body of the book are too well known to need comment, but attention may be drawn to the excellent chapter on the screw-cutting and other lathes, which contain a fully illustrated description of an electrically driven hexagon turret lathe.

The Engineering Index Annual for 1907. Compiled from the Engineering Index published monthly in the *Engineering Magazine* during 1907. Pp. 435. 6 in. by 9 in. (London: The *Engineering Magazine*.) 10s.

THE sixth volume of the Engineering Index, which is the second of the annual series, contains the usual useful collection of references to the engineering and technical literature of the year. As in the last volume, the classified system of arranging the items is followed in place of the strict alphabetical order of the earlier volumes. The arrangement is thus generally similar to that of the monthly instalments of the index which appear in the *Engineering Magazine*. The preparation of the index must have entailed a vast amount of labour, but a glance at the list of periodicals dealt with shows that the result can hardly be regarded as complete. The usefulness of such a volume would also be enhanced if it were published in January each year.

Switchboard Measuring Instruments for Continuous and Polyphase Systems. By John C. Connan. 146 pp. 5½ in. by 8¾ in. 117 illustrations. (London: E. and F. N. Spon.) 5s.

IT is not very easy to see for whom this book is written. Not for men who have to use instruments, certainly, though it may be of interest to a certain class of students. It reads throughout as if based not on what the author knows, but on what he has been told, either in lectures, or when set to do cut and dried experiments, or from reading of other men's work. If that is the case, we can congratulate him on the copiousness of his notes and the care with which he has arranged them, and we only hope that he will keep equally copious notes of real work when he comes to it, though he will not find it nearly such an easy matter. If he does he will be able to write an excellent book, for the present one shows most painstaking care in dealing with the matter at his disposal.

The Deinhardt-Schloman Series of Technical Dictionaries in Six Languages. Vol. III. Steam Boilers, Steam Engines, Steam Turbines. Edited by W. Wagner. 1,322 pages. 7 ins. by 4 ins.; about 3,500 illustrations. (London: Archibald Constable & Co.) 16s. net.

THE general arrangement of the third volume of the Deinhardt-Schloman Series of technical dictionaries in six languages is similar to the previous volumes on machine parts and tools and on electrical engineering respectively; that is to say, the ideas are arranged according to subject matter with the German, English, and French expressions on one side of the page, and the Russian, Italian, and Spanish on the other, while suitable illustrations are given in the central space. The latter part of the book consists of alphabetical indices with the Russian words separately, owing to the difference in alphabet. The present volume is divided into sections dealing respectively with boilers, steam engines, and steam turbines, each of which is extensively sub-divided. The illustrations are often very helpful from an explanatory point of view, and contain quite an interesting collection of miniature drawings of a great variety of Continental and British designs of boilers, furnaces, and automatic stokers. The turbine section appears very complete, and here, more especially with regard to the many methods of blade fixing dealt with, the illustrations are sometimes more explicit than the text. As in the last volume, we have noticed some misprints in the list of contributors and revisers which do not speak well for the accuracy of the proof reading.

The Calculus for Engineers and Physicists: Integration and Differentiation, with Applications to Technical Problems; and Classified Reference Tables of Integrals and Methods of Integration. By Prof. Robert H. Smith. Second Edition. 205 pp., 5 ins. by 7½ ins.; 32 illustrations. (London: Charles Griffin & Co., Ltd.) 7s. 6d.

IF an engineer who knows a little practical calculus already will go through this book and pick out the plums, he will find it a very pleasant one. So, also, will the man who read calculus at school and college, but learnt it as a mass of useless work and meaningless mental gymnastics, for it will show him that calculus is neither one nor the other; but the man who has no previous knowledge will, we fear, hardly appreciate it. One feels throughout that the writer has acquired his grasp of the subject by the methods of the schoolmen, and himself feels and thinks in their language, not in that of the engineer. To use an analogy, the book resembles a treatise written in English by a Frenchman; we admire his cleverness in doing it at all, and, with our insular superiority, we acknowledge his sense in thinking English the better language, although the result is not really English, and many of the expressions are only to be understood by those who know French. Most of the practical examples are well chosen, and the classified list of integrals will be very useful.

First Stage Steam. Written to meet the requirements of the Board of Education Examination, and containing the examination papers set in the years 1901-1907. By J. W. Hayward. Second Edition. 247 pp. 4¾ ins. by 7 ins. 132 illustrations. (London: W. B. Clive; The University Tutorial Press.)

THE object of this manual is to furnish information of the requisite quantity and quality to candidates for certain examinations of the Board of Education, and the limitations imposed by these conditions must be borne in mind when considering the suitability of the book for instilling into the minds of engineering students the principles upon which their future work will be based. The author has, however, on the whole, succeeded in rising above the level of the mere "cram" book, and a good feature of the scheme is the provision of a large number of explanatory figures, which strike the happy medium between diagrammatic representations of the principles involved and unnecessarily elaborate scale drawings. There are, of course, many parts of the subject which cannot be taught by a book without familiarity with steam plant at work, but the practical information given will be a help in enabling the student to understand what he sees. The explanations are clear and succinct, and the examination candidate is provided with plenty

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of questions and problems to practise on. The whole treatment is, of course, necessarily superficial, and only the merest introduction is given to the science of thermodynamics, as the employment of anything more than the simplest mathematics is forbidden.

Telephones: Their Construction, Installation, Wiring, Operation, and Maintenance. By W. H. Radcliffe and H. C. Cushing. 165 pp. 4 in. by 6¾ in. 125 illustrations. (London: Crosby Lockwood & Co.) 4s. 6d.

This book is dedicated to the amateur and small contractor. It is of American origin, but this in itself is of no great importance, as the practice in this country is in many respects similar. In the English edition, however, the introductory chapter relating entirely to American conditions should have been omitted, as might also the descriptions of the Edison transmitter, and the Fuller gravity, and Edison cells. The space so saved might well be occupied by descriptions of the popular hand micro-telephone and of the constructional details of the various switch-hooks. The latter device is called a hook switch, gauge is written gage, and another curiosity—which, however, is, we think, a printer's vagary rather than an Americanism—is "tantetion" for attention. Many of the illustrations are well-executed, and much of the advice is sound; yet we cannot but think that, unless the reader particularly desires to gain an acquaintance with American practice, he will be equally well served with one of the English books on the subject.

Electric Bells, and All About Them. By S. R. Bottone. Seventh Edition. 154 pp. 4¾ in. by 7½ in. 81 illustrations. (London: Whittaker & Co.) 2s.

Commencing dutifully with Thales, "who flourished about 600 years B.C.," experiments with sealing-wax and pith-balls, lists of conductors and non-conductors, and pictures of magnets with fluffy poles, the author leads his readers through the zinc-copper-sulphuric acid cell, the Smee, Daniell, and gravity cell to the Leclanché. Several forms of the latter are described, and the amateur is told how to make a dry cell. Previously to explaining Ohm's law, Mr. Bottone incidentally refers to current as "the amplitude of the continuous vibrations kept up in the circuit." He then gives illustrations of cells connected in series and in parallel—the latter in rather a clumsy manner. All this occupies but 57 pages; the remainder of the book gives amateurs instructions how to make electric bells, pushes, burglar-alarms, fire-alarms, and indicators. Magneto bells are dealt with briefly, and, in the last few pages, bell circuits connected to the supply mains are mentioned. We are glad to see that the amateur is warned that he will probably have trouble if he attempts to use the latter method. Although Mr. Bottone adopts as his sub-title "A Practical Book for Practical Men," the book is evidently written for the amateur.

English Prices with Russian Equivalents. By A. Adiassewich. 185 pp. 4 in. by 3¼ in. (London: E. & F. N. Spon, Ltd.) 1s. net.

This little pocket-book, which should be found useful to firms doing export trade with Russia, is on the same lines as a previous compilation dealing with French prices, issued by the same publishers. It consists of tables calculated at fourteen rates of exchange in Roubles per Pood, giving equivalent prices in English currency per lb. and per ton. We may mention that one ton is equal to 62·0275 poods, and that the equivalent of £10 is about 94 roubles 50 kopecks, more or less according to the rate of exchange.

Aldum's Pocket Folding Mathematical Tables. For the use of Engineers, Architects, Students, &c. 3¾ ins. by 6¼ ins. (London: E. & F. N. Spon.) 4d.

This six-page folder contains logarithms and antilogarithms to four figures, and a table of natural sines, tangents, and cosines, &c. Some useful constants taken from the Examination Tables of the Board of Education are also given. The folder is made of faced linen, and is convenient for the pocket; but the type is bad, the figures in some cases being difficult to read.

Questions and Answers in Electrical Engineering. By A. E. Moore and F. Shaw. 151 pages. 4¾ ins. by 7½ ins. 54 illustrations. (London: Longmans Green & Co.) 2s. 6d.

In the words of the preface, "this little book has been compiled primarily for the assistance of those students who intend to become candidates for the Elementary Examination in Electrical Engineering, held by the City and Guilds of London Institute," but we can thoroughly recommend this book to any students in electrical engineering. Although it consists entirely of solutions to about 150 questions set by the City and Guilds of London Institute in the preliminary grade of Electric Lighting, from 1899 to 1907 inclusive, the majority of the questions are of an eminently practical nature, and the solutions contain much valuable information with regard to wiring, testing, and the simpler problems connected with lighting installations. The descriptions of instruments and other electrical apparatus are very concise, and are well illustrated with carefully executed line drawings.

The Electron. The official monthly organ of Siemens Stafford Institute. Vol. I., Nos. 1 and 2. (Stafford.) 6d. each issue.

We have before us the first two numbers of a monthly magazine conducted by the employees of Messrs. Siemens Bros. Dynamo Works, Ltd., which forms the journal of the Siemens Stafford Institute, and also contains literature of general literary and scientific interest. The June issue has for its frontispiece an excellent portrait of Mr. Lee Murray, the present works manager at Stafford, who is well known to many through his connection with the Siemens interests both in Australia and South Africa. A considerable proportion of the pages are devoted to records of the athletic and literary life of the members of the Institute and in associated social, educational, literary and debating sections, and sports clubs, and a most flourishing condition of affairs is apparent in all these directions. Mr. Murray's presidential address to the Engineering Society, dealing with coal and its application to the production of power gas, is published at some length. The second issue contains a good deal of interesting matter to those who are or have been in any way connected with the various Siemens companies, as well as to engineers in general, and fully maintains the level of literary merit of its predecessor. The first article is a long Paper on the Siemens-Schuckert single-phase series motor, by Mr. M. Schenkel. The next is a historical article outlining the development of the English Siemens firms and the various changes which they have passed through from time to time, from the establishment of the small factory in Millbank Row in 1858 to the present division of the undertaking into the two closely allied but separate companies, whose manufacturing work is carried on respectively in the historic establishment at Woolwich and the extensive modern works at Stafford. This is followed by the first of a series of biographies of prominent men in the history of the Siemens firms, commencing with a reference to some of the earlier members of the Siemens family. The arrangement and get-up of the publication are excellent, and its contents reflect a most praiseworthy spirit of *esprit-de-corps* among the employees.

THE FUNCTIONS OF FLYWHEELS

By H. M. Sayers

THERE are three main purposes for which flywheels are used in electrical generators and the prime movers or engines driving them:—1st: To reduce the cyclic variation of speed due to the variation of torque or turning moment of the engine. 2nd: To reduce the speed variation due to sudden variations in the external load. 3rd: To restrain "hunting" in alternators by giving the rotating parts (including the flywheel) such a "free oscillation period" that resonance with forced oscillations, due either to the prime mover or to the load, is improbable. "Alternators" for this purpose may be read to include synchronous motors and rotary converters.

The relative importance of these flywheel effects varies with the characteristics of the engine and generator, the type of the latter, and the nature of the load.

Steam engines built for driving generators have usually two or three cranks, and give a fairly even turning moment, so that they make little demand upon the flywheel for the neutralisation of varying torque. If the load includes a lighting supply, and the engine has a low rotative speed, sufficient flywheel capacity is necessary to prevent flickering of incandescent lamps. The point needs attention in such engines working at early cut-offs and high pressures and vacuua; but, as a general rule, the flywheel required for the other purposes will be ample for this one.

With gas and oil engines the case is very different.

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In the extreme case of a single-cylinder engine working on the Otto cycle, there is but one impulse every two revolutions, and generally, whatever the number of cylinders, the impulses per revolution number only one-quarter of those which would be delivered by an equal number of double-acting steam cylinders. In addition to the relative infrequency of positive impulses, the "negative work" of the compression stroke adds to the cyclic irregularity, and to the energy storage capacity required of the flywheel. The requirement is generally defined by the specification that the variation in the speed of rotation over a cycle shall not exceed a certain percentage of the mean speed. To obtain the desired result the flywheel must be of such proportions that in passing from the maximum to the minimum speed it shall lose sufficient kinetic energy to supply the load, including friction and compression losses, between the end of one impulse and the commencement of the next; or, more exactly, during the time that the crank effort is less than that corresponding to the load. In the case of a single-cylinder gas or oil engine it may be taken that the flywheel has to supply the load for three strokes out of four by its deceleration, being accelerated during the fourth or impulse stroke from the lowest to the highest speed allowed by the specification, and decelerated during the three following strokes.

Then if the mean speed is N revolutions per minute, the specified permisible variation P revolutions, so that $N+\frac{1}{2}P=N_1$ and $N-\frac{1}{2}P=N_2$ are the maximum and minimum speeds during the cycle; and if the energy to be alternately stored and given up is F foot pounds, then $\frac{F}{N_1^2-N_2^2}=M$, where M is the foot pounds of kinetic energy stored in the flywheel at the speed of one revolution per minute, and is proportional to the moment of inertia of the flywheel about its axis. Professor Perry is responsible for introducing this quantity into mechanical calculations (see Chapter XI. of Perry's "Applied Mechanics"), and shows that $M=\frac{I\pi^2}{1800}$, where I is the said moment of inertia, when M is in foot pounds, the dimensions in feet, and specific mass in pounds per cubic feet.

An example from actual practice will best illustrate this. A single-cylinder Diesel oil engine rated at 80 b.h.p. at 160 revolutions per minute is specified to have a maximum variation of $\frac{1}{70}$, *i.e.*, of $\frac{160}{70}=2{\cdot}3$ r.p.m., so that the limits of speed are 161·15 and 158·85. There are 80 impulse strokes per minute.

The indicator card, Fig. 1, taken from this engine at full load and speed shows what the flywheel has to do.

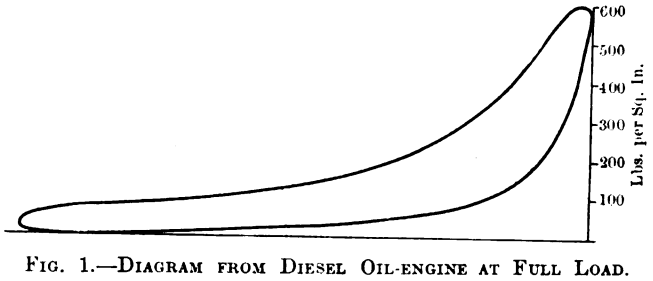

Fig. 1.—Diagram from Diesel Oil-engine at Full Load.

The area enclosed between the atmospheric line and the upper curve represents the gross work of the impure stroke, and that between the atmospheric line and the lower curve represents the negative work of the compression stroke; the difference is the "indicated power" per cycle. The scavenger and suction strokes cannot be distinguished from the atmospheric line.

The M.E.P. is 131·25 pounds, and as the cylinder dimensions give the constant of 384 foot pounds per stroke per pound pressure, the foot pounds available for useful work and engine losses during four strokes or one cycle are 50,400. The flywheel has to provide three-fourths of this, or 37,800 foot pounds.

But the M.E.P., as above stated, is the difference between the mean pressure in the impulse and the compression strokes, so that the impulse stroke diagram is really the whole area between the atmospheric line and the upper curve, and the compression diagram that between the atmospheric line and the lower curve. The two M.E.P.'s on this basis are respectively 199·3 pounds impulse and 68·05 compression. The latter corresponds to 26,130 foot pounds, so that the flywheel has to take up and give out 63,930 foot pounds per cycle. It will be noted that the heat losses in the compression stroke are not here separately accounted for; they are included with the other engine losses, as are the negative work done in the scavenging and suction strokes. The indicated energy of the impulse stroke is thus 76,530 foot pounds, of which the flywheel takes up 63,930, with a speed varying from 158·85 to 161·15. Then

$$\frac{63930}{(161{\cdot}15^2-158{\cdot}85^2)}=\frac{63930}{740}=86{\cdot}4.$$

The flywheel provided had a rim 10·75 ft. outside diameter, 7·75 inside diameter, and 1 ft. broad. Taking cast-iron as weighing 485 pounds per cubic foot, then

$$*\,I=485\times1\times(10{\cdot}75^4-7{\cdot}75^4)\times0{\cdot}00305=14{,}379 \text{ or}$$

$$M=\frac{485\times1\times(10{\cdot}75^4-7{\cdot}75^4)}{59{,}814}=79, \text{ very nearly,}$$

so that the flywheel rim provides about 90 per cent. of the required capacity. The arms, the crank, and the connecting rod may be reckoned towards the balance, and the dynamo armature also assists, with the result that no flicker is perceptible on the lamps. The weight of the rim above described is about 6¼ tons.

It will be obvious that governing by missing explosions calls for extravagant flywheel capacity, and this method ought to be quite out of date for electrical work.

The variation in the speed is not steady. The whole acceleration is imparted to the flywheel during the impulse stroke, while the deceleration is spread unequally over the three following strokes, being considerably greater during the last or compression stroke than during the scavenging and suction strokes. The result is often visible in a quick brightening of the lamps during part of the impulse stroke, and illustrates the fact that the rate of variation is as important as the range when steady lighting is an object. It is also of importance when the running of alternators in parallel is required, and properly belongs to the consideration of the flywheel in that connection.

The use of the flywheel in reducing speed variations due to sudden variations in the external load is confined to cases where the load peaks are of short duration, such as in traction and other power work; and by a natural extension flywheels are now employed in the Ilgner and allied systems for driving winding gear, rolling mills, and other machinery in which the demand for power varies through a wide range, in a cyclic fashion, with fair regularity.

Lighting loads vary in a continuous and comparatively slow manner, and do not permit of much speed variation, hence flywheels are of little use on generators for lighting in respect to load variations.

Traction loads, on the contrary, are continually rising and falling in a jerky way, so that the instantaneous output rarely corresponds with the engine power, the difference being made up by the alternate acceleration and deceleration of the flywheel. It is usual to specify the speed regulation of engines in some such way as the following:—"The variation of speed between no load and full load shall not exceed 5 per cent., and with the full load thrown on or off suddenly the sudden

* I for a hollow cylinder of length l, outside diameter D, inside diameter D_1, and w pounds per cubic foot $=\pi l(D^4-D_1{}^4)\times0{\cdot}00305$, and $M=\frac{\pi l(D^4-D_1{}^4)}{59{,}814}$. Perry, "Applied Mechanics," *loc. cit.*

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rise or fall of speed shall not exceed 7½ per cent." The first clause has mainly to do with governing, the second with flywheel action. Taking the case of a single-crank double-acting engine running light at full speed. On throwing on the load the power is supplied at the expense of the kinetic energy of the flywheel, including in this term all the rotating masses, and the speed falls until the action of the governor admitting more steam supplies the demand from the cylinder. The important question is then: During what interval of time has the flywheel to supply the full load? This will vary in the same engine with the piston position at the moment the load is put on. If thrown on immediately after steam is cut off, there will be an interval of one stroke, or half a revolution, before any additional steam supply commences to take effect. But if the load is thrown on at the commencement of a stroke, the lag of the governor will in most cases prevent additional steam being given on that stroke, so that the flywheel may have to supply the load for nearly one and a half strokes, or three-quarters of a revolution. Then, to satisfy the specification, the flywheel M must be such that $M \times [N^2 - (0{\cdot}925N)^2] = F$, where F is 0·75 of the full load foot pounds per revolution, reckoned on the brake horse-power. The specification, as above given and frequently met with, is ambiguous in that it does not define the standard or normal speed on which the variations are to be based. The flywheel calculated as above, with N as the upper, no load speed, would drop 7½ per cent. of that speed on the load being thrown on; but on the converse operation the rise would be at the rate of 7½ per 95 revolutions, or 7·9 per cent. So that to be on the safe side the lower speed should be taken as the standard. The full load speed seems to be the correct one to take as normal on general principles.

On throwing off the load the worst case is that a stroke has just been commenced, and admission is continued to the full load cut-off point. The flywheel has then to take up the full load foot pounds for that stroke, while accelerating from the full load speed to the specified sudden increased speed. This is a smaller number of foot pounds than required at the throwing on of the load, and if the flywheel is sufficient for the throw on, it will be ample for the throwing off requirement. What will really happen in the case supposed is that the acceleration will not be completed by the full load charge of steam, and that the next stroke will have the admission diminished by the governor, but not down to the no load cut-off point. This is all on the assumption that the governor is reasonably quick in its action, but not so quick as to overrun the speed variations and cause "hunting."

For sets of similar output and cylinder arrangement the energy storage needed is inversely as the speed. With a given flywheel the energy storage for a given small *percentage* speed variation is approximately as the square of the mean speed, so that the M of the flywheel should be inversely as the cube of the mean speed. Thus a set running at 100 r.p.m. requires eight times the flywheel M that is needed by a set of equal output running at 200 r.p.m.

This need not mean eight times the weight of flywheel. The M of a flywheel is proportional to the fifth power of its lineal dimensions, whilst its weight is proportional to the cube thereof; so that if a flywheel were known to be sufficient for a speed of 200 r.p.m., then one for a speed of 100 r.p.m. should have lineal dimensions $\sqrt[5]{8} = 1{\cdot}515$ times as great, and will weigh $1{\cdot}515^3 = 3{\cdot}48$ as much. It is, therefore, very nearly right to say that halving the speed means magnifying the flywheel one and a half diameters, when it will be three and a half times as heavy. In any practical application of such a rule, care must be taken that safe peripheral speeds and stresses upon arms and fastenings are not exceeded; but the design of flywheels is rather outside the present purpose, and will not be pursued further.

The application of electric power to such work as coal winding and rolling mills has led to a special employment of flywheels in combination with motor generators to provide by their acceleration and deceleration the great cyclic fluctuations in power needed. They thus act as accumulators between the fluctuating load and the generators, and as the speed and percentage variation permissible are much greater than can be tolerated on the prime movers, and the flywheel dimensions are not limited as they are when on an engine shaft, such flywheels are much more efficient and economical for the purpose of reducing speed variations due to load than equivalent flywheels on the generators. There are, of course, other advantages, most of which may be summed up in the better load factor of the generators and the distributing system. The calculations for such flywheels present no difficulty if the power cycle and period of the operation are known. In most of the systems in use the permissible speed variation is made great by the use of variable field excitation, or some form of "boosting" on the generator side of the converter, so that the voltage of the supply to the motor is kept up through a wide range of converter and flywheel speed, and the storage capacity per ton of the flywheel is comparatively large. Given these elements, the problem is then to provide a flywheel that in decelerating from the maximum to the minimum speed will give out the required number of foot pounds, exactly as in the oil engine example above worked out. The required energy will be, roughly, the product of the mean excess of power over the steady power supply called for by the work, into the duration of the excess demand per cycle, with due additions for conversion and other losses, but this will be modified by the electrical arrangements and the extent to which the motor or driving side of the converter is permitted to assist the flywheel by a larger intake from the mains during the deceleration period. Descriptions of several of these flywheel systems, due to Mr. A. P. Wood Ilgner, the Westinghouse Company, and others, will be found in Vol I. of Electrical Engineering.

The special use of flywheels on alternators is a branch of the parallel working of alternators, and lends itself to an abstruse analysis which will not be attempted here. Those interested may be referred to the two Papers read by Professor Bertram Hopkinson in 1903 to the Royal Society and the British Association. The stable parallel running of alternators is primarily due to such an electrical and magnetic design that the slightest difference of phase produces a considerable correcting moment, bringing up the lagging and retarding the leading machine.

The relation between this correcting force per unit of phase displacement and the moment of inertia of the rotating parts determines the free oscillation period of the machine, the relationship being such that the period $= \frac{2\pi}{\sqrt{\frac{c}{I}}}$, where c is the correcting force, and I the moment of inertia about the axis.

The value of c is perhaps most easily obtained from the usual design data in the form:—

$c = \sqrt{\frac{E i_o}{p}}$, when E is the open circuit voltage, i_o the short-circuit current at full speed, and $\frac{p}{2\pi}$ = frequency.

The moment of inertia I is that of the portion of the armature corresponding to one pair of poles (because the unit of angular displacement used is phase angle), and if the above expression is to give the period in seconds, I must be taken in centimetre × gramme × 10^7 units, *i.e.*, in kilogrammes × metres.[2]

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An alternator, synchronous motor, or rotary converter may be intrinsically unstable, as Professor Hopkinson shows, if in the first place the reactance Lp exceeds the ohmic resistance R; and if, in the second place, there is insufficient "viscous resistance" to phase swinging. The first-named condition of instability is usually present; the "viscous resistance" is mainly that due to eddy current caused by the swing of the armature about its mean position, and can be provided by the use of solid pole-pieces or copper bars threaded through the pole-faces to form a grid. The addition of flywheel power, or increase of I, does not improve the stability, but increases the period of the free oscillation. It follows that machines afflicted with intrinsic instability of this kind require an electrical or magnetic remedy; in some cases an alteration of the exciting current is sufficient, in others some damping device must be added.

Provided that an alternator is intrinsically stable in this respect, it cannot be improved for parallel running by the addition of inertia; in fact, the less the inertia, the more rapid is the action of the correcting force, and the smaller will be the amplitude and period of the swing, so that added flywheel rather deteriorates an alternator well designed in this respect.

If the free oscillation period or a multiple of it should correspond with the period of a cyclic irregularity in the turning moment of the engine or in the load, then hunting or phase swinging will be set up, and it is essential to practical working to prevent such a correspondence between the free oscillation period and forced oscillations of external origin. Here the flywheel comes in, as it increases the I of the armature, and so lengthens its oscillation period. In practical designs the armature period is usually in excess of fifteen times the current period, *e.g.*, at 50 ~ the armature oscillation period will usually be greater than one-third of a second. If, then, prime movers are employed in which there is a cyclic variation having a period between, say, one-quarter of a second and one second, particular care must be taken that sufficient flywheel inertia is added to lengthen the alternator period beyond that of the turning moment, or of the load, in the case of a motor or rotary. The special application of present interest is the driving of alternators by internal combustion engines. There is a danger that the lengthened oscillation period due to excessive flywheel power may set up governor oscillations as between engines, shown by the machines in parallel throwing the load from one to the other. This causes unpleasant voltage fluctuations, and requires alterations to the engine governors. It is not uncommon in alternating stations to run the engines with the governors out of action, or with the governors of only one engine in action, in order to prevent such troubles.

In the case of synchronous motors and rotary converters, it does not appear that flywheels can improve their performance, unless the load or the supply pressure has a cyclic irregularity of a period near to their free oscillation period. Such an irregularity may be derived from the prime mover in the supply station, where the remedy should be applied. If due to the load, an alteration in the exciting current will often prevent the synchronism. It should be said that in calculating the free oscillation period of such machines, the self-induction and resistance of the mains, &c., must be reckoned as part of the armature properties.

Apart from neutralising such synchronous irregularities, a flywheel can fulfil no useful function in the machines considered. It cannot meet fluctuations in the load, because the utmost permissible variation in the machine speed is but a small fraction of the normal speed; if that is exceeded, the machine falls out of step and out of service.

The motor or rotary must follow the generator as closely as possible, and added inertia can but delay the response and increase the work to be done by the "synchronising current" when phase differences occur from whatever cause.

In conclusion, it may be pointed out that the advantages of flywheels have to be paid for both in capital and working expenses. Besides the flywheel itself, heavier shafts and larger bearings have to be provided, and bearing and air friction met by additional power expenditure. In large, high-speed flywheels the air friction is quite a large item, and should be reduced to a minimum by sheeting between the arms, and generally providing a smooth surface of uniform cross-section circumferentially. From railway experiments this frictional loss is of the order of half a horse-power per 10 square feet of surface at a speed of 5,280 feet per minute, which is a little below that generally accepted as the limiting peripheral velocity for cast-iron flywheels; but it is much increased by roughness of the surface, and also if the air is in a confined space, as in a narrow wheel race, while it may go as high as half a horse-power per square foot in extreme cases, such as the rotor of an induction motor with a very small air-gap.

With induction-motor generator sets, especially when working on traction loads, there is no particular objection to the use of flywheels, but in practice there is no need shown for them. The torque of the induction motor increases rapidly when it drops its speed, and increases its slip a trifle under an increased load, so remaining while the load lasts. A flywheel only meets its load while its speed drops. Naturally, the d.c. end of the converter behaves much better under the former than under the latter conditions of driving.

It must not be forgotten that converters of both kinds run at high speeds, and have a considerable flywheel power, without any special addition, and that when it is desired to run them up in a hurry, as sometimes happens, the flywheel is only a hindrance. The general absence of flywheels on such machines is, therefore, thoroughly justified.

TRACK AND THIRD RAIL CREEPING

By E. Goolding

THE gradual movement that often takes place in one direction with both track and third rail is generally spoken of as rail creeping. To those not quite familiar with the term a certain amount of doubt arises, and it is invariably imagined to be synonymous with expansion and contraction. The movement of a rail subject to expansion and contraction respectively elongates and shortens the length of rail, producing, so to speak, a concertina action, but the term creeping is intended to imply a decided and continuous movement in one direction only—that is to say, the rail travels—and although the creeping is partly dependent upon the expansion and contraction of the rail, it must at the same time be considered as quite a separate and distinct condition.

On account of the known peculiarities connected with the creeping of track rails, the subject generally claims a considerable amount of interest. This creeping has been found to be still more noticeable with third rail, but it cannot be said that a corresponding amount of interest has been bestowed on this side of the question, and the object of this article is to put forward results of experiments, and so engender and direct a little more attention to rail creeping.

During the electrification of some 90 miles of steam-operated line, the equipment of the track with third

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rail introduced some interesting problems of third rail creeping and expansion. Owing to the difficulty of obtaining any data on the subject, and at the same time seeing the obstacles likely to be encountered, a careful investigation of the trouble was instituted.

Although the track and third rails are both supported by the sleepers, and are laid in juxtaposition, the conditions and strains to which they are subject will be found totally different. With the movement, creeping, and working conditions of track rails we are more or less familiar, since we have been afforded ample opportunity of observation, but third rail construction is, comparatively speaking, a modern introduction, and consequently it is not to be expected that we should be in possession of complete information as to its creeping propensities. It is a well-known fact to all railway engineers that to allow for the expansion and contraction which takes place with track-rails, L-shaped shims or strips of iron are put into the rail joints when the rails are being laid. In the case of tramway rails the question of expansion and contraction is of no consideration, inasmuch as the fluctuation in temperature has little or no effect on account of the rails being embedded in the ground. On the other hand, third and fourth rails are exposed, and therefore subject to the variations of temperature, and consequently vary in length (owing to expansion and contraction) in a similar way to the railway track. It does not follow that although the extreme variation in temperature to which the rail may be subjected (between summer and winter) is perhaps 120° Fahr. that the temperature of the rail will vary in the same proportion, for the simple reason that the extremes in temperature seldom last long enough to bring about a greater difference than 80° in the temperature of the rail itself. The section and weight of the rail, of course, makes some difference as to the rapidity with which the rail is influenced by the variation in temperature. It is to be expected that a Vignoles type of rail which possesses a large thin flange and web will on a hot day reach a higher temperature than a bull-headed track rail of the same weight.

The precautions taken to avoid trouble due to expansion of track rails appears from the above to have been very carefully allowed for at each joint, but it is questionable in practice whether each joint opens and shuts in response to the changes in temperature. It is only when great strain is put upon the rails (either in contraction or expansion) that any movement takes place, and then usually only at one joint. The creeping of track rails is partly due to this strain, the actual creeping taking place when the unstable strain existing in the rail is upset by the additional vibration of traffic. The effect of the strains set up by traffic is best understood by considering the following points:—The weight of a train depresses the track rails between the chairs, and, if the chairs have wood bottoms, presses the rails into the chairs, and chairs into sleepers, and sleepers into road-bed. The sum of these depressions may amount to anything from ¼ to 1¼ inch, and the train travelling in this depression produces, as it were, a wave, against which the locomotive is always driving. In addition to the strains set up due to the above causes, there is a further factor to be considered, and that is the pulling action of the locomotive, obtained through the adhesion of the driving wheels to the rail, which has the tendency to stretch the rail in front, and compress it behind. Owing to the many strains to which the rail is subjected, it is in a state of unstableness, and it becomes impossible to find out in which direction the result of these strains will tend to move the rail, the supremacy is only known when the rail creeps.

Generally speaking, there is not much trouble experienced in this country with track creeping, as it is avoided by anchoring the rail at a number of sleepers, and so distributing the strain. This point is mentioned, as it tends to show the marked difference of our permanent-way construction as compared with the American methods, where rail creeping is evidently of far more serious consideration than in this country.

It is said in Mr. Tratman's book on trackwork that on the Eads arch bridge over the Mississippi River at St. Louis, the track has been observed to move by creeping 42 ft. in one month.

The remarks pertaining to the movement of track rails will, to a great extent, assist in elucidating the creeping propensities of third rail. The observations and tests here given were taken at a selected number of points on some 90 miles of third rail, and records were kept during winter and summer. To make accurate observations, stout stakes with a centre pin on top were driven into the ground close to the third rail, and at a fixed distance of 36 inches (from the centre pin in the stake) a punch mark was made on the flange of the rail. A large number of these stakes were planted over the line so as to gather records under all conditions. As soon as the stakes were fixed careful observations were made several times a day, and continued during the best part of 18 months. Two typical records are illustrated in Figs. 1 and 2, but before dealing with them, it would perhaps be as well to mention first, the several points which have to be remembered, connected with the conditions to which the third rail is subject, since the conditions differ very widely from those prevailing with track rails.

The third rail is supported on insulators, and in no way clamped down; therefore (beyond being kept in place by guides on the insulator) it is, so to speak, a free agent, and can be looked upon when in a long unanchored length as an elastic body, having a concertina movement owing to the expansion. The stresses and strains to a certain extent depend upon the variations of temperature, and the ease with which the rail slides on the top of the insulators in response to the fluctuations of temperature. Its movements are more or less defined; but matters do not rest here. It is necessary to go a little further, and consider the complex strains due to traffic. It has been mentioned, when considering the give of the track, that the sleepers sink into the road-bed. This has an important bearing on the movement of third rail, since the insulators are fixed on the end of the sleepers, and consequently as the sleepers are depressed, the insulators are carried away from the third rail. The insulators are not spaced sufficiently far apart to allow the third rail to bend, and follow the movements of individual insulators; therefore the effect of a passing locomotive is to depress the sleepers, and thus take away in rotation the insulators from supporting the third rail. Besides this there is the question of the grade and action of the shoe on the rail, all of which conditions, acting in conjunction with the strain due to expansion and contraction, set up a state of tension, and the supremacy is only notified by a slow or quick creeping of the rail in one direction or another. Should there be no tendency for the rail to move, it cannot be assumed that the rail is not subject to any strain, but simply that the forces exist and are in a state of balance. Thus the conditions mainly responsible for third rail creeping are expansion and contraction, direction of traffic, road bed, and the action of the shoes.

The exact value to be allotted to these respective items is a matter of conjecture, but the above appears to be the order of their importance.

Fig. 1 gives the record taken on 1 in 100 grade, and the movement of the rail is against the traffic, and uphill the maximum movement of 6½ in. was reached on the sixth week, after which the rail slightly receded, and then remained stationary. In some 90 miles of track the writer only observed two instances of the above nature, and since the movement of the rail is the reverse to what was expected, the cause must be looked for as being quite outside the common, and in explanation the movement was attributed to what

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might be termed a siphoning action of the rail, inasmuch as at the point in question the rail is on a short up grade of 1-120, and continuing on a long down grade, the rail as before mentioned, being able to slide on the insulators, is drawn up the short up grade by the greater pull on the long down grade.

Fig. 2 gives a typical case of creeping, in which case the rail had moved about 3 in. before the test was started, and during a test of two months moved 7 in.,

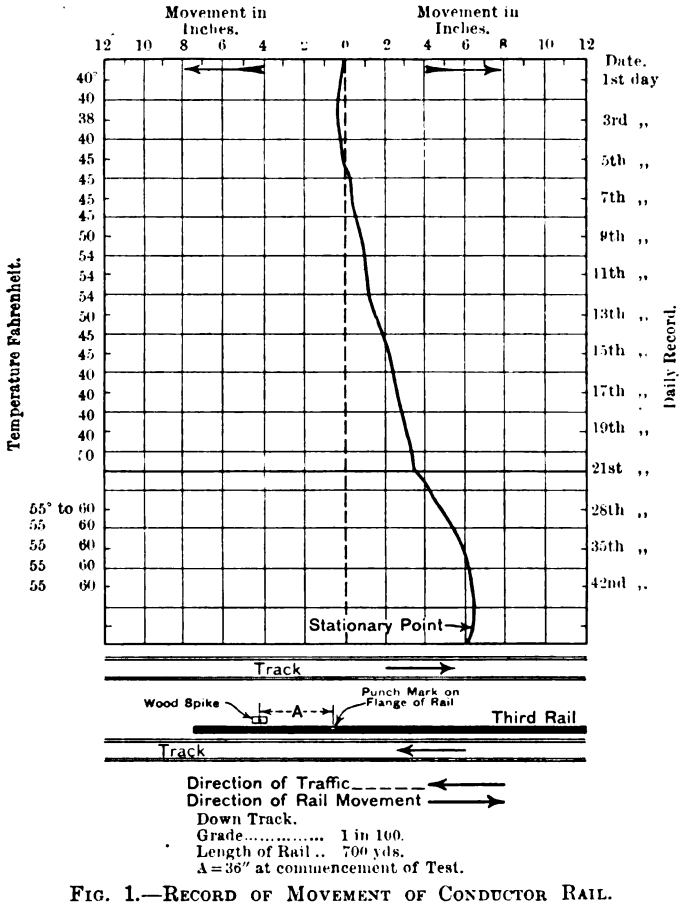

Fig. 1.—Record of Movement of Conductor Rail.

at which point it remained practically stationary. At a large number of points where stakes were driven and creeping was anticipated, there was no movement worth recording. On the other hand, several instances arose of excessive creeping at junctions, and in many cases, owing to the movement of the rail extension, lengths of copper had to be attached to the cable terminal,

From the tabulation of records it is natural to assume that some tangible conclusion could be arrived at to account for the creeping, but it was found that the results were of such a conflicting nature that it was impossible to give any definite statement of rules by which the movement of rails could be gauged. But it was satisfactorily found with few exceptions that the third rail, like the track rail, moved in the direction of the traffic, and that the vibration of the traffic re-

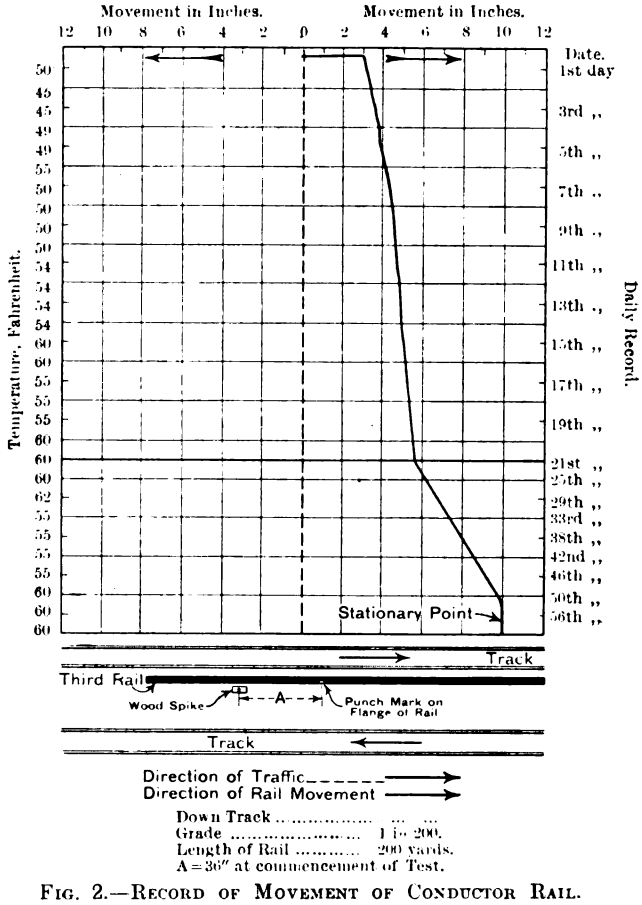

Fig. 2.—Record of Movement of Conductor Rail.

leases the tension set up in the rail (by variations of temperature), and so enables the rail to expand, and in expanding shoots forward to a new position, and this action constantly going on causes the rail to move or creep along.

Having this trouble and danger of rail-creeping to contend with, something had to be done to prevent th

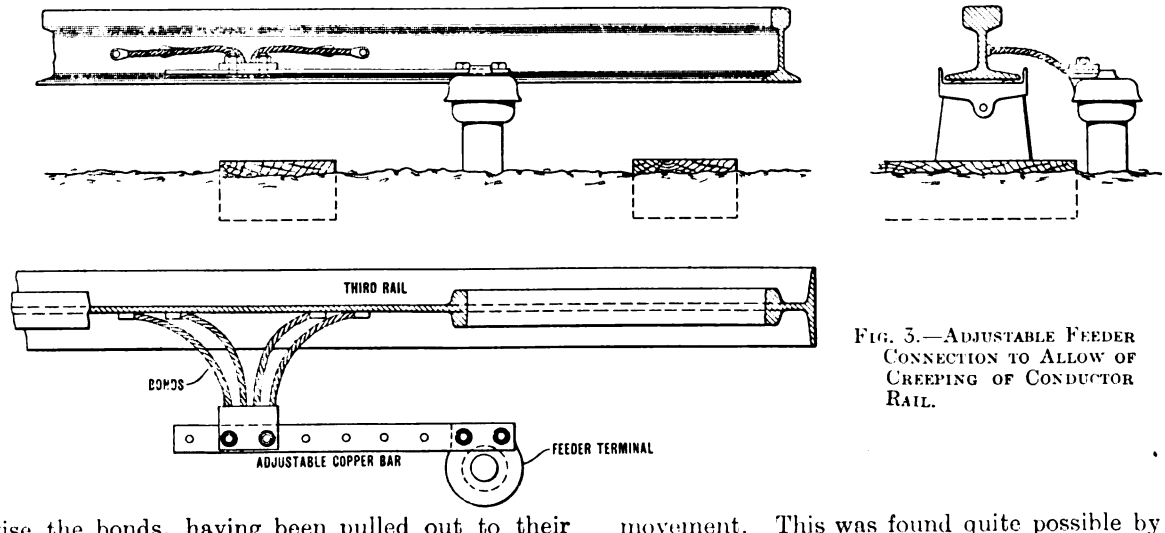

Fig. 3.—Adjustable Feeder Connection to Allow of Creeping of Conductor Rail.

otherwise the bonds, having been pulled out to their fullest extent, would have broken, or pulled the cable terminals out of the ground. An illustration of this is given in Fig. 3.

movement. This was found quite possible by allowing expansion joints every 60 yards or 100 yards, and effectually anchoring each such lengths. To endeavour to run longer lengths of rail is not advisable on account

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of the strain set up at anchored points. It might be interesting to mention here that when the writer was experimenting in this connection, it was found when anchoring half a mile of rail that a pull of anything up to 10 tons was obtained at the anchor; and since the pull has to be transmitted through some forms of insulator, and at the same time must not be attached to the sleepers, it became a very difficult and undesirable arrangement. It might naturally be asked why not copy track rails and allow sufficient flexibility of bonds at each joint, so that each joint absorbs the movement of its individual length of rail. This has been tried, and it has been found that the rail creeps along and crowds up to one end, and as soon as all the joints are tight the probabilities are that it will then start moving. The dangers attendant on third rail creeping are considerable, since the run on the pieces at the ends of the rail, will, if moved to any extent, foul the track, and should the rail get out of line, the shoe will not mount the rail, but catch on the side of the third rail and tear it up, and break the insulators until the train is stopped.

RECENT IMPROVEMENTS IN RADIO-TELEPHONIC METHODS AND APPARATUS

By L. H. Walter

ALTHOUGH quite a number of patents relating to wireless telephony have recently been published, only a few present features of fundamental or even special interest. Even in the case of these, it is not easy to decide, without experimental data, as to whether the methods described constitute any material advance. What can, however, be determined is whether they have the appearance, at least, of being workable. With these qualifications in mind, one or two of the more promising arrangements may be dealt with. Taking, first of all, methods utilising the spark discharge, these present particular interest, in that, were it possible to deal with equally large amounts of energy in a form suitable for speech reproduction, as distinct from mere transmission of musical sounds, the simplicity of the arrangements would, as in the case of wireless telegraphy, ensure them a measure of popularity at least equal to that which the arc at present enjoys.

It is well known that it is possible to reproduce music by means of Hertzian oscillations with even the simplest apparatus, whilst spoken words are but imperfectly reproduced, or not at all, when the spark frequency is low, as it usually is in the arrangements hitherto described. Ruhmer has pointed out in this connection how few inventors have realised the necessity of, or made provision for, spark frequencies well above those of the harmonics involved in the complex sounds which are in the majority in speech transmission.

A method which appears to overcome the drawback to the spark methods, so far as the question of sufficient energy is concerned, is that due to E. R. Clarke and M. Barr. These inventors make use of the properties of the resonance transformer, and in particular of the fact that if the natural period of the oscillatory current in the circuit is made shorter than the period of the impressed potential difference, the circuit can be brought into tune by adding to it further capacity or inductance, as is well known. If, then, a variable (or tuning) self-inductance be included in the circuit, a proper adjustment will give a maximum length of spark in the spark-gap. In this condition the arrangement is very sensitive to any alteration in the self-inductance, a very small variation being sufficient to stop the discharge, and it is this sensitiveness to small changes of the self-inductance that the inventors propose to apply. In practice, this may be effected in two ways. In the first, an arc is placed in shunt to the tuning inductance, and adjusted until no spark normally passes at the spark-gap, but so that the least disturbance of the arc will cause the potential difference across the condenser to rise sufficiently to spark across. The second and simpler way, which the inventors prefer, consists in causing the microphone current to act inductively on the tuning self-inductance, which, in such a case, acts as the secondary of a transformer.

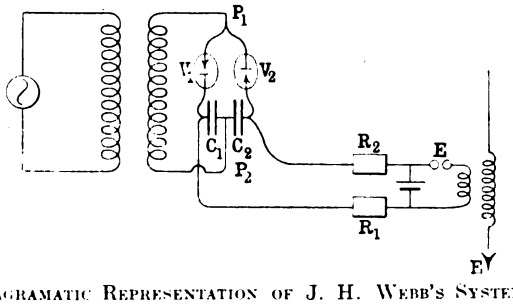
In this way a low-voltage (1 volt) microphone is said to be capable of controlling the spark-gap with great delicacy, and of enabling a large amount of energy to be dissipated by the variation of the small low-voltage microphone current.

The sparks of variable frequency naturally reproduce any musical sounds which affect the microphones, but for speech reproduction the impressed frequency of the supply current must be made sufficiently high. Though this obvious fact is stated, no information is given as to how, with these frequencies—sufficiently high to be higher than the harmonics concerned—the sparks are to be produced—a matter of some little difficulty. The arrangement thus seemingly involves, besides the use of a special alternator, a somewhat specialised arrangement for securing sparking at very high rates of speed.

The next method, that of J. H. Webb, is a spark method of transmission which aims at accelerated discharges, thus approaching the results obtained by the arc method more nearly.

The continuity of the oscillations is obtained by an application of Lodge's valve-tube storage method, and by the use of additional storage condensers of relatively large capacity. These condensers are maintained continuously charged, and only a small percentage of the therein accumulated energy is permitted to pass and charge the smaller condenser of the oscillatory circuit proper. The arrangement of the connections can be seen in the accompanying figure.

Here, C_1, C_2 are the two storage capacities, in series, and the joining conductor is connected to P_2, one of the leads of the transformer secondary. The other



Diagramatic Representation of J. H. Webb's System.

secondary terminal is connected to the other plates of the condensers, through a pair of valve-tubes, V_1, V_2, which are in parallel, but oppositely connected, so that alternate half-waves go through each to charge up the condensers, C_1, C_2. By this means, although both condensers are charged and connected in series, they are unable to discharge through the valve-tubes, so that the condenser circuit remains charged at twice the transformer secondary potential difference. One way of utilising this stored energy is to connect the two poles of the condenser, O, to the outer terminals of the storage capacities, C_1, C_2, through high-resistance conductors, such as slate rods or a water resistance,

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so that only a small amount of current can flow into the actual oscillating condenser, *O*. The condition for oscillations of maximum continuity is indicated by a steady singing sound from the spark-gap, and the adjustment of the resistance and spark-gap length are made with this end in view. An alternative way of convectively transferring a small charge induced on two rotating discs of insulating material is also described.

For wireless telegraphic signals it is proposed to employ the "continuous working" method of Fessenden and to vary the period as he does, or else to vary the coupling for the formation of Morse signals. As applied to wireless telephony, a microphone is used in the manner now well known, in which it short-circuits a part of the capacity in the oscillating circuit. A certain vague similarity between the action in this method and that in the now well-known rotating disc method of sparking employed by Marconi can be traced. Both aim at the acceleration, or rather the bringing closer together, of the discharge periods, and the similarity is to some extent increased when it is considered that the Marconi method is said to work even better when the supply current is alternating instead of direct.

The method next to be described, due to E. Ruhmer, is perhaps of greater direct interest than either of the preceding arrangements, in that not only is it an arc method, which means that one is certain that plenty of energy can be obtained, but because it is, like the first one described, a trigger arrangement, or one in which a very slight amount of energy can be used to effect a large variation in a considerable amount of energy. It further has the advantage that the sounds are not merely dependent upon a *variation* of the amplitude of the oscillations, but upon the actual amplitude, since in the normal condition the arc is not emitting any Hertzian radiation. For this purpose, advantage is taken of the sensitiveness of the arc in hydrogen to changes in the current when the latter is near the critical value, *i.e.*, at which the character of the arc changes from the stable to the labile state. The main idea is that if the arc is normally supplied with a current just sufficient to give the arc the stable characteristic, a very small reduction of the main current will suffice to change the arc to the labile state, in which state Hertzian emissions take place; and, on the main current being allowed to return to its normal value, the arc changes again to the stable form, and the oscillations cease. This is easily effected by a proper choice of the electrical dimensions, and in the sensitive condition the microphone current is used to initiate the transition from the one type of discharge (arc) to the other.

The microphone current can be made to act upon the main current in the usual variety of ways, inductively, for instance, but the inventor also proposes to make it affect the electromagnets which produce the magnetic field in which the arc is placed. If these electromagnets are polarised, the microphone current may be used to diminish the intensity of magnetisation, and since the demagnetisation process is incomparably more rapid and delicate than the inverse process, this certainty seems a valuable arrangement.

The radiation of energy, using such a method, is somewhat different in form from that usual in arc methods, in which the high-frequency current is generally only modified as regards frequency or amplitude, as in the methods of Stone and Blondel; it consists here of complex groups of impulses with blank or inactive intervals, the form of each group depending on the shape of the sound wave affecting the microphone. A simple vowel sound, such as *oo*, will thus be transmitted as a series of simple groups of electrical impulses of corresponding group frequency; a more complex sound, such as the vowel *e*, will, on the other hand, be transmitted as a series of complex groups, each main group (of the frequency of the fundamental tone) being formed of several smaller groups whose group frequencies are dependent upon the harmonics. This appears to be one of the most distinctive features of the method, taken in conjunction with the fact that these groups of impulses are not mere variations of a constantly emitted radiation, if the term may be permitted. The actual arrangements required in practice are so simple that they need not be detailed. Several other patents, however, deal more fully with the special arrangements of the arc electrodes, which need be here only briefly referred to. The electrodes of the arc gap are kept at a constant distance apart by means of a new device involving the employment of travelling bands of metal (aluminium) wire passing round distance pieces, over which they are tightly stretched.

As regards detectors suitable for wireless telephony, the one most generally used has been the electrolytic. Other less recent types, which are stated to give good results, are Fleming's oscillation valve and its offspring, the so-called "Audion" of de Forest. It is, however, noticeable that though, owing to the inclusion of a local battery, the latter is much more sensitive than the original valve, and was previously described by de Forest as the detector *par excellence* for telephonic purposes, he has, in his latest experiments in Paris, been using only a multiple detector of the crystal type. Detectors of this nature are now available in great variety. Though probably Braun's psilomelane was the first, it was not till Dunwoody described his form of detector, using carborundum, and Pickard the use of silicon, that attention was drawn to what Pierce has since shown is almost a general property of certain types of crystals. Later additions to the substances employed are titanium oxide, telluride of silver, and molybdenite. The Bronk "cell" used by the Amalgamated Radio-Telegraph Co. is also a crystal type detector, and a recent detector of the Gesellschaft für drahtlose Telegraphie, though described as a thermo-electric device, seems to partake somewhat of the characteristics of the crystal type.

In this detector two metals, copper and tin, for instance, are separated by a film of copper oxide, which has to be of a certain thickness and nature, and it seems possible to regard the arrangement as in a manner analogous to the crystal rectifying type, the oxide film reproducing in some way the peculiar properties which are shown by certain surface layers of the crystals. Still more remarkable is the fact that when considerable pressure is applied, the material pressed between two metals can be so completely non-conducting as to be what is usually accepted as an insulator. Thus von Lepel finds that an insulating dielectric pressed in this way between two spherical metal surfaces forms a very sensitive detector. How far one is at present from having arrived at a state of complete knowledge as to the action in even the simplest detectors can be seen from the fact that the steel-carbon detector, which has always been classed as a microphonic self-restoring coherer device, has now been shown by Austin to be able to act as a rectifier of alternating and high-frequency currents.

A further type of detector, which, so far as at present investigated, appears to act by coherence, but, strangely enough, will not permanently cohere, is the tantalum detector recently devised by the writer. This appears to have special advantages for sound and speech transmission; further, an auxiliary source of current being employed, one is not limited to the amount of oscillatory energy received as with the crystal detectors. In these latter, taking the efficiency of rectification at 60 per cent., Pierce's highest figure, the proportion of the received oscillatory current which is available for actuating the telephone receiver is only $0{\cdot}5 \times 0{\cdot}6 = 0{\cdot}3$.

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THE LOCARNO-BIGNASCO SINGLE-PHASE RAILWAY

ONE of the latest examples of a railway electrically equipped on the single-phase system is the narrow-gauge railway, Locarno - Pontebrolla - Bignasco, in Switzerland, the equipment of which has recently been completed by the Oerlikon Company. This railway is the outcome of numerous experiments made by that company on the experimental line, Oerlikon-Seebach-Wettingen. The Locarno-Pontebrolla-Bignasco line connects the town of Locarno, on Lake Maggiore, with several small towns scattered along the Maggia Valley, and is upwards of 28 kilometres in length. Many difficulties were encountered during the construction of this line, owing to the wild nature of the Maggia Valley. In some cases tunnelling was resorted to as a precaution against falling masses of rocks.

The water-power station is situated at Pontebrolla on the left bank of the Maggia river. The station as originally designed was for supplying light and power to the town of Locarno, and comprised two units of 600 h.p. each, water being taken at a point some 1,600 metres higher up the river. A canal, partly open and partly tunnelled, led to a small forebay on the right bank of the river opposite to the station. From the

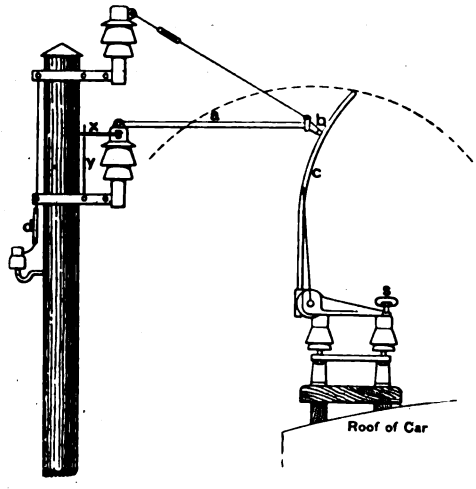

FIG. 1.—OVERHEAD CONSTRUCTION AND CURRENT COLLECTOR.

forebay, which was provided with gratings, sluice-gates, and an overflow, a pipe line, 1,500 millimetres internal diameter and some 100 metres long, led to the station below on the left bank, crossing the river on trellis girders. The effective head varied between 34·8 and 37·3 metres, according to the height of the water in the discharge pipe of the turbines. In order to cope with the demand for power made by the railway, two more units have been installed, and a second pipe-line has been laid parallel to the first. The new units, as in the case of the former, are direct coupled to spiral-type turbines running at 600 revolutions per minute, which were supplied by Messrs. Bell et Cie, Kriens. The rated output of each generator, with a power factor of 0·8, is 380 k.v.a. The generators are four-pole machines, and deliver alternating current direct to the line at 5,000 volts and 20 cycles per second. The voltage is regulated by means of a Thury regulator. The switchboard is of the most modern type, and is raised considerably above the level of the floor of the machine-room, all high-tension apparatus being beneath it in small fireproof partitions. Two main high-tension oil-switches control the sections Pontebrolla-Bignasco and Pontebrolla-Locarno.

The single overhead conductor for the line is of "Fasson wire," and has a cross-section of 50 square millimetres. It is supported on wooden poles 30 metres apart, except at crossings, and is on the left side of the line when travelling from Locarno to Bignasco. In the tunnels, however, it is suspended over the centre

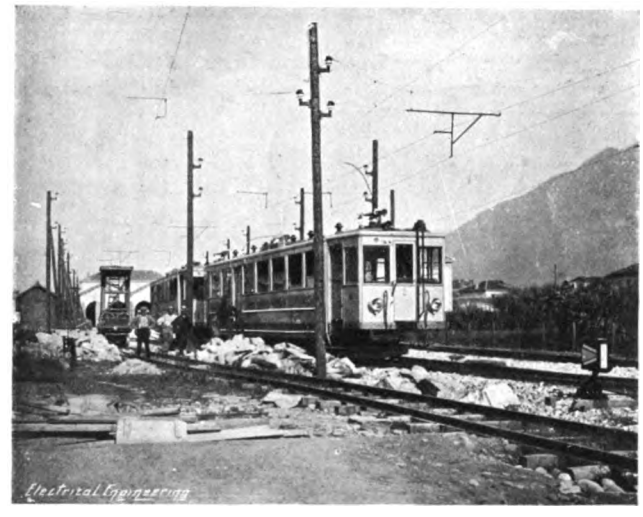

FIG. 2.—GENERAL VIEW OF CAR AND OVERHEAD EQUIPMENT.

of the track. The insulators, like those employed on the Oerlikon-Seebach-Wettingen line, are of the double-petticoat type, tested to 30,000 volts. The insulator pins are so fixed in sockets on the supporting arm as to be capable of turning. The reason for this will be explained later. The overhead conductor is divided into seven sections, each section being controlled by a high-tension switch, with horn blow-outs mounted on an iron mast. These switches act automatically, but can also be operated by hand. On the poles carrying the overhead conductor, but somewhat lower down, a 3-millimetre galvanised iron wire is carried on low-tension insulators. This wire, like the overhead wire, is also divided into seven sections, each section terminating at one of the above-mentioned section switches. Each of the high-tension insulator pins is connected to the

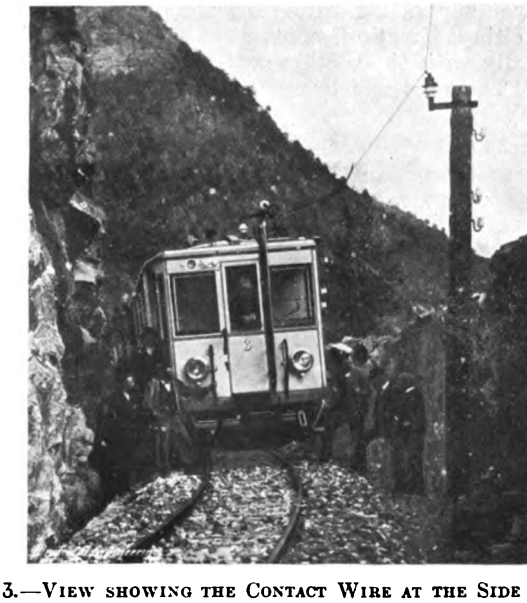

FIG. 3.—VIEW SHOWING THE CONTACT WIRE AT THE SIDE OF THE TRACK.

galvanised iron wire, as shown in Fig. 1, through a fine copper wire enclosed in an air-tight tube *d* of insulating material, the ends of which are closed by two

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metal caps. In the case of an insulator breaking down, current flows through the fine copper wire, along the iron wire to the automatic switch in that section, which immediately opens, cutting the section out. Almost instantaneously the tube of insulating material contain-

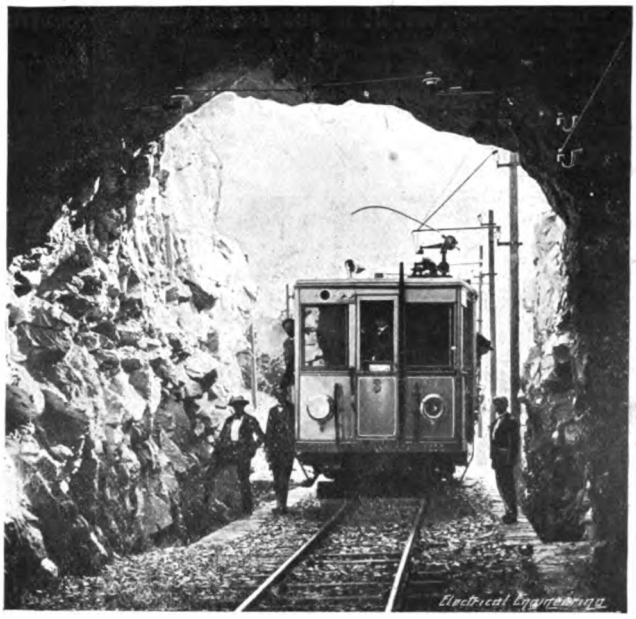

Fig. 4.—View from Mouth of Tunnel showing Suspension of Contact Wire over the Centre of the Track.

ing the copper wire explodes, owing to the expansion of the confined air, caused by the heating of the thin wire by the current. One cap remains hanging on the insulator pin and the other on the iron wire. The defective insulator is, in this way, very readily detected. The section switches are also brought into action, in case of the conductor breaking, in the following manner:—When the conductor breaks, the supporting arm a, which is attached to the metal cap of the lower insulator, swings round by reason of the tension of the conductor on the unbroken side, the insulator turning in its socket with it. Attached to the cap of the same insulator is a two-pronged wire x, between the arms of which projects a second wire-fork y, which is attached to the iron supporting arm. Upon x describing a small arc in either direction, contact is established with y, and finally with the section switch, which immediately opens. The rails which act as the return path for the

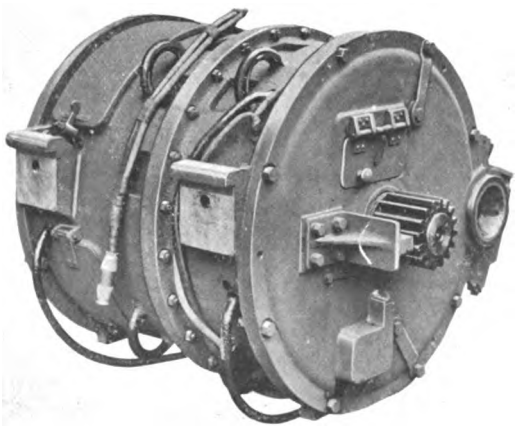

Fig. 5.—Oerlikon 40-h.p. Single-Phase Motor.

current are not bonded, but the ends and fish-plates are coated on their contact surfaces with a conducting substance before bolting together. Owing to the small current bonding was not considered necessary. The railway is being extended some distance into the town of Locarno itself, and, as may be expected, a lower voltage of 800 volts has been decided upon for that section.

Each motor-coach is provided with two distinct types of collector, one for the high-tension section outside Locarno, and one for the town section. The former

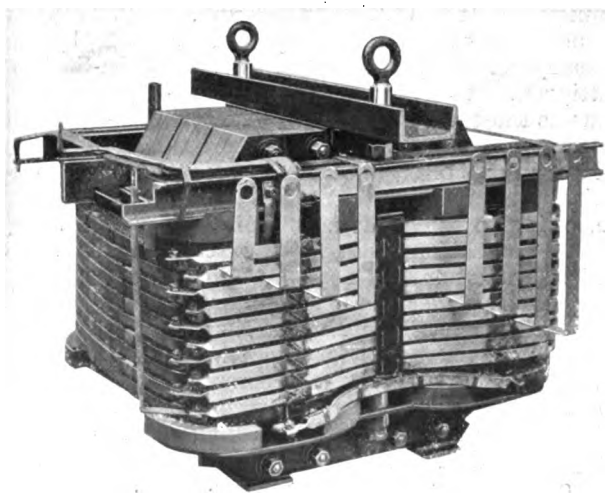

Fig. 6.—80-k.v.a. Transformer.

consists of a bent steel pipe, as shown in Fig. 1, with a replaceable strip of brass let in to make contact with the conductor. A coiled spring exerts a turning effect on the spindle to which the rod is attached, pressing the latter against the conductor with a practically constant force of about 6·5 lbs. This spring is so constructed that the pressure is independent of the position assumed by the rod in its arc of action, which embraces nearly 180°. One of these collectors is placed at each end of the car-roof, the two being connected in parallel. The extreme positions assumed by these collecting rods may be clearly seen in the accompanying illustrations. These collectors can be withdrawn from contact with the conductor, and lowered until they rest on the spring s (see Fig. 1) by means of a hand-wheel placed within reach of the motorman.

The low-tension collector is placed about midway between the two high-tension collectors, and consists of a double bow, supported on a light framework of steel tubes, the whole folding together very compactly on

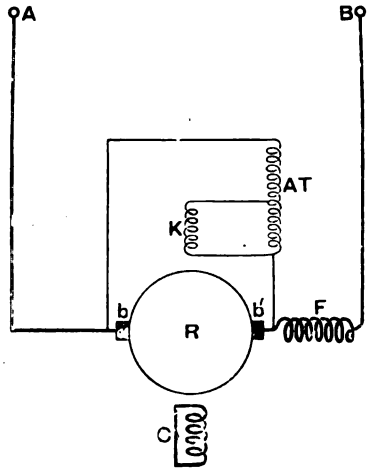

Fig. 7.—Diagram of Connections of Oerlikon Compensated Series Commutator Motor.

to the roof of the car when not in use. This collector, like the former, may be raised and lowered at will from within the car.

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Up to the present the rolling-stock consists of three motor-coaches and two trailers, besides several trucks. Further additions are, however, being contemplated.

The motor-coaches are of the double bogie type, four-axled, each axle being driven by an 860 h.p. motor through 1 : 5·15 gearing. Part of the baggage compartment, which is situated about the middle of the car, is partitioned off, forming a small fireproof cell containing the fuses, oil-switches, and other high-tension apparatus. Each car has two parallel-connected oil transformers rated at 90 k.v.a. suspended beneath the floor of the baggage compartment, one on each side, in order to distribute the weight equally. On the secondary windings are eight tappings, as shown in Fig. 6, which correspond to the eight positions of the controller drum. Variation of speed is obtained by placing a greater or less number of divisions of the secondary coils in the motor circuit. On the 800-volt section of the line the secondary windings of the transformer are used as an auto-transformer.

The controllers are a modification of the usual Oerlikon type, being provided with specially large contacts and blind contacts in the intermediate positions, which may be readily replaced. On account of the heavy currents to be dealt with, powerful magnetic blow-outs are employed.

The motors are of the Oerlikon series commutator type, 200-volt, 6-pole, with compensating and commutating windings. A diagram of the connections employed for the Val Maggia Railway motors is given in Fig. 7. A, B are the terminals; F the excitation winding, which is in series with the rotor R. b b^1 represent the brushes (in all six sets). The compensating winding C is short-circuited on itself. K represents the commutating pole windings connected to the small auto-transformer A T, which, in turn, is connected across the brushes. The rotor winding consists of an ordinary 6-pole lap winding provided with equalising connections and directly connected to the commutator segments without the intervention of resistance leads.

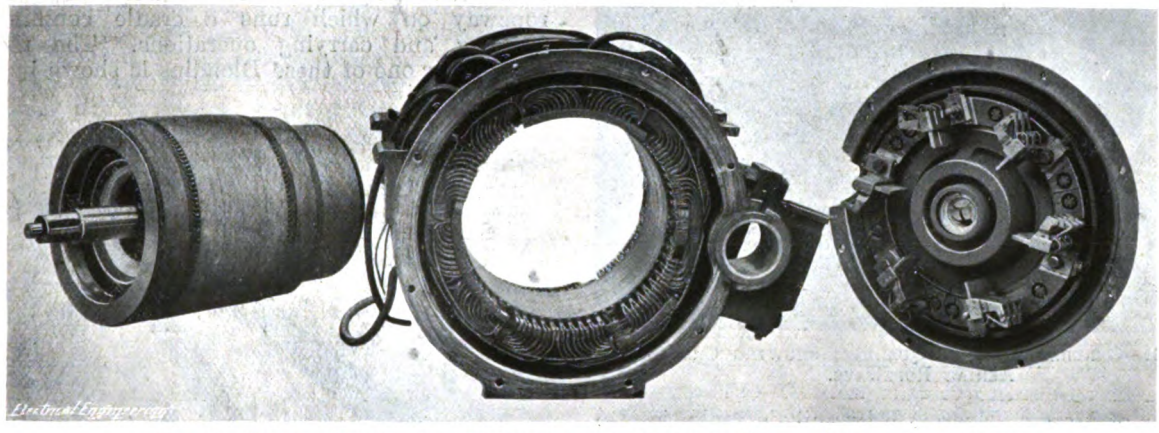

Fig. 8.—Rotor, Stator, and Brush-gear of Oerlikon 40-h.p. Single-phase Motor.

In Fig. 8 the windings of a stator are clearly shown, also the exciting and compensating coils superimposed on one another. In addition there are six small coils each embracing a single tooth, which form the commutating poles.

The cars are provided with pneumatic brakes and sand-boxes, the necessary air being furnished by two air-pumps, each connected by gearing to a motor. Air is stored in a reservoir at a pressure of four atmospheres. Lighting and heating circuits, the former at 55 volts, the latter at 200 volts, are tapped off the secondary windings of the transformers.

ELECTRIC EQUIPMENT OF RUBISLAW QUARRY

THE Rubislaw Quarry is some two miles to the west of the city of Aberdeen, and is being worked continuously for the production of a hard quality of grey granite, largely used for building purposes. The quarry is about 300 ft. deep, divided into two levels, and is about a mile in circumference. Fig. 1 is a general view of part of the quarry, showing the arrangement of the cranes on the lower and intermediate levels, and the "Blondins," or aërial ropeways, across the quarry at the surface.

The rock is first drilled by means of portable compressed-air drills, blasting charges then being inserted and the loose product hoisted either by the cranes from level to level or by the Blondins in a single operation. The larger blocks are raised bodily, while the smaller ones are hoisted in large rope baskets or nets. Until about a year and a half ago the quarry was worked by steam cranes and other steam machinery, which were supplied by a ring steam main from boilers situated at one end of the quarry. As might be imagined, the losses due to condensation in this main were considerable, and this fact, combined with a number of other considerations, such as a supply of cheap power from the Aberdeen Corporation, induced the owners of the quarry (the Rubislaw Granite Co., Ltd.) to convert the installation for electrical working. They retained as their consulting engineer Mr. Charles H. Merz, and Messrs. Siemens Bros. Dynamo Works, Ltd., were entrusted with the conversion as main contractors. This firm supplied all the electrical plant, including transmission lines, switchboards and motors, part of the mechanical equipment being sublet to sub-contractors.

Continuous current at 440 volts is obtained from the Aberdeen Corporation mains, an additional feeder having been laid down for the purpose. At the office buildings of the company at the quarry, this feeder is led to a panel fitted with a Wright demand indicator and a recording watt-hour meter. The current then passes through two circuit breakers, which control the whole of the supply, and also serve to protect the meters from a short-circuit in the event of accidental falling of the bare wires, &c., and thence by a bare overhead main on wooden poles to a controlling switchboard placed in the same house in which the large 20-ton crane motor is installed. This house is situated

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at the edge of the quarry, as shown in the general view, and in a central position with respect to the various motors.

The switchboard consists of an incoming mains panel, feeder panels, and lighting panel; an earth

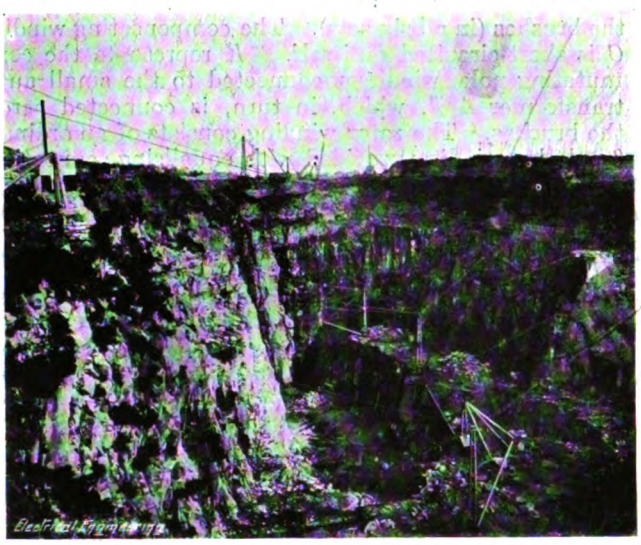

Fig. 1.—General View of Quarries showing Cranes and Aerial Ropeways.

indicator of Messrs. Everett Edgcumbe's make is also provided, so that any "earth" on the system may be readily detected and put right. This control board is connected with a ring main encircling the quarry, consisting of hard-drawn No. 000 gauge copper wire, supported at suitable intervals round the top of the quarry on insulators mounted on special brackets. The design of the latter is such that the ring main can be easily shifted if this becomes necessary in the process of quarrying. Current is conveyed from this ring main to the various motors by insulated cables, the connections being made by clamps which may be easily removed, if necessary. At the west end of the quarry it was necessary to carry the mains across a wide gap to the opposite side of the quarry. For this purpose the mains were brought vertically down the cliff a certain distance, and then run horizontally across the quarry, being supported by a number of special brackets fixed to the guy ropes of the crane. This is shown in the general view of the quarry (Fig. 1).

Altogether there are 10 cranes in operation, each equipped with a Siemens C type motor, controller and switch-box, the entire equipment being of substantial design and waterproof, as it is mounted in the open

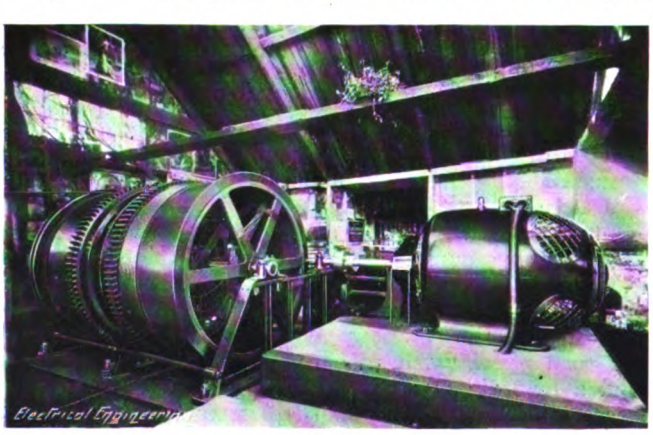

Fig. 2.—Winding Drums for Aerial Ropeways driven by 75-h.p. 440-volt Motor.

with no housing or covering whatever. The switch-boxes contain circuit breakers and fuses. The motors are series wound and of from 25 to 75 b.h.p. The largest motors are used for driving the 20-ton crane, which works on the ground surface and has a lift of 300 ft., and the four Blondins. In these instances the motors are installed in separate houses overlooking the quarry. The 20-ton crane and motor-house can be seen in the background in Fig. 3. The controllers are of Messrs. Siemens "KA" type, with "forward" and "reversing" motion with one handle, and are in all cases, except in the larger sizes, combined with their resistances, a convenient design occupying little space. The mechanical alterations to the cranes, to adapt them for electric driving, were executed by Messrs. Martin & Co., of Kelvin Works, Newcastle-on-Tyne. Each Blondin consists of a wire ropeway on which runs a cradle combining both hoisting and carrying operations. The motor and gearing for one of these Blondins is shown in Fig. 2.

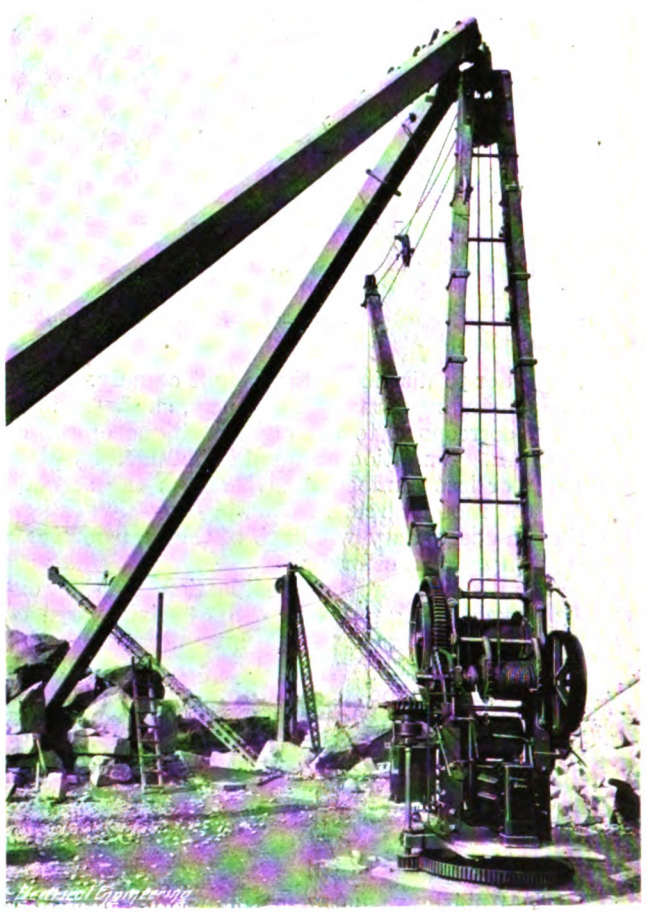

Fig. 3.—15-ton Electric Crane, with 20-ton Crane in Background.

The plant further includes two centrifugal pumps, driven through flexible couplings by Siemens motors. Both pumps are installed at the foot of the quarry, and are capable of lifting 7,500 gallons of water per hour through an 8 in. main against a head of 300 ft. Provision is made for an extra 100 ft. at a future date. The motors are of 25 b.h.p. each, and run at 1,200 r.p.m. The cable feeding these pump motors is led direct from the control board down the cliff, being fixed to the 8 in. water main. There is also a very complete compressed-air system, including an Ingersoll-Rand compressor driven by a Siemens 104 b.h.p. motor. The air is carried by a ring main round the quarry to receivers at suitable points, from which it is taken to the various drills. A very complete stone-breaking and crushing plant has been installed by Messrs. Baxter, of Leeds, the crushers, rotary screens, and fine rolls being driven by motors ranging from 18 to 40 b.h.p.

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ELECTRICITY IN MINES

Reports of H.M. Inspectors of Mines

THE reports of H.M. Inspectors of Mines for the various districts into which the country is divided for colliery inspection purposes contain, amongst other matters, a good deal relating to the uses of electricity in mines, especially as regards accidents attributed to electrical causes, and in many of these reports it is shown how greater care and stricter observance of the Home Office rules for the use of electricity in mines could have avoided fatalities. The number of electrical accidents reported is trivial in comparison with those due to other causes, but it is none the less important to investigate such as have occurred and consider the means by which similar accidents can be avoided. An extensive digest of the collected reports is given in the *Colliery Guardian*, from which portions of the reports are abstracted.

In the Swansea district Mr. J. Dyer Lewis reports one fatal accident due to the use of electricity underground, in which a workman was killed in consequence of a leakage of electric current due to a fault in a switch-box A small 6 h.p. power motor, drum, and other fittings appertaining to a haulage gear, were erected above the railroad upon a platform of steel girders built into the sides of an archway. Current was supplied by a three-phase alternating plant, periodicity 48, and 550 volts pressure. Armoured cables fixed to the sides of the shaft, conducted the current down a pit, and junctions were arranged for a supply of power to a pump erected in a room cut into the side of the shaft, about midway between top and bottom, for another large pump at the pit bottom, and for the haulage motor. The electrician considererd that the contact of the girders with the strata efficiently earthed the haulage motor and its fittings. He had tested the earthing, and had found it absolute. The motor had been working a quarter of an hour before the accident occurred, and the motor man was at his post, when a connection in a switch-box blew out. The platform was soon "alive," and the motor man was pitched from it, and fell upon a coal-laden tram which was on the roadway beneath. The current appeared to have been conducted along a steel haulage rope suspended on sheaves at the side of the roadway, for about 200 yards to a terminal sheave, and returned along the rope lying on the floor of the heading, which was very wet for a considerable distance. A fireman, who happened to be about 80 yards away from the motor, was the first to feel a shock, and called for help. Several men came to the rescue, and one of them upon gripping the rope became unconscious. The current having been switched off at the pit bottom, the injured man never regained consciousness. An earth wire of copper was subsequently attached, and conducted any leakage to the sump at the shaft bottom.

Mr. J. S. Martin, the inspector for the Southern district, also records a single fatal electrical accident. This occurred at the Ebbw Vale Company's Marine Colliery. An underground electrical haulage engine operator received a fatal shock at an intermediate haulage engine station, between the shaft and another haulage engine station further inbye, nearer to the faces, while twisting one of the lighting cables around an insulator in order to take up slack. The lighting current for the engine-room and vicinity is provided from the power plant at 540 volts. There is a make-and-break switch provided with two fuses which blow at 1 ampère. Breakages of the cable appear to have been not infrequent from one cause or another, and they were repaired by whoever was at hand, twisting the wires together without covering them at such points. Gloves, although provided, do not appear to have been worn very regularly on these occasions. On April 24, the day before the accident, a journey rider made a joint as described and left the wires uncovered, so that deceased, not having cut off the current or used gloves at the time of winding up the cable, came in contact with the bare wires and got a shock, which proved fatal, as no one present knew how to render first aid. The electrician, although aware that breakages were frequent, had provided neither rubber nor tape to cover these joints of repair, nor does he appear to have given it the personal attention he should have done, and which was expected of him. He has since been superseded. A shaft fire, due to electrical cause, was reported at the Marine Colliery in the same district. Here the separation doors between the shafts were found to be on fire in consequence of an electric cable having short-circuited where it was carried through a hole in the side and close to the frame of the door, upon which it evidently had rested, contrary to Section VII. (2) of the Electrical Special Rules. The cable, a well-insulated one, must have been rubbed in some way to cause it to fail at this point. It being a fiery mine, and the fire being adjacent to the return air, the result might have been serious. Mr. Martin remarks that electricity continues to be developed at the mines in this district for haulage and pumping purposes. The newer mines in Monmouthshire are being laid out with a view to large generating plants. It has also extended in the Forest of Dean collieries, in which section of the district is situated Trafalgar Colliery, the pioneer of electricity in the mines of at least this district and the South Wales coalfield. Bristol and Somerset have also got small installations at some of the mines.

The report of Mr. Robert McLaren for the East Scotland district mentions one fatal accident due to the use of electricity, which, as will be seen from the following account, would have been avoided by the exercise of reasonable care. The accident occurred at Bowhill Colliery, Fife. The system is alternating, with voltage of 500, three-phase, and the cable is armoured. In the Lochgelly Splint Coal dook a three-throw pump had been started a few days prior to the accident. While the motor was in motion deceased attempted to put in some flooring under the cable, and raised it, with a piece of iron to lever it up, with the result that the sharp end cut through the insulation, making the piece of iron "live," and causing the full current to pass right through the man. The motor was properly earthed.

The same report also contains a note on the prosecution of a mine manager for contravention of the electrical rules. In this case, which occurred toward the end of 1906, a miner was killed by an electric coal-cutter becoming "live," and the current, passing up the haulage rope, came in contact with the man. The cause of the motor becoming "live" was due to a defect in the bushing, and proceedings were sanctioned for contraventions of (1) Section I., rule 11, failure to employ a competent person; (2) Section I., rule 1 (*a*) and Section III., rule 30, failure to have trailing cable in connection with coal-cutter heavily insulated and effectively covered throughout; and (3) Section I., rule 1 (*a*) and Section V., rule 35, failure to have holes in motor casing substantially bushed with insulating bushes. The person employed to look after the electric plant had no technical knowledge of the subject. The trailing cable consisted of a cable covered with insulation, and having an outer covering of plaited leather, and, in the opinion of Mr. Ram, the electrical inspector for the Factory Department, the internal insulation was too light, and did not comply with the terms of the rule, "heavily insulated," and the bushing consisted of a brass ring countersunk into the motor casing, and through this bushing the bare cable, inside an indiarubber tube, passed into the motor. The defence, which was taken up by the makers of the motor and cables, was that the person in charge was competent, the trailing cable was heavily insulated, and the india-rubber tube was an insulated bush. The Sheriff took the case to avizandum, and subsequently convicted on the third count, and found the other counts not proven.

Mr. Ronaldson's report for the West Scotland district mentions a case where a man was killed by electric shock in the

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Polmaise Colliery. The shaft bottom was lighted by incandescent lamps arranged two in series, the current being taken from the power cable, and the conductors were placed inside iron tubes earthed by being connected to the armour of the shaft cable, which in turn was connected to the sole-plate of the dynamo on the surface. The electrical supply is alternating, with a voltage of 500 and a periodicity of 50. The deceased and other two men observed electric sparks passing between the tube containing the lamp leads and an iron beam with which it was in contact. The deceased went to the switch close at hand to cut off the current, and, on touching it, received a shock which caused his death in about 15 minutes. Apparently the iron tube in which the leads were enclosed had become temporarily live. Owing to alterations being carried out at the shaft bottom, the tubing in which the leads were enclosed was not joined directly to the armour of the shaft cable, but was temporarily connected with it by a piece of steel rope. There must have been some defect in the earthing arrangement. Two non-fatal accidents by electric shock were reported. The first occurred to a roadsman who was handling a live cable at a switch-box, and the second occurred to a drawer, who got his hand severely burned by taking hold of a cable, the insulation of which had been cut through by a fall of roof.

Mr. R. Donald Bains' report for the Durham district gives particulars of two accidents caused by electricity, resulting in the deaths of two persons and injury to another, and three accidents by which three persons were more or less injured. Both the fatal cases occurred in connection with coal-cutting machines; the first at Burnmoor Colliery, and the second at Lumley Colliery. Both collieries belong to Messrs. the Lambton Collieries, Ltd. The accident at Burnmoor caused the death of the master shifter and injury to the machineman. The machine was of the bar type mounted on skids, and driven by an alternating-current 500-volt motor of 30 h.p. The current was taken to the motor from the gate-end switchbox by means of a trailing cable, fastened down to the side of the machine by means of a piece of hemp rope. By this means, so long as there was slack cable behind the machine, the cable is kept from being squeezed between the timbers supporting the roof and the machine. This piece of rope was, shortly after the accident, found cut in two, and the cable jammed tight between a chock and the projecting bracket on the framework of the machine, and one of the conductors laid bare. The cause of this was that, contrary to Section V., rule 7, of the Special Rules for the Installation and Use of Electricity in Mines, it was being dragged along by the machine, and was in consequence taut. The squeezing off of the insulating material, and the consequent contact of the bare conductor with the machine, electrified the machine itself, the hauling rope already referred to, and the ground in the immediate vicinity. The man attending to the machine had not been aware of what had occurred, and was in the act of working a ratchet lever to adjust the height of the machine, when he received a shock and was thrown down between the machine and the face. There he stayed, not daring to move, but shouting for help. The master shifter came forward, but received a shock and was thrown down. His lamp was extinguished, and he then turned and crawled along the face, with the intention of reaching the gate-end switchbox to switch off the current. Crawling in the dark he touched the hauling rope, and from it received a fatal shock. Other men, hearing the machineman shouting, hastened to the gate-end box and switched off the current. The machine attendant had also received a shock, but not a fatal one. There was in the trailing cable an earth return. The method of connecting the earth return to the frame of the coal-cutter was by means of a pin, on which was a collar. The end of this pin was threaded to screw into a hole in the coal-cutter frame, and it was intended that on the pin being passed through a brass plate, to which the earth return wire was soldered, the shoulder, or collar, should press against the brass plate and so make a connection. As a matter of fact, the hole in the machine frame was not big enough to allow of the pin being screwed deep enough to permit the collar on the pin to touch the brass plate. The side of the pin, however, would, in all probability, touch the inside edge of the hole in the plate as it passed through, but this would not make a firm contact or connection. The trailing cables were in lengths of 70 yards. These lengths were joined together by specially arranged junction boxes, which were so made that the connection between the earth return carried in each length of trailing cable was not automatic, but had to be made by placing in position an iron bridge-piece. Further, it was easy for this bridge-piece to be so placed as not to connect the earth return in each length of trailing cable.

In the present instance, Mr. Bain thinks that the earthing of the coal-cutter motor (which, being a portable motor, is not required by the Special Rules) was inoperative; and that this was due either to the connection direct to the frame of the machine being faulty, or to a bridge-piece connecting two lengths of earth return in the trailing cable not being in its proper position. The direct cause of the leakage of current was the fact that the trailing cable was allowed to be dragged along by the machine, and, as a consequence, was squeezed between the coal-cutter and a chock, and the insulating material thereby scrubbed off one of the conductors. Since the accident steps have been taken to make the passage of the trailing cable along the face as automatic as possible, and to so arrange the junction boxes in the trailing cable that the connections of the earth return cannot possibly be otherwise than correctly made. The second case was very similar to the above. A conductor in the trailing cable became exposed, and caused the machine to be electrified. The machineman received a shock and died. Of the three non-fatal cases, one occurred at Langley Park Colliery, belonging to Messrs. the Consett Iron Co., Ltd. A man received a slight shock by touching a cable, the insulation of which had been cut through by a fall of stone. The second case occurred at Newbottle Colliery, belonging to Messrs. the Lambton Collieries, Ltd., and was due to a leakage of current from the trailing cable of a coal-cutting machine. The last case occurred at North Biddick Colliery, belonging to Messrs. the Lambton Collieries, Ltd.

Two explosions, which were due to the use of an unenclosed motor in certain circumstances, are mentioned in Mr. W. H. Pickering's report on the Yorkshire and Lincolnshire districts. These occurred at Westgate Colliery, belonging to Mr. Henry Ellison, of Cleckheaton. The motor was attached to a pump. The engineman omitted to switch the current off from the pump motor when he came out of the pit shortly before he started the fan. Had he done so these two explosions would not have occurred. At it was, in starting the fan, and leaving the open-running motor with the electric current on it, he did exactly what was required to cause the first explosion, for to get to the air pipes the gas had to pass the sparking commutator of the motor. On Mr. Walker making an inspection and investigation of the circumstances, he found that no less than nineteen of the General Rules of the Coal Mines Act and Electricity Special Rules had been violated. Convictions were obtained and substantial penalties inflicted.

Mr. H. Hall's report on the Liverpool and North Wales district does not record any accidents traced to electrical causes, but makes a few general remarks regarding electrical working in mines. He does not apparently regard electrical coal-cutting with much favour. He considers that it is remarkable how quickly the persons put in charge of electrical machinery grasp its details and dangers, and are thus able to handle it with safety. Mr. Hall would have preferred that the Electrical Special Rules should have required the precautions against the ignition of fire-damp to be enforced throughout every part of a mine where safety lamps are in use instead of only to such parts where General Rule No. 8 applies. A considerable increase in the use of electric power for hauling and pumping in this district is recorded.

Three accidents in which electrical working was concerned are reported in the Midland district, and commented on by Mr. A. H. Stokes. In one of these a boy travelling along a roadway touched an electric cable at a place where there was a minute hole in the insulation, which accounted for the leakage, and, as the roadway was wet, he received a shock and his hand was burned. Another accident occurred to the enginewright while testing for leakages of current by means of the leakage indicator. Having pushed over the arm of the switch, a strong "earth" was discovered, and when moving the arm back to the neutral point (before disconnecting the switch), the current followed the movement of the switch and brought his hand in contact with the arc thus formed. He should have temporarily cut out the indicator when he found the leakage. Another accident occurred to the motor driver in the mine when a heavier train than usual was being drawn up the incline from the workings. At a steep part of the roadway it caused too much overload to be put upon the motor, and as the driver was standing with one hand on the controller and the other on the clutch gear, he received a slight shock. Four cases of danger from electricity have been reported during the year, all of them due either to abraded cables or defects in the earthing of the current. Considering the extensive use now being made of electricity for motive power under varying conditions, Mr. Stokes thinks this record is highly favourable, and bears testimony to the value of the new special rules for ensuring safety.

Mr. H. Johnstone, in his report on the Staffordshire district, speaks of one fatal and one non-fatal accident by electricity, resulting in one death and injury to one person. At Littleton Collieries, South Staffordshire, a lad was in charge of a 9 to 10 h.p. 500-volt continuous-current haulage motor, fitted with a double-pole switch, and a controller of the tramway type. Wishing to slack out a yard of rope, he moved the controller to the first contact, but it failed to act, owing, as subsequently transpired, to the spiral wire of a resistance coil having broken behind an insulator. He then moved the controller to the second contact, when the motor began to race. He shouted to a fireman who stood near that something was wrong, and presumably threw his hand back to pull out the switch which was behind him. From the burns upon the back of his hand and forearm, his hand appeared to have come in contact with the uncovered blades of the switch, and he had then fallen against the heated resistance coils. He was killed instantly. The motor had been installed a considerable time prior to the establishment of the special rules for the installation and use of electricity in mines. Availing himself of the powers con-

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ferred upon him by Rule 55, the inspector directed that this and all similar switches in the mine should be enclosed or otherwise covered, and this has since been done. At Sneyd, North Staffordshire, on June 11th, an electrician received a severe shock on touching a main junction box situated close to shaft bottom. The current was 440 volts, three phase. A leakage was known to exist, there being a dead earth on one phase, and the junction box referred to was opened while endeavouring to locate it. It was traced to a badly-made joint at the screens, which led to the armouring of the cable becoming live. Fortunately no serious results ensued. One or two cases of failure of insulation causing "dangerous" occurrences are also mentioned in the same report, and the following accident in the Florence Colliery, North Staffordshire, is mentioned. A blower of gas under the holing at a longwall face was ignited by an arc caused by a breakdown of the insulation on one of the field leads of an electric coal-cutter, an earth on the surface having occurred at the same time. Fortunately, there was no accumulation of gas, and the burning blower was promptly extinguished by the machine chargeman.

In Mr. F. A. Gray's report relating to the Cardiff district, it is stated that only one accident occurred through the use of electricity, and the injured cause was very slight. At the National Colliery a new three-phase 250-h.p. haulage motor was being tested by the colliery electrician and the electrician of the firm who supplied the plant. The voltage was 550. A spare panel on the switchboard was used for the test. The colliery man said he left the controller handle in the off position, and went and put in the switch, when, to his surprise, the rotor of the motor began to revolve, and the ammeter registered 100 amperes. This could not have occurred until the controller handle was put in the on position unless there was short-circuiting in the controller. The firm's electrician called out "stop," and as the colliery man drew the switch back there was an extensive arc or flash which burned him on the face and hand. The controller handle was found to be in the on position after the accident, and after a test was made of the controller it was found to be free from electrical defect. On account of this accident, and until this and the other switches are altered, it was decided that in no circumstances is one of the panel switches to be put in or out until the bus-bars are made dead by taking out the main switch, which breaks under oil.

In the same report a very remarkable case is recorded of damage in a mine due to lightning. At Nantgwyn Colliery, during a severe thunderstorm, the headgear was struck, and the discharge descended the pit, nearly 500 yards deep, by the guides and haulage ropes. At the pit bottom the master-haulier, who was handling the main haulage rope, received a shock which knocked him down. He said he saw a flash of light running along the rail. A shackler, who was in the "slum" near the shaft, had one hand resting on a tram, and the other on a wrought-iron pipe, received a shock, and saw a large flash of blue light, which he said lit up the place like daylight. The hitcher saw flashes on the guide ropes. The current passed in along the haulage rope in the 6 ft. seam about 600 yards, where a haulier said he saw greenish-coloured sparks given off from the tail rope, which was not moving. It also travelled in along the haulage rope in the 9 ft. seam for a distance of 485 yards, where several sparks were seen, and both there and in the 6 ft. seam a sound resembling the exploding of a squib was heard. All the electric lights on the surface were put out, and the fuses had to be renewed. Since this occurred lightning conductors have been attached to all the pit headgears of this colliery.

ELECTROLYTIC PRODUCTION OF COPPER TUBES, SHEETS AND WIRE

MR. S. O. COWPER COLES read a Paper at the Bristol meeting of the Institution of Mechanical Engineers, in which he described the "centrifugal" process for the direct electrolytic production of copper tubes, sheets, and wire.

The refining of copper by electrolysis has now assumed vast proportions, and the annual output of electrolytic copper in the year 1907 has been estimated at 400,000 tons, equal to 56 per cent. of the world's production, and the capital sunk in the industry at about £15,000,000. The whole of the copper thus produced is in the form of rough slabs or cathode plates which have to be smelted and worked to the desired forms. Electro-metallurgists have been striving for many years to devise a process which does away with the smelting of copper after it has been electrolytically refined, and to electro-deposit copper after the refining operation in such a form that it can be placed direct on the market as finished tubes, sheets, and wire.

It was observed shortly after Elkington practically applied Faraday's law to the refining of copper in the year 1865, that the current density, or the rate at which the copper is deposited, could be considerably increased by circulating the electrolyte or moving the electrodes. Wilde was one of the first to use a cylindrical cathode, his object being to deposit copper on iron rollers for textile printing purposes, for which he took out a patent in the year 1875. The anodes consisted of copper cylindrical tubes, and the iron cylinder to be coated with copper (the cathode) was placed in the centre of the cylindrical vat and caused to rotate on its axis. The next development of importance was the Elmore process, which consists of using horizontal mandrels on which copper sheets or tubes are deposited, while agate burnishers travel continuously over the copper, so as to consolidate it, and to prevent the growth of copper trees or nodules. Even with the use of a burnisher, however, the current density cannot be increased beyond 30 amperes per square foot. Dumoulin introduced, at a later date, a process for burnishing copper during deposition with sheepskin, and claimed that the process had also the advantage of insulating any projections that might be formed by coating them with a thin film of animal fat, thus preventing further deposition until the surrounding depressions are raised to the common level. It was claimed for this process that a current density of from 30 to 40 amperes per square foot of cathode surface could be employed at a voltage of about 1·6 per vat. This process was tried on a large scale in England, but was soon abandoned. Attempts have been made at various times to further increase the rate of deposit by Swan, Elmore, Thofehrn, Graham, Poore, and others, by impinging jets of the electrolyte against the cathode surface.

The author, when carrying out some experiments on the production of copper tubes and sheets by electro-deposition on rotating cathodes, observed that when the speed was greatly increased entirely new results were obtained, and that a current density of 200 amperes or more per square foot could be employed, the copper remaining smooth and having a tensile strength equal to the best rolled or drawn copper. This observation led to further experiments, which resulted in evolving the process now known as the centrifugal copper process for the manufacture of sheets, tubes, and wire.

After a long series of experiments had been made to determine the best composition for the electrolyte and the most economical current density to employ, the critical speed was accurately determined by means of revolving cathodes in the form of cones; and by observing the point at which the copper remains smooth, 200 amperes per square foot was found to be the most economical current density.

One of the chief difficulties inherent in any electrolytic process for the production of copper tubes and sheets is having any working parts, such as bearings, in an acid solution. This difficulty was eventually overcome by constructing vats in the form of an annular ring. By such an arrangement all working parts are outside the vat and do not come into contact with the electrolyte, so that the bearings can be lubricated in the ordinary way. The cathode consists of a steel or cast-iron cylinder closed at one end, to which is attached on the inside a steel rod projecting below the edge of the mandrel to guide it into position; the cylinder can be 5 or 6 ft. in diameter, or even larger, so as to produce a copper sheet of, say, 20 ft. long by 4 or 5 ft. broad. Anodes composed of crude copper are placed around the mandrel with intervening spaces, and are fed forward by suitable mechanical means, as the copper dissolves away, so as to keep the voltage constant.

One great advantage of the centrifugal process is that a very low voltage is required even when employing a very high current density; for instance, only 0·8 of a volt is required at the terminals of the vat when working at a current density of 200 amperes per square foot of cathode surface. The effect of revolving the cathode is five-fold; first, it keeps the electrolyte agitated, so that there is always a fresh supply of copper ions in proximity to the cathode; secondly, each molecule of copper as it is deposited on the cathode is burnished or rubbed down by means of the skin friction between the revolving cathode and the electrolyte; thirdly, the rotation prevents any foreign matter that may be in suspension in the electrolyte settling on the cathode and becoming entangled by further copper being deposited around or over it; fourthly, it brushes away any air-bubbles on the cathode, which are the cause of nodules forming; and, fifthly, the rotation of the cathode ensures the thickness

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of copper being uniform, even when a mandrel of, say, 8 ft. in length is employed.

The method of making tubes by the centrifugal process is as follows :—A mandrel somewhat smaller than the finished internal diameter of the tube is prepared by coating it with an adhesive layer of copper by first depositing copper upon the surface from alkaline solution and then thickening it up in an acid solution, the surface being highly burnished and treated chemically to ensure the easy removal of the deposited tube. The mandrel thus prepared is then placed in a vat. When the desired thickness has been obtained the mandrel is removed and placed in a horizontal or vertical lathe, and a round-faced roller run over the surface so as slightly to expand the deposited copper, which can then be readily drawn off. Copper sheets are prepared in a similar manner, the only difference being that the mandrels are of much larger diameter, and a narrow insulating strip is fitted down one side so that the sheet can be easily removed by inserting a tool under one of the edges of the deposited copper. It is no more costly by the centrifugal process to make thin sheets than thick ones; copper foil can be made in five minutes direct from crude copper.

Copper tubes produced by this process without any drawing have given a maximum stress of 17 tons, and tubes after drawing have withstood a pressure of 3,000 lb. per square inch without showing any signs of distress.

Sheets made without any rolling have given a maximum stress of 28 to 30 tons and more per square inch, according to the peripheral speed at which the mandrels were revolved. The formation of copper trees and nodules was another difficulty that had to be overcome, but which has been reduced to a minimum in the centrifugal process, for the reason that impurities held in suspension in the electrolyte have no opportunity of settling on the cathode, and all gas-bubbles are swept from the surface on which the copper is being deposited.

The production of copper wire by electrolytic means is a more difficult problem than the production of copper tubes and sheets. Various processes have been suggested and tried from time to time such as the electro-deposition of copper on thin wire, until it has obtained a considerable thickness, and then drawing the thickened wire down to a comparatively fine wire. Swan and Saunders have both experimented with such processes, but so far they have not been worked commercially. Elmore's process consists of producing copper tubes by his burnishing method, cutting them into long spirals and then drawing them into wire. Other experimenters have tried placing an insulated spiral strip on a cylindrical mandrel so as to produce long copper spirals, but such an arrangement only allows of a very low current density being employed, on account of the nodules which form on the edges of the strip, even at very low current densities, rendering the strip unsuitable for drawing down into wire.

Copper wire is made by the centrifugal process in the following manner :—A mandrel similar to that used for making copper sheets is employed, around which a spiral scratch is made, the pitch being determined by the size of wire required. The effect of the spiral scratch (which need only be very light, but must be angular), is to cause the crystalline structure of the copper to form a cleavage plane. The copper divides exactly at the apex of the scratch, that is, the copper deposited in the scratch is equally divided and forms a small V-shaped fin on two sides of the copper strip. If the scratch is not angular, but rounded at the base, the copper will not divide, as the crystals are radial. After the desired thickness has been obtained, approximating the pitch of the spiral scratch, the mandrel is removed from the depositing cell and placed in a vertical position on a lathe, and the copper strip is unwound at an angle of about 45° to the face of the mandrel. During the process of unwinding the small fin or burr is removed by passing the wire through a suitable die and then through a wire-drawing machine provided with three or more draw-plates to reduce the strip to the desired diameter. By employing a mandrel of 6 or 7 ft. in diameter, lengths of wire four or five miles long can be made in one operation.

ELECTRICAL EQUIPMENT OF THE OTTAWA MINT

A PAPER read recently before the Canadian Society of Civil Engineers by Mr. A. H. W. Cleave, and reported fully in the *Canadian Electrical News*, describes the mechanical and electrical equipment of the Ottawa branch of the Royal Mint. Power is supplied to the Mint in the form of two-phase alternating current, at a pressure of 2,140 volts, and with a frequency of 60 cycles. There are three transformers for the power load, and three for the lighting, two in use, and one spare in each case. They are single-phase, oil-insulated, self-cooled transformers. The power transformers supply a motor-generator with two-phase current at a pressure of 500 volts. Their normal rating is 100 kw. each. The transformers for the lighting are rated at 15 kw. each, and have a secondary pressure of 214 volts. The motor of the motor-generator set is a two-phase, 225-h.p. motor, running at 800 r.p.m. The generator is a 150-kw. compound-wound continuous-current machine, generating at 225 volts. There are in all 32 compound-wound, continuous-current motors in use in various parts of the Mint, ranging from 1 to 30 h.p. The power circuit is on the two-wire system, and the lighting circuit on the three-wire system: all wires are run in steel conduits. There are 415 16-c.p. 102-volt incandescent lamps, and 17 arc lamps. The latter are alternating-current enclosed lamps, taking 7 amps. each at 102 volts. The buildings are supplied with an efficient telephone system, and electric clocks and bells are also provided.

The machinery in the die department consists of a die-sinking press, two die-turning lathes, and a die-hardening furnace. The press and lathes are driven by a motor through an overhead shaft. In the die-press the blow is given by a heavy flywheel, 5 feet in diameter, which is keyed to a triple screw of 6 in. diameter. The flywheel is rotated by two rapidly revolving discs, which can be brought into contact with its leather-covered rim. One friction disc raises, and the other depresses the screw. Each coinage die requires three blows from this machine before the impression received is sufficiently sharp in all its details. After each of the first two blows the die is annealed in the furnace. After the third blow it is turned to the correct size, and then hardened and tempered. It is usual for a pair of dies to strike about 80,000 pieces before they are unfitted for further use. In the machine shops grinding, drilling, milling, and planing machines are installed. One 14 in. by 72 in. Norton roll-grinding machine and a Bertram planing machine have individual drive, but the smaller machines are driven in groups from shafting. Other machines in the blacksmith's and carpenter's shops are electrically driven. The furnaces in the assay department are heated by oil-fuel in conjunction with an air blast from electrically-driven blowers. In the coining department each rolling mill is driven by its own motor, through gearing. The motor, gearing, and roll housings are all on one bedplate, thus ensuring rigidity and perfect alignment. The first motion shaft carrying the driving pinion runs in its own bearings, and, at one end, is connected with the motor through a flange coupling outside one of the bearings. The driving pinion is situated between these bearings, so that the motor is entirely free from any thrust. At the other end of this shaft, outside the other bearing, a small flywheel is keyed. The second motion shaft gears with the shaft driving the bottom roll, and this latter shaft gears through double helical gearing with the shaft which drives the top roll. The rolls are connected with the gearing by means of breaking spindles and muff couplings. The couplings are held up to their work by adjustable wood distance pieces. The motors run at 600 revolutions per minute, and the rolls at from 40 revolutions per minute for the breaking down mill, to 60 revolutions per minute for the finishing mill.

The breaking-down mill is driven by a 30 h.p. motor fitted with an overload release, which is set to cut out at 50 per cent. overload. The distance between the rolls is regulated by means of worms and worm wheels actuating large, single, square thread screws of half-inch pitch. There are 50 teeth in each worm wheel. The worm shaft is divided in the centre, the halves being connected by means of a friction coupling, so that when it is necessary to "parallel" the rolls, one end only of the top roll may be moved at a time. This worm shaft is actuated by hand wheels at either end, one complete revolution of which closes or opens the rolls 0·01 inch. The hand and worm wheels are fitted with indicators and divided circles, so that adjustment of the rolls can be made as fine as 0·0005 inch. For ordinary rolling it is usual to work to 0·001 inch at this mill. The thinning mill is driven by a 20 h.p. motor, in the same manner as the breaking-down mill. The rolls in this mill are 12 in. in diameter, and 14 in. in length, and are driven at 50 revolutions per minute. The finishing mill is driven by a 10 h.p. motor. There are three cutting machines, each driven by a separate motor, and capable of cutting blanks for all sizes of coins, at the rate of 300 per minute. The coining presses, of which there are three, are of the type in which the pressure is given to the coins through levers and toggle joints. The hard

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steel knuckles of the toggle joints are of exceptionally large dimensions, so that coins can be struck at the rate of 100 per minute without any danger of them becoming overheated. Each press is driven by its own motor, and arranged so that the drive can be made either through a belt or gearing. The number of blows struck per minute can be varied from 30 to 100 by means of a five-step controller. Other electrically-driven machines are the copper tumbling barrel for cleaning the blanks before they receive the impression from the dies; the overlooking machines or travelling bands, on which the coins pass before an inspector; the defacing machines for destroying faulty coins; counting and bag-filling machines, and various other pieces of apparatus. A refinery will shortly be erected in connection with the Mint, in which gold will be treated by the electrolytic process.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN the *Chemiker Zeitung* of August 5th, Professor H. Stockmeler contributes an article of considerable interest upon "Advancement in the Chemistry of Metal Working and its Various Branches." The article is to be continued, and the present portion deals mainly with metallic depositions and the various improvements in the electrodes used and the electrolytes employed.

One of the most important points which always has to be considered by electro-platers is the removal of all traces of grease and impurities on the electrode. Of late it has become customary to remove grease by electrolytic means. The articles to be plated are made the cathode in hot caustic potash solutions or solutions of potassium cyanide, common salt and so forth. The alkali given up at the cathode and also the hydrogen act as cleansers, and the grease is carried to the surface of the electrolyte, if it is animal fat in the form of soaps. But the fact of the grease floating on the surface of the electrolyte is a disadvantage, because when the cathode articles are withdrawn, they, on being raised out of the liquid, again become coated with grease from the matter floating upon the surface. In order to get over this difficulty it has been suggested, and even patented by Barth, of Frankfort (German Patent 195,975), that the upper layers of the liquid shall continually be allowed to flow away. The grease is then removed and the electrolyte is again returned to the bath.

Carbon anodes, it is well known, are very subject to corrosion, particularly when employed in baths containing cyanides, chlorides, or acids. In gold baths which usually contain cyanide it is therefore customary to employ anodes of platinum. Messrs. Siemens & Co., of Charlottenburg (German Patent 179,211), suggest the employment of silicon carbide (carborundum) as electrodes. This material is not only a very good conductor, but is a splendid electrode material, because it is practically unacted upon when used as anode. For example, an electrode of ferro-silicon was used in a solution of strong hydrochloric acid with a current density of 7–8 amperes per square decimeter, in 24 hours it lost 34 per cent. in weight. Under similar conditions a graphite electrode lost 17 per cent. in weight in 50 hours, but in 100 hours a silicon carbide electrode showed no measurable loss. On the other hand, ferrosilicon electrodes are fairly stable when they contain about 80 per cent. of silicon, but in this case the resistance is high. The *Chemische Fabrik Griesheim Elektron*, in their German Patent 193,367, protect the use of electrodes consisting of ferrous oxide, which, when in the molten condition, has added to it variable quantities of powdered, ferric, chromic, or manganic oxide. Carl Lindeman, of Magdeburg, German Patent 187,029, finds that carbon electrodes will withstand chemical anodic action better if they are saturated with platinum chloride and then ignited.

The rendering of non-conducting materials conducting upon the surface, so that metals may be deposited upon them, is a subject which has for many years received attention, several new patents having recently been taken out in this connection. Heller and Baumgartel (German Patent 189,410) paint the articles china, porcelain, &c., with petroleum and gold graphite. This latter is made by dissolving two grams of gold in aqua regia, evaporating to dryness, dissolving in 500 c.c. water, then adding 10 grams of potassium cyanide and one kilogram of finely powdered graphite. This mixture is then heated to 600° C., and then mixed with petroleum, is painted on the articles, which are then strongly heated. The surface is now evenly coated with a conducting film. Another method is to place the articles in a smoky flame; they are then said to be conducting, owing to the film of lamp-black formed on the surface.

There are various suggestions for treatment of aluminium in order to plate it with other metals. Most of the methods consist of scouring in alkaline or cyanide solutions or both, and do not appear to be any advance upon what has been done or suggested before.

A considerable amount of important work has been carried out upon the exfoliation of nickel when plated upon other metals, or, for that matter, upon itself. Nickel-platers are aware that when nickel is deposited from warm baths it is very much less apt to peel off than when cold baths are used. Römmler finds that electrolytic nickel always contains small quantities of hydrogen, but that the quantity is very much less at 75° than at 18°. Deposited metals which contain occluded hydrogen are invariably more brittle than when there is none present; this therefore explains why better deposits are obtained when the temperature is raised.

It was also shown that nickel exfoliates much less when the bath contains small quantities of free acid, the amount, however, must be very small. The higher the current density, however, the larger the amount of acid which may be added. Boric acid is often added to nickel baths, and all sorts of other things as well. We are of the opinion that nickel-platers would be much wiser to simplify their recipes and have as little extraneous matter as possible in their baths. Many recipes which one comes across contain substances which have directly opposed effects, and simply neutralise each other.

Rather complicated details for coating metals with tin are described, the articles being treated with a paste consisting of 5 per cent. zinc dust, 0·4 per cent. silver chloride, 12 per cent. salt, 0·9 per cent. of a tin salt, 20 per cent. tartaric acid, and 51·7 per cent. chalk. The older method in which tin or tinned articles are boiled with tartaric acid, and this solution, is afterwards employed, for tinning is simpler—the articles only requiring to be placed in the solution and connected with a piece of zinc.

In the English Patent 13,977, Mr. S. O. Cowper-Coles describes an electrolytic method for the manufacture of zinc dust. According to the patent, the zinc is electrolytically deposited in a spongy condition, and then in order to get rid of surface oxidation it is heated in a reducing atmosphere. The electrolyte is an alkaline one, consisting of a solution of caustic soda, and it is continually saturated with the zinc from anodes of this metal. On the other hand, the solution may be regenerated separately from the electrolytic cell, although even in this case an electric current is employed to dissolve the zinc. Probably the zinc powder obtained by this method can hardly be technically useful owing to the large amount of oxidation of the metal which would take place when drying it, and therefore it would require a considerable reduction before the oxide was got rid of.

Load Factor and Diversity Factor.—Mr. C. Le Maistre, Secretary of the British Electrotechnical Committee of the International Electrotechnical Commission, informs us that the definition of diversity factor, to which we took exception last week in the list of terms suggested by the Committee, was included in error, and that this should be, as we pointed out, the definition of "works load factor." The accepted definition of diversity factor is to be "The number obtained by dividing the sum of the maximum loads of the individual consumers supplied from any works during a given period of time by the maximum load delivered from the works during the same period."

Synchronising Public Clocks.—A Committee of the British Science Guild has made some recommendations with regard to synchronising public clocks, a subject to which considerable attention is being devoted at the present time. The committee suggest approaching the Postmaster-General, to ask that in the case of post offices, the time signals sent to the offices should actually automatically set at least one of the clocks in each public office to standard time; to form a deputation to the London County Council to ask them to have all public clocks under them, or in any way under their influence, synchronised in the same way; to take similar action with reference to the clocks under the control of the Corporation of London, the railway companies in London, and the Office of Works, which it is believed is responsible generally for the clocks in Government departments. The committee further recommend that the Local Government Board be asked to take the necessary steps to secure the passing of a bye-law calling upon persons exhibiting clocks publicly to have such clocks synchronised, or, failing this, for such clocks to be done away with. Similar action could be taken later on for provincial towns, and afterwards for smaller centres in Great Britain. It is understood that steps are being taken to carry out the recommendations of the committee.

The British Association.—*The Times* publishes some further particulars of the proceedings of the forthcoming meeting of the British Association in Dublin. Among the Papers of electrical interest down for reading under Section A (Mathematical and Physical Science) are the following:—"On the Measurement of Large Inductances containing Iron," by Sir Oliver Lodge and Mr. B. Davies; "Further Experiments on the Constitution of the Electric Spark," by Mr. T. Royds; "The Self-Inductance of Two Parallel Wires," by Dr. J. W. Nicholson. *The Times* also includes a Paper by Mr. A. P. Trotter on "The Position of the Mercury Ohm in British Legislation," but we are able to state that this Paper has been withdrawn. The programme of the Engineering Section is not dealt with.

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ELECTRICAL SCIENCE

British and American

Selenium-Aluminium Bridges.—G. M. Minchin, in a Paper in the July *Proceedings* of the Royal Society, gives details of his experiments on a new type of sensitive selenium cell. The cell —which, by the way, the author calls a "seleno-aluminium bridge"—is made by placing a plain piece of aluminium at each side of a very thin sheet of mica, and then cutting perpendicularly through the three layers. The cut edge is taken and trued up, and on it is smeared a very thin layer of molten selenium. The aluminium pieces are thus electrically bridged by the selenium. The selenium is, of course, heated in the well-known way till it assumes the brownish-grey conducting form. When the length of the bridge is about a centimetre, and the thickness of the mica about one-hundredth of a millimetre, the resistance of the bridge under an E.M.F. of two volts may be about 40 or 50 megohms. The author states that it is advantageous to coat the selenium with a thin layer of solid paraffin. After numerous experiments, the author has been led to an empirical formula connecting the intensity of light falling on the selenium with the current through it before and after. If i_1 be the intensity of light of a definite wave-length which alters the current C_o into C_1 under an E.M.F. of about two volts, and i the intensity of the same light which alters C_o into C, then the experiments with red light and with blue light fit the formula:

$$\log \frac{C}{C_o} = \left(\frac{i}{i_1}\right)^n \log \frac{C_1}{C_o}.$$

For red light the index n is found to be 0·262, for blue light it is 0·36. There are described also experiments on the effect of the time of exposure of the selenium to the light, on the resistance of the selenium. Unfortunately the author does not anywhere in his Paper give the reader any notion of the absolute sensitiveness of the "seleno-aluminium bridge," and does not offer any comparisons of the sensitiveness of his form of selenium "cell," as compared with well-known types.

Battery for Very Constant Currents.—The ordinary form of Weston cell serves admirably as a laboratory standard of E.M.F., but cannot be used as a source of steady current, because of irregular cathode reactions. The cell is a cadmium amalgam, cadmium sulphate solution, mercury sulphate, mercury combination, and has a very small temperature coefficient of E.M.F. Some time ago G. A. Hulett found that the presence of a certain amount of sulphuric acid removed the irregular cathode reactions. He has therefore now designed and constructed cells of large electrode areas capable of giving comparatively big currents with a constancy quite unapproached by the best secondary batteries. Full details appear in the *Physical Review* for July. A cell for giving currents up to one-thousandth of an ampere is made by taking a wide-mouthed bottle with a bottom of about 100 sq. cm. area, and pouring in about five millimetres of mercury. Then the electrolyte is poured in to a depth of 4 or 5 cm. The electrolyte is made by adding 10 c.cm. of strong sulphuric acid to a litre of water, and dissolving in this an equal weight of cadmium sulphate crystals. The other metal pole of the cell is the cadmium amalgam, and this is carried in a shallow glass cup suspended by a glass tube from the paraffined cork in the neck of the bottle. Connections to the two electrodes are made in the usual way by platinum wires sealed through glass tubes. The mercurous sulphate layer with which the mercury electrode must be covered is formed *in situ* by passing current through the cell. A still larger cell has been made, having a mercury surface of 340 sq. cm., and four amalgam cups, each of 5 cm. diameter. This cell on open circuit had an E.M.F. of 1·02206 volts. Its internal resistance was less than an ohm. When closed by a 100-ohms resistance the P.D. across the terminals dropped to 1·01691 volts; when closed by 20 ohms the P.D. was 0·99196 volt, and after half an hour was 0·99190 volt. Four of these cells joined in parallel have been used for a considerable time to furnish a current of 0·15 ampere for bolometer work.

Continental

Thermoelectric Detectors.—In reply to Branly (see p. 223), C. Tissot points out, in the *Comptes rendus* for July 27th, that his tellurium detectors work without a battery, and are therefore not based upon a mere coherer effect. When they are connected with the antenna in parallel with a galvanometer, the galvanometer shows a deflection when waves impinge upon the system. The latter would hardly produce the unidirectional effect described if the detector simply operated by a variation of the closeness of the contact. Another characteristic difference is that the thermoelectric detectors respond, not in accordance with the amplitude of the variation of potential, but in accordance with the mean energy impinging upon the system. This may be proved by measuring the energy with a bolometer, an instrument by means of which detectors may be tested quantitatively. Good results are also obtained with other substances occupying extreme positions in the thermoelectric series, notably with fused sulphide of copper and its natural variety (chalcosine), as well as Becquerel's alloy, containing ten parts bismuth and one antimony. The thermoelectric detector may be described as a "total-effect" instrument. It has properties which fit it in a special way for the receipt of signals in selective telegraphy and in wireless telephony.

Selenium Cells.—A difficulty often encountered in the construction of photoelectric selenium cells is that the liquid selenium congeals into drops, and so fails to cover the surface evenly. In the *Physikalische Zeitschrift* for August 1st, W. S. Gripenberg shows how to avoid this by using selenium vapour instead of fusing selenium. Two grooves are cut into a glass plate, as closely as possible together, and parallel to each other. These grooves are rendered conducting by means of a deposit of platinum, and are connected with the terminals. The plate is then exposed to selenium vapour, preferably in an atmosphere of dry carbon dioxide. It is important that the plate should not be too hot, as otherwise the selenium fails to be deposited. A very slight silvering of the glass surface before depositing the selenium may possibly be useful. Such photoelectric cells are easily protected from damp and injury. The author has not suffered from any short-circuiting in this type. Since the grooves can be drawn very close together, the cells have a very small resistance, even if the layer of selenium is very thin.

Minimum Spark Potential.—The question as to whether there is a difference of potential below which no spark discharge can be obtained, whatever the limits within which the air pressure and size of gap are varied, is still far from being satisfactorily answered. J. E. Almy, in the *Physikalische Zeitschrift* for August 1st, brings forward some results which show, at all events, that no very small spark potential can be obtained by making the sparking distance excessively small. For electrodes he used fine platinum wires fused at the points, where they formed spheres only 0·008 cm. in diameter. The gap between them was measured by the interferometer. In another series of experiments steel needles, with a radius of curvature of 0·0007 cm. at the point, were used. He then obtained no discharge at 330 volts when the gap was as small as a quarter of the wave-length of sodium light, or fifteen millioneths of a cm. At 360 volts a discharge was obtained, but it was a kind of glow discharge, enveloping the point of the needle, but not proceeding from the point. There is no indication that a further reduction of the spark-gap would make discharge any easier. A P.D. of 300 volts (one electrostatic unit) is therefore required to pull an electron out of a piece of metal into the open air. For that is the interpretation of this form of "independent" discharge.

The French Association for the Advancement of Science.—The annual meeting of the French Association for the Advancement of Science is being held at Clermont Ferrand. The presidential address of Prof. Paul Appell, of the Sorbonne, dealt with education, and strongly condemned the present examination system. A feature of the second day's proceedings was Sir William Ramsay's lecture, entitled "A Fundamental Problem," in which the electron theory of the constitution of matter was discussed.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Aug. 6th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

16,503. **Leading-in Wires for Tungsten Lamps.** Deutsche Gasglühlicht A.G. (Auergesellschaft). Nickel leading-in wires give trouble owing to the nickel, when fused round the tungsten, forming a fusible alloy which runs down and leaves the end of the filament of diminished area. With copper fused round the filament end, the filament is apt to break through before the fused globule has solidified. The patent is for using a leading-in wire composed of two metals, such as nickel and copper, one of which readily forms alloys and the other does not. The two metals may be mechanically united, *e.g.*, copper-coated nickel, or may be in the form of an alloy. Four claims, four figures.

18,022. **Modified Connection of Field Regulating Switches.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). This device is intended more particularly for separately excited generator fields. A fixed field resistance is arranged permanently in series with the field coils, and an adjustable resistance is arranged, so that

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it can be shunted either to the field or to the series resistance. At first it short-circuits the field, and its resistance is gradually increased until the coils are unshunted. The next stop of the switch handle places the adjustable resistance in shunt with the fixed resistance, and further movements gradually cut out resistance until the fixed resistance is short-circuited and the field is directly across the line. Three claims, one figure.

19,113. **Conduits for House Wiring.** H., A., and H. Pendlebury. The ends of the conduits are tapered instead of being screwed. The couplings and fittings are similarly tapered internally in an inverse direction. Both surfaces are machined. The ends of the pipes are also machined and tapered (or rounded off) internally. Three claims, five figures.

23,045. **Arc Lamp.** D. Timar and K. von Dreger. An arc lamp constituting an improvement on a former patent (No. 4,374 of 1902). The carbons are with their ends upwards, and are parallel when the arc is burning. Owing to the ends burning into a conical shape, it is necessary to bring the points together for striking the arc. To rotate the carbon holders is not sufficient, as the carbons then touch at some distance from the end, where the diameter has not been reduced by the burning. Under the present patent one of the holders not only rotates but moves away from the other holder when the lamp is switched on, in such a way that the points of the carbons are brought together to strike the arc. Three claims, seven figures.

24,251. **Neutralising Static Induction Effects on Telephone and Telegraph Wires on Single-Phase Railways.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). The catenary is charged to the same potential as the trolley wire, but its potential wave is displaced 180° in phase. The static effects of the trolley wire and its catenary on a neighbouring telepnone or telegraph wire thus neutralise one another. To charge the catenary in this way it is connected to earth through the secondary of a transformer, the primary of which is connected between the trolley wire and earth. It is mentioned in the body of the specification—although it is not claimed as an invention in the patent—that electromagnetic induction disturbances are largely avoided when sub-stations are connected to both ends of the trolley wire, as current then flows in both directions to the car, and the two inductive effects on the telephone wire tend to neutralise one another. Four claims, one figure.

26,404. **Speed-controlling Device for Hoisting Motors.** Siemens Bros. Dynamo Works (*Siemens-Schuckertwerke*). The ordinary check brake usually fitted on hoisting mechanism is so arranged that it is normally held out of action by the current until a certain speed is reached; at this speed the brake circuit is broken by a centrifugal governor, and the brake is thus temporarily applied. As the check brake is generally of too great power for this purpose, an alternative arrangement is proposed with the brake magnet divided into two parts, one of which is in circuit with the switch actuated by the centrifugal governor; or a stepwise action may be obtained by the further modification of having a switch in each of the parts of the brake magnet, the second switch being opened only at a higher speed than that at which the first switch is opened. Four claims, four figures.

1908 Patents

5,950. **Conduits for House Wiring.** Barton & Sons, Ltd., A. Barton and A. J. Harper. The socket end has a number of axial slits. The spigot end is placed within, and a ring which is tapered internally is then pulled over the slit spigot, drawing it tightly over the socket. One claim, four figures.

6,051. **Hardening Tantalum.** Siemens & Halske, A.G. It is known that silicon in proportions up to 1 per cent. is a hardening agent for tantalum. The present invention is to the effect that from 1 to 10 per cent. may be added without appreciably affecting the other good properties of the metal. This is especially the case with the ductility, which, however, diminishes when the proportion of added silicon is between 5 and 10 per cent., in order to harden the metal for the manufacture of parts of machines or for tools. A method of uniting the two metals is described by compressing a mixture of them and heating it by an electric arc between tantalum electrodes *in vacuo*. One claim, no figures.

9,289. **Multiple Maximum Demand Meter.** Hermann Aron. A double or multiple tariff meter, in which each counting mechanism operates its own maximum demand indicator, so that the maximum demand during different periods of the day is recorded separately. One claim, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

8,851, Mavor & Mavor & Coulson, Ltd. Polyphase induction motors.

14,451, Thompson (*Ges. für Drahtlose Telegraphie*). Production and detection of electric oscillations.

16,327, Lake (*Ingersoll Rand Co.*). Electro-pneumatic percussive tools.

16,485, Lenner. Regulating or controlling and measuring currents.

16,523, Brown, Boverie, & Cie, Akt.-Ges. Steam turbines with an impulse and reaction part.

16,577, Buchholz. Frames for supporting conductors in the open.

16,615, British Thomson-Houston Co., Wedmore, & Hamlyn. Protective devices for distribution systems.

16,630, Hudson & Bowring, Ltd., & Bowring. Life-guards.

16,719, Forbes. Arc lamps especially for signalling and searchlights.

16,735, Harrison. Electro-chemical deposition of metals.

16,862, Hake. Automatically operating gas or other valves or electric switches at predetermined times.

17,015, Marshall, Crookes & Robson. Portable electrically-driven machine for grinding, sawing, milling, and the like.

17,059, Grote & Ely. Arc lamps.

17,546, Preston & Theobald. Lamp holders.

18,924, Von Kando. Current-collecting devices for locomotives.

19,039, Wilkinson. Tramcar brakes.

19,784, Allgemeine Elektricitäts Ges. Switch mechanism for signalling systems.

20,361, Brooks & Alston. Tremblers of induction coils.

20,460, Haslop. Device for cleaning or trueing electric contacts.

20,662, Irgolitsch. Brake skate with sand strewing device.

23,710, Reist. Ventilating dynamo-electric machines.

23,801, Condon. Electrical water heaters.

25,426, Singer. Portable electrical vibratory massage apparatus.

25,863, Feather. Supporting trolley wires.

26,154, Siemens Bros. Dynamo Works & Birrer. Rotors of A.C. machines.

26,435, Bosch. Electrical ignition apparatus.

27,260, Goldschmidt. A.C. machine.

27,891, Barnett. Signalling to vehicles running on rails.

1908 Patents

2,152, Trivelli. Obtaining radio-active bodies from uranium or its compounds.

2,495, Bloxam (*Siemens Schuckertwerke-Ges.*). Electrically-propelled motor road vehicles.

2,871, Hutton. Appliances for use with telephone transmitters for preventing the overhearing of telephone conversations.

3,418, Wilkinson. Tramcar brakes.

3,583, Seibt. Radio-telephony.

3,860, Marks (*Electrical Manufacturing Co.*). Switches.

3,979, Fraser & Chalmers, Ltd., & Whitmore. Valves of mixed pressure turbines.

5,015, Harrison (*Electric Railway Improvement Co.*). Method of joining metallic bodies by means of an electric current chiefly designed for use in bonding rails.

5,948, Geb. Korting Akt.-Ges. Injectors.

7,586, Jones. Electrically-operated signals for railroads.

7,792, Sexton & Sexton. Sand distributing apparatus for tramcars.

8,017, Branco & Gumpert. Process for the manufacture of a material from peat for electric and heat insulation, sound-deadening, and other purposes.

8,288, Felten & Guilleaume Lahmeyerwerke Akt.-Ges. Differential relays.

8,414, Allgemeine Elektricitäts-Ges. Commutator motors.

9,479, Schäffer. Supporting hooks for lamp filaments.

9,501, Baggett. Arc lamps.

9,577, Allgemeine Elektricitäts-Ges. Dynamo-electric machines.

9,637, Siemens Schuckertwerke - Ges. Dynamo-electric machines with commutation poles.

11,432, Firm of Unterburg & Helmle. Actuating device for magneto-electric ignition apparatus.

13,837, Buchholz. Means for mounting on poles slotted hollow arms for supporting electric conductors in the open.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

13,854, Snook. X-ray system.

14,596, Lohay. Control of mechanism from a distance.

15,118, Siemens & Halske Akt.-Ges. Signalling installations particularly for fire alarms.

15,370, Beschelberger. Automatic switch device for the inductor of telephone apparatus.

15,491, Soc. pour l'Utilisation de l'Air et de ses dérivés. Safety device for high-pressure apparatus.

Expiring Patents

No patents of electrical interest expire during the current week.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	—	10½—11	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10⅝	
Do. 6% Cum. Second Pref.	10	6	6%	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	100—103	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	—	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co., Ld.	5	10	—	7—8	
Do. 7% Cum. Pref.	5	7	7%	6¾—7¾	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	93—101	
Ch. Cross. W. E. & City E. S. Co.	5	5	—	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3—4	−⅛
Chelsea Electric Supply Co., Ltd.	5	4½		3—3½	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	5/-*	9¼—10¼ xd	
Do. 6% Cum. Pref.	10	6	6%	11½—12½ xd	−½
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ld.	10	5	—	7¼—8¼ xd	
Do. 6% Cum. Pref.	10	6	6%	10¼—10⅝ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	98—101	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	¾—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	58—65	−2
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	96—99 xd	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	—	8—9	
Do. 4% Deb. Red	Stock	4	4%	94—97 xd	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	2½	2/6	⅞—1⅜	
Do. 6% Pref.	5		6	4½—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅜—5½ xd	+¼
Do. 4½% Cum. Pref.	5	4	4½%	4⅜—4⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. D	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5		2/6*	5½—5¾	
Do. £2 Paid	5	8	4·85d.*	2½—2⅝	
Do. 5% Pref. (fully paid)	5	5	2/6	5⅛—5⅜	
Do. £2 Paid	5	5	4·85d.	2—2⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	12—13	
Oxford Electric Co., Ltd.	5	7	—	5¾—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5/-	7—8 xd	−¼
Do. 7% Non-Cum. Pref.	5	7	7%	6¼—7¼ xd	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%	68—72 xd	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	—	1—1¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	—	⅛—1⅛	
Do. 5% Cum. Pref.	5	5	5%	1⅜—2⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5/-	7½—8½ xd	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	91—93	+1
Central London	Stock	3	3%*	69—71	
Do. 4% Preferred	Stock	4	4%	87—89	
Do. Deferred	Stock	2	—	52—55	−1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	81—84	
City and South London Cons.	Stock	4½	—	32½—33½ xd	
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114 xd	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112 xd	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110 xd	
Great Northern & City Pref. "A"	10	11½d.	—	⅞—1	−¼
Gt. Northern, Piccadilly & Brompton	10	4	—	7½—7¾	
Do. 4% Perp. Deb.	Stock	4	4%	90—92	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	4	—	35—36	−1½
Do. 3½% Preference	Stock	3½	—	86—89	
Do. 3½% "A" Pref.	Stock	3½	—	76—79	
Do. 3½% Convertible Pref.	Stock	3½	—	73—76	
Metropolitan District	Stock	—	—	11½—12½	
Do. 6% Perp. Deb.	Stock	6	6%	113—118	−2
Do. 4% Deb.	Stock	4	4%	71—75	
Do. Perp. Extension Pref. (5%)	Stock	—	—	21—26	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	45—49 xd	
Underground Elec. Railways Co of London 5% Profit Shg. Sec. Notes	Various	5	—	38—43	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	—	86—91	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅜—1⅝	
Do. 6% Cum. Pref.	10	6	—	4¼—4½	
Do. 5% Perp. Deb.	Stock	5	5%	95—98	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	6/-	12—13 xd	
Do. 6% Pref.	10	6	6/-	12¼—13¼ xd	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3¼—3⅝	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Street Tramways Co.	4	4/6	2/-	⅞—1¼ xd	
London United Trs., Ld., Cm. Pf.	10	5	—	6½—7½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	79—84	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	¾—1	
Do. 5% Cum. Pref.	1	5	—	⅝—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	93—96	
Provincial Tramways Co. Ltd.	10	4	3/-*	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	7½d	¾—1 xd	
Do. 4% Deb. Red	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	75—80	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	3⅝—3⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	15/-*	57—60 xd	+1
Do. 6% Pref. Ord.	Stock	6	30/-	102—103½ xd	−½
Do. Def. Ord.	Stock	1	—	15⅞—16⅜	+⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	83—86	
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	/-*	13¼—13½	+⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	98—100	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99—101 xd	−1
Do. do. (Mauritius Sub.)	25	4	—	100—102	
Eastern Ext. Australasia & China	10	7	2/6*	12½—13	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	99⅜—101 xd	
Eastern Telegraph Co.	Stock	7	1½-*	134—137	+1
Do. 3½% Pref.	Stock	3½	3½%	83½—85½	
Do. 4% Mort. Deb.	Stock	4	4%	101—103	
G. N. Tel. Co. (Copenhagen)	10	20	5/-	27—29	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—¼	
National Telephone Co., Ltd., Pref.	Stock	6	6%	106½—108½ xd	+½
Do. Deferred	Stock	6	6%*	115⅝—117⅝ xd	+½
Do. 6% Cum. 1st Pref.	10	6	6%	10—12 xd	
Do. 6% Cum. 2nd Pref.	10	6	6%	10—12 xd	+½
Do. 5% 3rd Pref.	5	5	2/6	5¼—5⅜ xd	
Do. 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	102½—104½	+½
Western Telegraph Co., Ltd.	10	7	3/-*	13⅜—14½	
Do. 4% Deb.	Stock	4	4%	99½—101½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	1 2½d.	1/4½d.	¾—1	
Babcock & Wilcox, Ord.	1	20	—	3¼—3⅛	
Do. 6% Pref.	1	6	—	1⅞—1⅞	
British Insulated & Helsby Cables, Ltd.	5	10	3/-	6⅛—6⅜	
Do. 6% Cum. Pref.	5	6	—	6—6⅛ xd	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	102—105	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅞—1⅛	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅞	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	53—58	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5½—5⅝	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	3/-	1½—1⅞ xd	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	90—93	
Dick, Kerr & Co., Ltd.	1	10	—	1½—1⅝	
Do. 6% Cum. Pref.	1	6	6%	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A," £3 paid	5	2/6	—	⅛—⅜	
Do. do. (fully paid)	5	4/2	—	1½—2½	+⅜
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	½—⅝	
Do. 7% Cum. Pref.	2	—	2/9½	1⅜—1⅝ xd	
Do. 4% 1st Mort. Deb.	Stock	4	4%	66—71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	84—87	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	—	10⅜—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	5/-*	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98½—100½	+⅜
Tel. Const. & Maintenance Co.	12	17½	12/-*	31—33	
Do. 4% Deb. Bds. Red.	100	4	4%	100—102	
Willans & Robinson Ord. Shres.	1	5	—	¾—1⅛	
Do. 6% Cum. Pref.	5	6	6%	2½—3	−⅛
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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LOCAL NOTES

ABERDEEN: *Tramway Accounts.*—The accounts of the Corporation Tramways Department, which we gave in our issue for July 30th, were passed at a meeting of the Corporation last week.

Municipal Tramways Conference.—The Convener of the Tramways Committee and the General Manager are to attend the annual conference of the Municipal Tramways Association, which will be held in Nottingham in September.

Supply for Wireless Telegraphy.—The Electricity Committee report that they have been in correspondence with the Admiralty in regard to the supply of electricity to a proposed wireless telegraphy station to be erected at Stoneywood. The committee recommended that a supply be given at a flat rate of 3½ per unit, the Admiralty to guarantee a payment of £350 per annum for five years, the Corporation to lay the feeder cables from Ferryhill to Stoneywood, and the Admiralty to pay the sum of £1,000 towards the cost.

ARGENTINE: *Telephone Progress.*—At the end of 1907 the United River Plate Telephone Co. had 15,499 subscribers and the Co-operative Co. 5,601.

AUSTRALIA: *Victoria Tramways.*—The *Australian Mining Standard* says that although the revenue of the St. Kilda-Brighton (V.) electric tramway for the year which closed on June 30th was actually £911 higher than that for the previous year there is again a deficiency on the year's operations of about £5,450. This, however, is not much more than half of last year's deficiency, which amounted to £9,782. But it must be borne in mind that the fire which destroyed the power-house, the car-sheds, and rolling stock in March, 1907, necessitated heavy expenditure, both last year and this; the outlay on this account during the previous financial year was £9,941, and during the year just closed £5,000 more has been spent on replacements. Then heavy interest charges have to be taken into account, and these amounted to about £2,000 for the past year. The balance-sheet, therefore, stands as follows:—Estimated expenditure, £15,800; estimated revenue, £10,350; estimated loss, £5,450. If it were not for the £5,000 for replacements, and the £2,000 interest, the loss would have been only £450. The actual revenue for eleven months was £9,700, and that for June is estimated at £650, making up a total of £10,350; whilst actual working expenses were £10,800. The total cost of making good the damage caused by the fire was estimated at £15,200, and of this £12,941 has been expended up to the end of June, leaving £2,259 still to be provided.

Victoria.—The Bendigo City Surveyor has drawn up a scheme for utilising one of the falls in the Coliban water race, between Sedgwick and the Crusoe Reservoir, for generating electricity for public lighting in the city and suburbs. The estimate for supplying and fixing a generating plant, including a transmission line to the city boundary, is estimated at £10,260. The report has been referred to the committee of the Council for consideration.

BANBRIDGE: *Electric Lighting.*—Messrs. T. L. Miller, Wilson, and Pegg have placed a scheme of electric lighting before the Council, under which they show considerable savings compared with the present system of public lighting by means of gas. A special meeting is to be held to consider the matter.

BARRY: *Electric Lighting.*—The Barry Chamber of Trade has disapproved the proposed electric lighting scheme of the Council.

BELFAST: *Cavehill and Whitewell Tramways.*—At the last meeting of the Corporation a resolution was moved "That it be an instruction to the Tramways and Electricity Committee to postpone further negotiations with the Cavehill and Whitewell Tramway Co. for the purchase of that company's undertaking for twelve months." The mover of the resolution stated that his reason for it was the unsatisfactory position of the Corporation tramways undertaking. After some discussion the resolution was withdrawn, the Mayor stating that so far as he knew, the Committee had no intention of buying the company's undertaking.

Tramway Fares.—At the weekly meeting of the Tramway and Electrical Committee on Monday the fares question was again discussed for some time, and the Town Clerk, Sir Samuel Black, submitted counsel's opinion, which was that the fares recently put in force are in accordance with the law.

BERKHAMSTED: *Provisional Order.*—The Chesham Electric Light & Power Co., Ltd., have notified the Council of their intention to apply for an electric lighting Provisional Order for the district.

BLACKROCK: *Electric Supply.*—At the August monthly meeting of the Council a report was presented with regard to the Central Ireland Electric Power Bill, which has been passed by Parliament, containing all the clauses which were specially provided to safeguard the interests of Blackrock. A provisional agreement has been entered into between the Council and the promoters of the Bill for a supply at 1¼d. per unit up to a certain point, and 1½d. per unit after that.

BOURNEMOUTH.—*Electric Cliff Lift.*—An electric lift on the West Cliff was opened on August Bank Holiday. It will be remembered that a similar lift on the East Cliff was opened a short while ago.

BRIGHTON: *Power Supply.*—A provisional agreement between the Electricity Committee and the London, Brighton & South Coast Railway Co., for a supply of electric power to the company's Brighton works (full particulars of which we gave in our last issue), has been confirmed by the Corporation. In moving the adoption of the agreement at the last meeting of the Corporation, Alderman Carden, the Chairman of the Electricity Committee, suggested that some portion of the £750 standing charge to be paid by the railway company should be placed towards the repayment of the capital charge, and thus shorten the time for the repayment of the loan. The agreement was eventually signed and sealed.

BURNLEY: *Death of Tramway Committee Chairman.*—The death took place on August 5th of Alderman Metcalfe, who was Chairman of the Tramways Committee, to which position he was appointed in 1906.

CARDIFF: *Condition of Tramway Track.*—Notice has been given of a resolution at a City Council meeting, asking for the appointment of an expert to investigate the "causes of the disgraceful and dangerous state of the tramway track and to recommend the best way of placing and keeping the said track in a satisfactory and safe condition."

Tramwaymen's Wages.—The Tramways Committee has again been considering the conditions under which the tramway employees are working. After a long discussion it was decided to pay the men time and a quarter overtime after nine and a half hours per day, and not to give increased wages.

CLEVEDON: *Electric Lighting.*—A proposal that the Council should apply to the Board of Trade for an electric lighting Provisional Order was rejected at the last meeting.

COLCHESTER: *The Electricity Works.*—The local papers state that a report of the Council in committee concerning the position of the electricity department has been presented, but that it is so mysteriously worded as to convey no information. It may be recalled that some time ago complaints were made as to alleged nuisance from the electricity works, and as extensions were contemplated, Messrs. Mordey and Dawbarn were called in as consulting engineers to advise on the whole position, and especially as to the erection of a new generating station on another site. A consultative sub-committee has been formed, but no definite proposals from it have been forthcoming. It was stated in the Council last week that the works are so fully loaded that if an accident happened to one of the machines during the "peak," either the tramways would have to be suspended or part of the lighting shut down. It appears that Messrs. Mordey and Dawbarn have advised the Corporation that there is a cheaper way out of the difficulty than building a new station, but no definite information was given at the last meeting, when the matter was discussed.

DAMASCUS: *Electricity Supply.*—A British Consular report states a line of 3⅓ miles of electric tramway was ready and open for traffic on February 7th, while the lighting part of the project was not finished till July. Very few private houses are as yet lighted by electricity, but it is expected that most of the well-to-do people will soon use it. The hotels, coffee houses, and theatres are now nearly all lighted with electricity, besides the great mosque and the principal streets. The railway stations are not so lighted.

DARLINGTON: *Tramway Revenue.*—For the first seven months of 1908 there has been a decline of 7 per cent. in the tramway receipts, a result which is attributed to trade depression.

Electricity Charges.—The charge for private lighting is to be reduced to 3½d. per unit, owing to the competition from gas. This is the lowest price in the North of England with the exception of Newcastle, which is the same.

DARTFORD.—*Rural Provisional Order.*—The Board of Trade have decided to defer for six months the question of revoking the Strood and Dartford (Rural District) Electric Light Order, 1903.

DENNY: *Electricity Supply.*—The Town Council has unanimously decided to proceed with a scheme of electricity supply. An agreement has been come to with the Electric Power Co

DONAGHADEE: *Electric Lighting.*—A firm of electrical engineers have placed before the Council comparative figures showing the saving which would be effected by the establishment of an electricity works as against a gas works. Further particulars have been asked for.

DUNDEE: *Tramway Accounts.*—The annual report of the Tramways Committee shows that the revenue for the past year amounted to £60,572, and the expenditure to £39,879. The balance of £20,692 has been applied to capital charges, depreciation, renewals, &c. The passengers carried numbered 16,176,134, an increase of 621,229, and the mileage run was 1,281,552, an increase of 118,760.

Third-Party Risk.—At the last meeting of the Town Council objection was taken to the proposal to set aside £1,000 out of revenue as insurance against third-party risks. It was suggested that this sum was inadequate, and that £1,500 should be so allocated. The committee's recommendation to set aside

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£1,000, however, was passed, it being pointed out that they had never yet paid more than £525 in one year.

FELIXSTOWE: *Nuisance from Electricity Works.*—Complaints have been made of alleged nuisance from residents near the electricity works, and the letters in question have been referred to the engineer.

FINLAND: *Telephones.*—In a British Consular report it is pointed out that in Helsingfors the number of telephone subscribers already exceeds 7,000, the population being 160,000. The telephones are not a Government monopoly and their cost never exceeds £3 3s. per annum.

Electric Railways.—The electric railway from Hyvinge station to Naas estate, a distance of 9·3 miles, built at a cost of about £16,000, has been in operation since January, 1908, and was recently officially inaugurated. This line may probably be extended to Hangö and Forssa.

GILLINGHAM: *Local Government Board Inquiry.*—Mr. H. R. Hooper, of the Local Government Board, has commenced an inquiry into the general position of the Council's electricity undertaking, mainly with the view of ascertaining in what manner the present loss may be mitigated or obviated. Mr. Hooper some time ago carried out a similar inquiry at Buxton, and as his recommendations in that instance proved beneficial, he has recommended that Mr. A. D. Chalmers, the Gillingham Council's electrical engineer, should pay a visit there, as the circumstances of the two places are peculiarly identical. When this recommendation was laid before the Council at its last meeting, opposition was taken to the Council having to pay the expenses of the trip, it being suggested that the journey was being made simply to educate the engineer up in his own work. It was ultimately decided that the engineer should visit Buxton.

GLASGOW: *Electricity Accounts.*—The gross revenue of the electricity undertaking for the year to May 31st was £255,462, and the working expenditure £115,318; from the balance there has to be deducted £54,715 interest on loans, and £52,308 sinking fund charges. The balance for the year is therefore £51,061, compared with £44,824 last year. From this balance there has to be written off £50,151 for depreciation, and the balance of £910 has been transferred to reserve fund account, which now stands at £22,122. The total capital expenditure to May 31st, less depreciation, stood at £1,685,085, of which £147,798 were expended during the year. The number of consumers is now 16,926, an increase of 1,429 for the year, and the quantity of electricity sold to private consumers was 31,087,522 units, an increase of 26 per cent. over the previous year. There are now 3,853 motors, with a total horse-power of 25,748, connected to the mains, against 3,302 motors in the previous year, with a total horse-power of 19,805. The public lighting consists of 857 arc lamps, and the maximum demand upon the station was 22,186 kw., compared with 19,645 kw. during the previous year. In view of the favourable position of the undertaking (the income for the year having increased by £28,557, whilst the working expenditure has only increased £9,081), the Committee recommend considerable concessions in the charges for electrical energy. For private lighting purposes the charge will be 5d. per unit instead of 3½d. per unit, whilst the charge to the Watching and Lighting Committee for public street lamps has been reduced by £2 per lamp per annum.

GRANTHAM: *Audit of Electric Lighting Companies' Accounts.*—The Council, which has the option of purchasing the undertaking in the town of the Urban Electric Supply Co. at the end of seven years, and afterwards at the end of every seventh year, has decided to support the Bermondsey Town Council in its protest against the action of the Board of Trade in doing away with the official audit of electric lighting companies' accounts, and to accept the audit of the companies' own auditors.

GRIMSBY: *New Generating Set.*—A new 500-kw. generating set has been erected at the power station, and will shortly be ready for testing.

GREENOCK: *Electricity Surplus.*—After meeting interest and sinking fund charges, there is a surplus of £700 upon the working of the electricity undertaking for the past year.

HALIFAX: *Record Tramway Receipts.*—During the three days of the Yorkshire Show, the receipts upon the Corporation tramway system amounted to £1,375, being £711 more than those for the three corresponding days of last year.

HASLINGDEN: *Through Tramway Communication.*—Negotiations between the Haslingden and Rawtenstall Corporations as to through running of electric trams have, for the present, been broken off.

Tramway Supply.—Owing to the fact that the Lancashire Power Co., with whom the Council had arranged to take a supply, does not now intend to carry their cables into the district for the present, a difficulty has arisen with regard to working the tramways. The reconstruction of the lines from horse traction is nearly completed, but under their Act of Parliament the Council is prevented from erecting a generating station. The Local Government Board has been communicated with.

HASTINGS: *Sunday Trams.*—Notwithstanding the Corporation a few weeks ago passed a resolution that Sunday trams should only be allowed on the understanding that the profits from them should not be taken into account in any purchase negotiations, the Hastings Tramways Co. continues to run its cars on Sundays. It is said that the opinion has been expressed by two eminent King's counsel that the resolution of the Council is illegal.

HULL: *Municipal Tramways Conference.*—The Chairman of the Tramways Committee, Deputy Chairman, the Tramways Manager, and the Electrical Engineer have been authorised to attend the Tramways Conference in Nottingham in September.

ITALY: *Genoa: Tramway Tunnel.*—A tunnel more than a mile in length, said to be the longest in existence for use by a tramway, has just been opened by the Genoa Street Railway Co. It connects Genoa with Rivarolo. The work of constructing the tunnel was commenced on June 1st, 1905.

LEAMINGTON: *Accident to Electrical Omnibus.*—An electrical omnibus, belonging to the Warwick and Leamington Electrical Co., was descending a steep incline near Leamington on Monday last week, when the brakes failed to act, and the vehicle got out of control. The driver managed to steer the vehicle safely until a waggon lower down the hill blocked the road, and in endeavouring to avoid this the omnibus dashed into a cottage on the roadside. Ten of the passengers were injured, and had to be conveyed to the Warnesford Hospital, Leamington.

LEITH: *New Generating Set.*—A new steam dynamo was put into operation at the electricity works last week, when the Convener of the Electricity Committee took the opportunity of reviewing the progress of the undertaking since its inception. He stated that in 1898 the plant installed consisted of five small steam dynamos of an aggregate capacity of 720 h.p.; in 1900 a further 550 h.p. was added; in 1901 another of 500 h.p. capacity; two further sets of 600 h.p. each were added in 1903, and one of 1,000 h.p. in 1905, whilst with the 1,000 h.p. set just put into operation, the total capacity of the plant in the station was now 4,770 h.p. It is interesting to note that this latter set has cost only about £200 more than the 500 h.p. set of 1901 in capital cost.

LIVERPOOL: *Tramway Loans.*—Tenders to the amount of £1,785,000 have been received in response to the Corporation's invitation for tenders for £500,000, the average rate of the tenders being £2 6s. per cent. discount. The rate at which the last bills were issued was £3 4s. 9½d. per cent.

LONDON: *Westminster: Smoke Nuisance.*—In his annual report the Medical Officer of Health, Dr. F. J. Allan, again draws attention to the desirability of steps being taken to have the qualification "black" omitted from the section of the Public Health Act which deals with smoke nuisance. Dr. Allan asserts that it is owing to the smoke nuisance in Westminster that in 1907 there were in Westminster 200 hours of sunshine less than in the suburbs of London.

St. Pancras: Tramway Track.—A deputation has waited upon the Highways Committee of the London County Council to urge the retention of the wood paving of the tramway tracks along Hampstead Road and High Street. In reply to the request, Mr. Whitaker Thompson, the Chairman of the Highways Committee, pointed out that as the Borough Council had insisted upon the conduit system, which necessitated an additional metal rail and therefore further increased the cost of maintenance, the Borough Council should meet the County Council by agreeing to pay the increased cost of maintaining the wood paving. The committee could not see their way to treat St. Pancras differently from the rest of London. A resolution was passed at the last meeting of the Borough Council authorising the Town Clerk and the Borough Engineer to continue during the vacation negotiations with the London County Council with a view to arriving at a settlement of the dispute.

Stepney: Meter Rents.—The Electricity Committee reports that they find the Council is in an unduly disadvantageous position with regard to those consumers whose consumption is regulated by time switches. A rental of 6d. per month is charged for these time switches, and the Borough Electrical Engineer has demonstrated to the Electricity Committee that the consumers effect a very considerable saving in their accounts by their use. As, however, the cost of the installation and maintenance of these instruments is more than that of the ordinary meter, the committee are of the opinion that the present time switch meter rental should be increased to 2s. per month in order to cover the out-of-pocket expenses of the Council. This report has been adopted.

MAIDSTONE: *Electricity Finances.*—The accounts for the year to March 31st show a surplus, after meeting capital charges, of £1,278. The units sold show an increase of 200,000 over last year, three-fifths of which is due to the Loose and Tovil tramways, but, in spite of the introduction of metal-filament lamps, the units sold to private consumers for lighting showed an increase of 5·5 per cent. In several towns, although the number of consumers had increased, the units sold for lighting purposes, the engineer points out, had decreased. The units sold for power purposes did not show such a large increase as last year, owing chiefly to several large consumers not being so busy. The revenue has increased by £1,400, while the costs have only increased by £411, and the gross profit upon the average capital employed is the satisfactory figure of 8·1 per cent. The total costs per unit sold is 1·05 pence. In the final paragraphs of his report Mr. Hoadley says that what is very badly required, however, is a reduction in the selling price of metal-filament lamps. Electrical cooking and heating apparatus was becoming

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much cheaper, and more reliable, and the price was bound to come down still further as the apparatus became more general. In the field of power supply, especially where small units of power were required over an area, electric motors stood practically alone, and to-day it was in very few cases that prejudice or want of confidence in their ability to do the work had to be overcome.

MANCHESTER: *Mutual Telephone Co.*—At the meeting of the Corporation on Thursday, Dr. Skinner proposed the appointment of a special committee to consider and report upon the position of the Corporation towards the Mutual Telephone Co., Ltd., and as to whether or not any payment should be made by the Corporation to reimburse the expenditure incurred by the company in endeavouring to promote a telephone system for Manchester. Dr. Skinner argued that the Council was in honour bound to make some recompense to the company in consequence of their having incurred expenditure as a result of a resolution which was subsequently rescinded. The motion was lost.

Trolley Omnibuses.—At the last meeting of the Corporation, a recommendation by the Tramways Committee authorising the Chairman, the Deputy-Chairman, the Chairman of the Permanent Way Sub-committee, and the General Manager of the tramway, to visit Germany to inspect some trolley omnibuses was carried. One councillor, however, objected to the constitution of the deputation on the ground that none of the members possessed any scientific knowledge of the subject, and suggested the appointment of some other persons who understood the business, and who would be able to bring back an intelligent report. It was pointed out that if the trolley system of omnibuses was found practicable it would be very useful in certain districts for which the Tramways Committee is bound to provide a service. For instance, Urmston was approached from Stretford by narrow winding lanes, and the adoption of the system there would save a large expense in street widenings.

Compensation for Tramways Accidents.—At the last meeting of the Corporation it was stated that the amount of compensation paid for tramway accidents during the past year was £15,000, against £9,000 for the previous twelve months. The Chairman of the Tramways Committee said he could only account for the increase by the fact that people were beginning to realise more the claims they could make for compensation for any slight accident. It would soon become a question for consideration whether the Tramways Committee should endeavour to make the best terms by insurance or go on as hitherto.

NEWCASTLE-ON-TYNE: *Tramwaymen's Grievances.*—The Newcastle Tramway Workers' Union has petitioned the Corporation Tramways Committee for protection of the drivers against cold and wet. The revision of some day duties which in some cases were spread over 13 hours with more than nine hours' actual work, was also asked for, and the recognition of long service in the case of enginemen and firemen at the power station, brakesmen and handy men at the depôts, none of whom were granted the 1s. a week conceded to workers last year in recognition of three years' service. The committee has replied to the effect that the covering in of the motormen's driving platform, &c., could not be entertained, and in regard to the revision of day duties, the committee considered that they had done all in their power and could do nothing more. As to the recognition question, the committee considered that nothing further could be done in the matter. On the holidays question the committee, in their reply, stated that they must have the services of the men on Saturday. The Union has decided to ask the Tramways Committee to receive a deputation on the questions in dispute.

NEWPORT: *Power Supply by Non-Statutory Companies.*—The Corporation has, in response to a communication from the Incorporated Municipal Electrical Association, agreed to support the views expressed at the Nottingham Convention with regard to opposing the granting of wayleaves along their tracks by railway companies to non-statutory electric power supply companies for the purpose of laying mains. The question was raised by the Scotch representatives at Nottingham *apropos* of a suggested scheme of this nature in the West of Scotland.

Third-Party-Risks.—The Electricity Committee have decided to accept the offer of the British General Insurance Co. to insure the tramways against claims above £1,000 and up to £10,000, with a total of £20,000 in one year, at an annual premium of £70; and they have also decided to reduce the proportion to be paid to the Corporation's own fund to £400 per annum, instead of about £650, as at present.

NORWAY: *New Electric Railway.*—H.M. Embassy at Christiania reports the opening of the first electric railway in Norway, from Thamshaven to Svorkmo, a distance of about 20 miles. The power station is some six miles from Thamshavn and the power is generated by a waterfall 58 metres high, developing 3,000 horse-power, and driving five turbines. In addition to passengers, the railway will carry copper ore from the Meldal mines, the owners of which are also the proprietors of the railway.

NUNEATON: *"Rateable Value" Basis of Charging.*—A new scale of charging for electric supply has been put into force, viz., on the basis of 15 per cent. of the rateable value of the property supplied, plus 1½d. per unit. Consumers preferring the old flat rate of 5d. per unit will be allowed to continue on this.

OLDHAM: *Smoke Nuisance.*—At a meeting of the Town Council last week, Councillor Cheetham asked why mill companies were continually prosecuted for the emission of black smoke from their factory chimneys, whilst the electricity station belched forth black smoke daily, and was allowed to continue without prosecution. He contended that the power station chimney was a bigger nuisance than any other in the town, and whilst the Corporation were the biggest owners in this respect, he would refuse to support any further prosecutions for black smoke nuisance. The Chairman of the Electricity Committee replied that the smoke inspector had taken numerous observations of the power station chimney and found no fault with it.

OXFORD: *Electrobuses.*—It is stated that the Electric Vehicles Development Co. has made application to the Corporation for permission to run a number of electric omnibuses.

PAISLEY: *Electricity Finances.*—The Borough Treasurer, in submitting his annual statement regarding the financial position of the various departments of the Burgh, states that he found the electricity department in somewhat straitened circumstances, mainly owing to the short term allowed for repayment of loans and the large ratio of capital to earning power. This year the deficit was £853, and it was clear that they had been selling current at less than cost price. Admittedly private lighting was a remunerative item, and therefore the loss must arise from the supply for power and traction purposes. The greatest gainers evidently were the Paisley and District Tramways Co., who took 1,581,870 units out of a total of 2,035,612 for power and traction. A very adverse factor during the year had been the excessive price of fuel, which cost £1,163 more than in the previous year.

PERTH: *Extension of Electricity Boundary.*—An inquiry under the Private Legislation Procedure (Scotland) Act, 1889, was held last week, into an application by the Corporation to extend the boundaries of the city and the limits for the supply of electricity, &c. The application also included authority to construct certain new tramways. For the latter purposes borrowing powers amounting to £11,500 were asked. These portions of the order were passed by the Commissioners.

PERU: *Electrical Appliances.*—According to a British Consular report the market for electrical appliances in Peru is very limited. In Lima there are electric tramways, urban and suburban, and an electric light plant. Electric power is very little used for industrial purposes; 100 horse-power per hour costs £1 1s. 6d. Light for private houses is expensive, 16 candle-power lamps cost about 8d. per kilowatt hour. Moreover, the Santa Rosa Electrical Company have a clause in their concession which stipulates that no consumer can use any appliances which they (the Company) do not provide. The regulation of the current supplied by this Company is very unreliable, so that lamps are continually being burnt out and the light is very unsatisfactory. It is estimated that there are 25,000 lamps actually in daily use in the town of Lima. The Company also supply light to Callao, but many, if not the majority of people at this port, prefer to use gas which, bad as it is, is found to give more satisfaction.

PLYMOUTH: *Electricity Accounts.*—The Electricity accounts, which were abstracted in our issue for July 23rd, were approved at the meeting of the Council on Monday. Mr. Anthony, in moving the adoption of the minutes of the Electricity and Street Lighting Committee, said the receipts for private lighting had fallen off, no doubt due to the fine weather during June last, when there were only five wet days; in June, 1907, there were only the same number of fine ones. The annual report of the electrical engineer was entirely satisfactory, and reflected great credit upon Mr. Okell and the electricity staff. In spite of the increased price of coal, the price of the electric light had been kept the same as before. The reserve fund had now gone up to over £9,000, and it was thought the time had now arrived when the reserve fund should be invested, and the interest used as a contribution towards the sinking fund charges. He thought some of the committee could assist the Electric Light Committee in this matter, and have the Corn Exchange and the Meat Market and other public buildings lit with the electric light. A petition had been received from residents of property in Treville Street suggesting that the electric light should be used instead of gas. It indicated that, as far as the public were concerned, they preferred electricity to gas. Unfortunately the Council had cut down the estimates, and the committee were unable to accede to the request.

PORTSMOUTH: *Electricity Surplus.*—The sum of £2,000 has been handed over to the relief of rates from the profits of the electricity undertaking for the past year.

ROCHFORD (Essex): *Tramways and Lighting.*—The Rural District Council has decided not to offer any opposition to a proposed scheme of tramways and electric lighting embracing Leigh and Hadleigh.

SALFORD: *Tramway Accounts.*—The annual report of the General Manager for the year ended March 31st, 1908, states that the total length of tramways worked by the Corporation at that date was as follows:—Salford, 36¾ miles (owned by Corporation); Manchester, 9½ miles (running powers by agreement);

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Eccles, 8 miles, Swinton and Pendlebury, 6¾ miles, Prestwich, 7 miles, Whitefield, 4½ miles (all the above are leased to the Corporation); Trafford Park, 2½ miles (worked jointly with the Manchester Corporation). The total mileage owned or worked was therefore 75 miles. The total quantity of electrical energy used during the year for haulage, lighting of cars, &c., was as follows:—Supplied by Salford, 7,195,501 units; Manchester, 1,185,029 units; Eccles, 322,054 units. After making allowance for the quantity recharged to the Corporations of Manchester and Bury, the total quantity used by Salford cars was 8,575,959 units. The car mileage run in connection with the above amounted to 5,416,948 miles, giving an average consumption of 1·58 units per car mile. There were 176 cars in stock on March 31st, but consequent upon the increasing demands tenders have been accepted for the supply of 24 cars of the single truck, double-deck type, with outer covers. The traffic returns for the year show an increase in the gross receipts of £6,947, but the average receipts per car mile are slightly less than the figure for the previous year, due in a large measure to the large amount of wet weather prevailing in the summer months. From the Borough Treasurer's statement of the income, expenditure, and financial position of the tramways undertaking, at March 31st, 1908, it is seen that the year's working resulted in a gross profit of £92,276, to which must be added interest on investments, &c., making a total available balance of £96,761; payments to local authorities for running powers, &c., absorbed £25,893; interest and sinking fund charges, £41,970; repairs, &c., of property, Church Street, £92; contribution in relief of rates, £18,000; depreciation and renewals fund, £10,806. The amount standing to the credit of the depreciation and renewals fund at March 31st, 1908, was £58,307. The following further particulars relating to the undertaking are given in the report:—Total borrowing powers, £1,192,599; borrowing powers exercised, £684,858; unexhausted borrowing powers, £507,741; gross capital expenditure, £689,384; traffic revenue, £238,856; total revenue (including interest on investments, &c.), £244,048; working expenses, £147,286; passengers carried, 45,771,611; percentage of working expenses to receipts, 60 per cent.; average revenue per car mile, 10·67d.; working expenses per car mile, excluding power cost, 4·47d.; average working expenses per car mile, including total power cost, 6·44d.; average fare per passenger, 1·25d.; total amount of sinking fund in hand and unapplied, £98,764 3s. 11d.; amount of sinking fund applied in reduction of debt, £46,708 2s. 9d.

Proposed New Generating Station.—Negotiations are proceeding for the acquisition by the electricity department of the site of the Wilburn Street depôt for the erection of a new generating station.

SHEFFIELD: *Tramway Accounts.*—For the year ended March 25th last the revenue from the Corporation tramway system was £292,395, whilst the total working expenses were £177,949. After meeting capital charges there is an actual credit balance of £47,471. The number of passengers carried was 77,568,686.

SOUTH SHIELDS: *Electric Railway.*—The powers of the North & South Shields Electric Railway Co. for the compulsory acquisition of land belonging to the Corporation have expired.

Electricity Accounts.—The accounts of the electric lighting undertaking, which were given in our issue for July 16th, have been adopted. The gross profits for the year amounted to £12,070, equal to 6·8 per cent. interest on the capital outlay.

SOUTHGATE: *Electric Supply.*—Mr. W. C. C. Hawtayne has been retained to advise the Council with regard to the agreement with the North Metropolitan Electric Power Supply Co., at an inclusive fee of £31 10s.

STEYNING: *Electricity Charges.*—The Brighton Corporation have notified the Council of increase in the electric supply tariffs to 4½d. per unit for lighting, without restriction; 2d. per unit for power and heating, and 2s. 6d. per quarter rental for meters. Complaint is made that the flat rate for lighting is 4d. in Brighton, and the Council think Steyning should be granted the same terms. The respective Town Clerks are to confer.

STOCKTON: *Overhead Wires.*—The Cleveland and Durham Electric Power Co. has communicated with the Rural District Council with regard to their overhead wires in Haverton Hill district, and pointing out the arrangements made to render them as safe as possible. The company point out that the length of span is short, the voltage much less than that ordinarily allowed in tramway cables, whilst the cables are stronger, and the risk of breakage is reduced to a minimum. In addition, the protective device would come into operation immediately the wire snapped or touched anything. The question has been deferred for a fortnight, and in the meantime information will be obtained as to the conditions imposed upon the company in other districts.

SUNBURY: *Electric Lighting.*—Notice has been received by the Council from the Electric Light & Traction Co. of their intention to apply for an electric lighting Provisional Order for this district.

SWINTON: *Re-opening of Tramways.*—A portion of the old Dolter surface-contact system has now been converted to the overhead trolley system, and opened for traffic. The section now working is between Rotherham and Swinton, and the remaining section, about two miles, between Swinton and Mexborough, is being pushed on with. Local satisfaction is expressed at the cars now keeping schedule time.

TORQUAY: *Electric Supply.*—An application has been received from the Dolter Electric Traction Co. for an increase in the maximum supply of current for tramway purposes, and upon this a report has been made by Messrs. Kincaid, Waller, Manville & Dawson, the consulting engineers to the Corporation. In this report the suggestion is made that an oil-driven plant should be installed in the present power station at an estimated cost of £6,820, but the committee are unable to recommend the acceptance of this suggestion. They have, however, considered in detail a report by the electrical engineer, which pointed out that whatever additional plant was installed in the present station, it would only meet the difficulty temporarily, and that in his opinion the ultimate removal of the works would have to take place in a year or two. He was of the opinion that before any decision was arrived at in regard to the addition of plant on the present site, the tramway company should be asked to give a guarantee not to apply for a further increase in their maximum demand for a period of at least two years. In order to meet the present demands of the company, Mr. Storey, the electrical engineer to the Council, suggests that the present motor generator should be divided up and a new high-speed steam engine and sole-plate fitted to the direct-current portion, thus forming a completely new unit of 250-kw. capacity. He also proposes to put in a new surface condensing plant with electrically-driven air and circulating pumps. With the cost of removing foundations and other alterations, the estimated cost of this scheme is put at £2,954. This recommendation has been confirmed by the Council.

WIGAN: *Electricity Finances.*—Mr. H. R. Hooper resumed last week on behalf of the Local Government Board, the inquiry into an application for sanction to additional capital expenditure upon the Corporation electricity undertaking, which was commenced as far back as in November, 1906. The first inquiry, which was divided into two parts, viz., the expenditure of unauthorised capital, and proposed extensions at the generating station, was adjourned, *sine die*, the inspector asking that more elaborate details be prepared. Since then, it has been thought advisable to hold two inquiries, one dealing with over expenditure, the other with the proposed extensions. To this suggestion the Board agreed, and the inquiry was resumed on July 29th last, dealing only with over expenditure The inspector was quite satisfied with the particulars produced, and at the conclusion of the inquiry, complimented the officials on the way the information had been prepared. The position now is that excess expenditure over loans, to the extent of £22,696, has to be sanctioned, in order to put the matter upon a proper footing. The way will then be clear for an application for sanction to further loans in the ordinary way. Most of the excess is represented by an overdraft at the bankers.

WIMBLEDON: *Electricity Accounts.*—The accounts of the electricity undertaking for the past year show that although the receipts were considerably more than in previous years, there was a decrease of £150 in the profits. This was caused by the increased price of coal, increased rates and taxes, and by the fact that nearly £1,200 more was absorbed in repayment of loans than in previous years.

Water Supply.—The Electric Lighting Committee has decided that the construction of a weir across the river Wandle, at an estimated cost of £150, be proceeded with for the purpose of improving the supply for condensing water to the electricity works.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ABERDEEN.—Expenditure to the extent of £6,681 is to be incurred in connection with the supply of electricity to the districts of Woodside, Old Aberdeen, and Bucksburn.

The Electricity Committee has decided to recommend the Corporation to proceed with an extension of the electricity works, without delay, at an estimated cost of £16,000.

BOURNEMOUTH.—The Electrical Engineer recommends the installation of additional generating plant in the tramway power station.

DERBY.—A Local Government Board inquiry was held last week at the Guildhall, Derby, into an application by the Corporation for sanction to borrow £7,500 for the purposes of the electrical undertaking. Of this amount £5,750 is for mains and services, and the remainder for motors, transformers, radiators, and arc lamps.

DUBLIN.—The Lighting Committee has recommended that a

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loan of £10,000 be applied for in connection with the further extension of the electric lighting plant.

GRIMSBY.—An additional feeder for supplying the Great Central Railway Co. with current at the docks is to be laid at an estimated cost of £175.

HORNSEY.—The Borough Council is to extend its mains from Turnpike Lane along Wightman Road at an estimated cost of £370.

LEYTON.—Sanction has been received from the Local Government Board for the borrowing of £895 for the provision of additional plant for the tramways.

LONDON COUNTY COUNCIL.—Tenders are invited for (*a*) the supply and delivery of low-tension cables, cable boxes, and other material required for the wiring and fitting for electric lighting and for power purposes of the electricity generating station at East Greenwich, and the central car repair depôt, Woolwich Road, S.E.; (*b*) for the wiring and fitting for electric lighting of the central car repair depôt; (*c*) for the supply, delivery, and erection at certain of the Council's tramways sub-stations of high- and low-tension switchgear; and (*d*) for the supply, delivery, and erection of six 500-kw. and one 150-kw. motor generators. Full particulars from the Clerk to the Council (fee, £2 for each specification, returnable), and tenders by September 8th.

REIGATE.—Tenders are invited for the supply and erection of a complete surface condensing plant with cooling tower, &c. Full particulars from the Electrical Engineer (fee, £1 1s., returnable), and tenders to the Town Clerk by August 20th.

SALFORD.—On Tuesday Mr. Tulloch, of the Local Government Board, held an inquiry at the Town Hall, *re* an application by the Corporation for sanction to borrow £15,281 for the purposes of the electricity undertaking. It was stated that the amount was required as follows:—£11,707 for cooling plant; £575 additional expenditure on the turbo-generating plants, and £3,000 for the extension of the Prestwich lighting system, over which the borough had control.

ST. ANNES.—The Local Government Board have sanctioned the borrowing of £3,500 for mains extensions.

SOUTHAMPTON.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £3,000 for the purposes of the electric lighting undertaking. The loan is for prospective expenditure upon new mains and services.

STRETFORD.—Tenders are invited for the following work in connection with their electrical undertaking:—Contract No. 27, steam boilers and accessories. Contract No. 28, economisers and accessories. Contract No. 29, mechanical stokers. Forms of tenders, &c., from the Town Clerk (fee one guinea, returnable in each case), and further particulars from Mr. T. L. Miller, 19 Brazennose Street, Manchester. Tenders to the Town Clerk by August 24th.

WHITEHAVEN.—A Local Government Board inquiry was held last week at the Town Hall with reference to an application by the Corporation for sanction to borrow £1,700 for electrical purposes.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Rebuilding of premises of T. Venables & Sons, drapers and furnishers, 103–115, High Street, Whitechapel.

Additions to St. James's Schools, Forest Gate. Architects, Newman & Jacques, 2 Fen Court, E.C.

Wesleyan Sunday Schools at Canning Town. Architects, Withers & Meredith, 50 Cannon Street, E.C.

Stores, Stables, &c., at Stratford. Architect, W. Stewart, 4 Aldgate, E.

Additions to premises at Stratford of Young & Martin. Architect, P. H. Adams, 65 Leadenhall Street, E.C.

Alteration of premises in Aldgate for provision importers. Builders, Vigor & Co., King Street, Poplar.

Additions (£1,350). Custom House School. Builder, H. C. Horswill, 182 Green Street, Forest Gate, E.

E.C.—Extension of premises by J. Buchanan & Co., distillers, 26 Holborn, E.C.

N.—Eighteen houses and one shop at Muswell Hill. Architect, W. J. Keith, 7 East India Avenue, E.C.

Fifteen houses, Hornsey. Architect, John Farrer, 2 Coleman Street, E.C.

Premises in High Street, North Finchley, for London & South-Western Bank, 170 Fenchurch Street, E.C.

St. Alban's R.C. Church, Finchley, for the trustees.

Additions to Convent Laundry, Highgate. Builders, E. Kerry & Sons, 63 High Street, Highgate.

Eight houses, Finchley. Builder, C. W. Scott, Church End Station, Finchley.

Three houses, Finchley. Builder, J. Chillingsworth, Bibsworth Road, Finchley.

Two houses, Stroud Green. A. W. Jones, North Finchley.

Gymnasium at Muswell Hill. Builders, T. D. Steed & Sons, 2a, Langdon Place, N.

Moravian Sunday School, Hornsey. G. Mabey & Co., Upton Manor, N.

N.E.—Rebuilding of business premises in High Street, Shoreditch. Builders, J. Haydon & Sons, Teesdale Street, Hackney Road, N.E.

N.W.—Proposed extension of tramway depôt. Collindale, Chief Engineer, Metropolitan Electric Tramways, 4 South Place, E.C.

S.W.—Development of new road, Putney. Architect, J. C. Radford, 223 Upper Richmond Road, Putney.

W.—Buildings in Askew Road, Hammersmith. Architect, J. J. Kelf, 215 Hoe Street, Walthamstow.

Adaptation of Stratford House for Lord Derby. Lofts & Warner, Estate Agents, 130 Mount Street, W.

Buildings in Berkeley Street, Piccadilly. Builders, Patman & Fotheringham, Islington.

Shops and showrooms, Great Portland Street. Architects, J. W. Simpson & M. Ayrton, 3 Verulam Buildings, Gray's Inn, W.C.

W.C.—Offices in Aldwych for insurance company. Marler & Marler, surveyors, 176 Sloan Street, S.W.

Alterations, Adelphi Restaurant, Strand, to fit as public offices, Sir Horace Tozer, Agent-General for Queensland, 1 Victoria Street, S.W.

PROVINCES.

BARKING.—Hospital buildings for District Council. Architect, C. J. Dawson, East Street, Barking.

BEDFORD.—Offices for County Council (£2,650). W. W. Marks, Clerk, Shire Hall, Bedford.

BOLTON.—Restoration St. George's Church. Architect, J. L. Simpson, Bolton and Liverpool.

BURTON-ON-TRENT.—Police station and court-house. Architect, Hy. Beck, 30 High Street, Burton-on-Trent.

EASTBOURNE.—Alterations, business premises. Architect, F. G. Cooke, 3 Hyde Gardens, Eastbourne.

EAST HAM.—Rebuilding "Red Lion" public-house, High Street.

Extension of Liberal Club. J. H. Carte, "Knighton," Aldersbrook Road, Ilford.

GRAVESEND.—School (£9,350). Architect, J. J. Robson, 335 High Holborn, W.C. Builder, G. Gates, Frindsbury, Rochester.

HULL.—Completion (£25,170) City Hall. Architect, J. H. Hirst, City Hall, Hull. Builder, W. Sanderson, Temple Street, Hull.

ILFORD.—Hospital. Architects, Armstrong & Wright, 38 Grainger Street West, Newcastle-upon-Tyne.

MANSFIELD.—Additions to Braemhill Schools (£3,100). Architects, Vallance & Westwick, White Hart Chambers, Mansfield.

RAWTENSTALL (Lancs.).—Weights and Measures Office. H. E. Clare, clerk, County Council, Preston.

RICHMOND.—Development Selwyn Estate. Worsfold and Hayward, surveyors, 80 Cannon Street, E.C.

Alterations to Richmond Theatre.

Business premises, North Road, Richmond. Architect, W. Vincent, 3 West Park Crescent, Kew Gardens.

ROTHERHAM.—Secondary school (12,287). Builders, H. Arnold & Son, Doncaster.

SALFORD.—Baths in White Street. Architects, Mangnall & Littlewoods, 42 Spring Gardens, Manchester.

Alterations to St. James's Hotel, St. James's Street.

SOUTHAMPTON.—Fire station (£4,210). J. A. Crowther, Borough Engineer. Builders, Dyer & Sons, Bevois Hill, Southampton.

WALSALL.—Additions to "The Four Horse Shoes," for the Wolverhampton and Dudley Brewery Co.

Additions to Mission Church for the Church Council of St. John's, The Pleck.

WIGAN.—Circus and Assembly Hall in Library Street, for J. Worswick & Sons.

WIMBLEDON.—Extension of Technical Institute.

Conversion of St. George's College into Pension. Architect, R. A. Hinds, Wood Nook, Wimbledon Hill.

Residence and motor-house. Surveyors, Boyton, Sons & Trevor, 70 Coleman Street, E.C.

Twenty-nine houses, Melrose Avenue. C. Barwell, The Elms, Merton, Wimbledon.

Shop and showrooms. Builders, Whitehead Bros., 21 Hill Road, Wimbledon.

WINCHESTER.—Offices for County Council. Consulting Architect, T. G. Jackson, 14 Buckingham Street, Strand, W.C.

Lamps, Public Lighting, and Miscellaneous

BOLTON.—The Electricity Committee invite tenders for the supply of 25,000 tons of bituminous engine slack to be delivered at the electricity works, Spa Road. Tenders have to be in by noon on August 27th.

KINGSTON.—The Works Sub-Committee of the Town Council have been requested to consider the question of the lighting by electricity of the public lamps in Canbury Gardens.

PORTSMOUTH.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £5,000 for public lighting purposes. During

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the course of the inquiry Mr. F. A. Tulloch, the inspector, said that he had investigated the expenditure of certain amounts upon incandescent street electric lighting, and was inclined to think that this was an extravagant means of illumination in comparison with the cost of gas lighting in the town. Mr. W. S. Foale, the electrical engineer, pointed out that it was in consequence of the previous expenditure upon incandescent electric street lamps that the Gas Co. reduced their charges by 5s. per lamp per annum, and thus showed a considerably cheaper method of illumination. In the present case, however, metal-filament lamps would be used, which would considerably reduce the charges for current.

SPAIN.—Tenders are invited for the supply of four electric cranes at Huelva. Tenders, Huelva, September 6th. A deposit of 5 per cent. of the value of the tender (which must be increased to 10 per cent. if the tender be accepted) will be required. A copy of the form of tender and other general information may be seen at the Commercial Intelligence Branch of the Board of Trade.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Victorian Postmaster-General's Department has accepted the following tenders:—300 counters for switchboards, at 7s. 3d. each, £108 15s., the India Rubber, Gutta Percha, and Telegraph Works Co., Melbourne; 3 cable waggons, at £16 5s. each, Wearne Brothers, Port Melbourne; 125 translators, telephone, ordinary, at 11s. 8d. each, 50 translators, telephone multiplex, at 12s. each, 100 telephone attendants' head and breast telephone sets, at 36s. each, J. Bartram & Son, King Street, Melbourne; one mile of 50-pair silk and cotton insulated telephone switchboard cable, £190, one mile of 100-pair silk and cotton insulated telephone switchboard cable, £565, British Insulated & Helsby Cables, Melbourne.

BRIGHTON.—The tender of Messrs. Siemens Bros and Co. for cable and pilot wire, in connection with the supply to the London, Brighton & South Coast Railway Co.'s works, at £3,194 and £57 10s. respectively, has been accepted.

FINCHLEY.—The Council has accepted at £964 the tender of Mr. A. E. Faulks for extending the engine-house at the generating station.

FULHAM.—The Electricity Committee has accepted the tender of G. Aldington, Wimbledon, at £12, for repairs to the destructor shaft.

MANCHESTER EXHIBITION.—Messrs. Ward & Goldstone have received a contract for the supply of wires and cables for the Electrical Exhibition in Manchester, through Messrs. Lomax Kendal & Co., who are the contractors.

ROTHERHAM.—The Council has accepted the tender of the Worthington Pump Co. for an electrically-driven pump at £283.

SALFORD.—The Council has accepted the tender of the Blasberg Engineering Co. at £11,457 for the supply and erection of a water-cooling plant; also the tender of Waring & Gillow, Ltd., at £344 for re-wiring portion of the Royal Technical Institute.

THIRSK.—A contract has been entered into with the Northern Counties Electricity Supply Co. for public lighting for three years at £205 per annum.

WALSALL.—The Electricity Committee has decided to purchase a 3-in. Venturi water meter from George Kent, Ltd., for measuring water from the canal in connection with new condensing plant at £70. The tender of Jesse Tildesley, Ltd., at £18 10s. for steel girders for the cooling tower and purifier foundations has been accepted.

WIMBLEDON.—An offer of the British Electric Transformer Co., Ltd., to supply two 50-kw. transformers in exchange for five disused transformers and the payment by the Council of £66 has been accepted.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire-bars, net c.i.f. port of arrival, quoted on Tuesday night was £64 to £64 10s. per ton (last week £61 5s. to £61 15s. per ton).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the creditors of the Easton Light Co., Ltd., will be held at Broad Sanctuary Chambers, Westminster, London, on August 18th, at 4 p.m. Creditors desiring to be present should communicate with the liquidator, Mr. L. Philips, at the above address.

Creditors of the Seville Tramways Co. are requested to send particulars of their claims to the liquidator, A. F. Judd, 2 Broad Street Place, Finsbury Circus, London, by September 8th.

LEA RECORDERS.—Among recent orders for these recorders, which are made by Mr. James E. Lea, 46 Brown Street, Manchester, are: One for the Derby Corporation Electricity Works, one for Messrs. Bolckow, Vaughan, & Co., six for the London County Council, and one for the St. Pancras (London) Borough Council.

COMPANY MORTGAGES, &c.

BRITISH ELECTRIC TRACTION COMPANY.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date, and not required to be registered under Section 14 of the Companies Act, 1900, has been filed. Particulars—Floating charge on the company's undertaking and property, present and future, including uncalled capital, dated June 30th, 1898, securing £1,473,653 perpetual debenture stock, in favour of the Electric & General Investment Company, Ltd.

GUILDFORD ELECTRICITY SUPPLY CO.—Particulars of £25,000 debentures, created by resolution of November 21st, 1905, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £200. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

REASON MANUFACTURING CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—Trust deed, dated December 18th, 1900, securing £25,000, charged on certain lands in Preston, Brighton, with factory and other buildings thereon and company's general assets.

SWITCHGEAR COMPANY (BIRMINGHAM).—A trust deed dated June 30th, 1908, to secure £2,000 debenture stock, charged on the company's property, has been registered. Holder—J. Sermon, 140 Eccles New Road, Weaste, Manchester.

SWITCHGEAR CO.—Second Debenture, dated July 7th, 1908, to secure £2,000, charged on company's property, present and future, including uncalled capital, has been registered. Holders—Cowans, Ltd., 4 Queen Victoria Street, E.C.

MISCELLANEOUS CITY NOTES

AMERICAN TELEPHONE & TELEGRAPH CO.—Messrs. Baring Bros. & Co., Ltd., are prepared to buy the coupons of the 4 per cent. convertible gold bonds falling due on September 1st, at the current rate of exchange.

COMPANIES STRUCK OFF REGISTER.—Notice is given that the names of the following companies, among others, will be struck off the register at the end of three months, and the companies dissolved, unless cause is shown to the contrary:—Accumulator Syndicate; Dorchester and District Electric Supply Co.; Kingsbridge and South Devon Electric Lighting and Traction Co.; Penarth Tramway Syndicate.

ELECTRIC SUPPLY CO. OF VICTORIA.—The directors recommend a dividend of 6 per cent. on the preference shares for the past year, carrying forward £782.

MARCONI'S WIRELESS TELEGRAPH CO.—The share certificates for the 7 per cent. cumulative participating preference shares are now ready, and may be had on application at the office of the Company, Watergate House, Adelphi, London, W.C., in exchange for bankers' receipts for payments on application and allotment.

MATHER & PLATT.—An interim dividend on the ordinary shares of 5 per cent., free of tax, for the half-year ended June 30th, being at the rate of 10 per cent. per annum, has been announced.

OLDHAM, ASHTON & HYDE ELECTRIC TRAMWAYS CO.—The directors have declared an interim dividend of 5 per cent. per annum, less tax, on the ordinary shares for the past half-year.

OXFORD ELECTRIC CO.—An interim dividend of 5 per cent. per annum, less tax, has been declared upon the ordinary shares for the past half-year.

POWER GAS CORPORATION.—The capital of this company has been reduced from £350,000 to £300,000, divided into 250,000 ordinary shares of £1 each and 100,000 deferred shares of £1 each.

SIR W. G. ARMSTRONG WHITWORTH & CO.—An extraordinary general meeting was held on Friday, when an issue of £1,000,000 4 per cent. debenture stock was authorised. This stock has been sold *en bloc* to the Law Debenture Corporation, who have offered it to the public at 102½.

APPOINTMENTS AND PERSONAL NOTES

As a compliment to the mains superintendent, Mr. Mackay, on the occasion of his marriage, the Aberdeen Corporation Electricity Works Department gave a smoking concert on Friday, the chair being occupied by Mr. J. A. Bell, the City Electrical Engineer. A presentation was made to Mr. Mackay.

Mr. J. Slevin, the electrical and tramways manager of the Wigan Corporation, has, it is stated, in consequence of being relieved of a portion of his duties in the tramways department through the appointment of a traffic manager, intimated his willingness to accept a reduction of £50 in his present salary.

The salary of the Electrical Engineer to the Eccles Corporation, Mr. H. Angus, has been increased from £250 per annum to £350 per annum.

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COMPANIES' MEETINGS AND REPORTS

BAKER STREET AND WATERLOO RAILWAY CO.—At the half-yearly meeting on Monday, Sir George Gibb, the Chairman of the company, presiding, the report and accounts given in our last issue were adopted. The Chairman congratulated the proprietors on the very satisfactory progress of the undertaking. For the first time they had entered the ranks of dividend-paying railways, being able to pay not only the full 4 per cent. on the preference stock, but also, out of their own resources, a dividend at the rate of ¾ per cent. per annum on the whole of the ordinary shares. He believed that in the four half-years since the railway was opened the railway had shown a larger percentage growth in business than had previously been shown by any Tube railway undertaking, and this must be regarded as a most encouraging feature. During the June half-year they had carried nearly 13 million passengers, an increase of three millions, or a little over 30 per cent., as compared with the corresponding six months of 1907. The explanation of the relatively good growth in their traffic was, he thought, to be found in the location of the railway, which had created an entirely new facility to travel, and did not depend, as many new lines did, on the diversion of traffic from any other railway route. The development of through traffic was especially satisfactory. They had through bookings with nine different companies, and out of a total traffic of about 13 million passengers, about 4,750,000, or 36 per cent., had been passengers travelling with through tickets. The through traffic exchanged with the Central London Railway amounted to 40,000 passengers per week. Their exchange with the Piccadilly Tube had been 55,000 per week, and with the City and South London about 30,000 per week. He watched the development of this through traffic with great interest, because it was undoubtedly in the general development of traffic movement, not on one line only, but on all lines, and by close harmony of working and co-operation in advertising and in working, that the best hope for the prosperity of the urban railways in London lay. He sincerely hoped that the era of narrow jealousy and foolish fighting had passed away. They must, however, be content with a smaller yield from a through passenger than they got from a local passenger. On the "Bakerloo" Railway the average fare from local passengers, including workmen, was 1·55d., while their average receipt from their proportion of through traffic was only 1·56d. per passenger. The balance available for dividend, apart from the payment by the Underground Company under their guarantee, was £20,892, and the Board recommended a dividend declared at the rate of 4 per cent. per annum on the preference shares and a dividend at the rate of ¾ per cent. per annum on the ordinary shares. The Underground Company held all the ordinary shares except £298,030. They had guaranteed a dividend at the rate of 5 per cent. per annum on the whole capital until the Paddington extension had been either completed or abandoned, and under this guarantee they paid for the past half-year £2,142, which payment, together with the balance of net revenue available, made up the dividend on the shares held by the public to the rate of 3 per cent. per annum. With regard to the Paddington extension, the directors were not yet prepared to make a definite recommendation. The matter was still under the consideration of the Board, who hoped to be in a position to make a recommendation on the subject at the next half-yearly meeting.

BLACKWOOD & FLEETWOOD TRAMROAD CO.—The report for the half-year to June 30th states that, including the sum brought forward, there is a profit of £3,662 after providing for debenture interest. The directors recommend a dividend of £4 per cent. per annum, which will absorb £3,000 and writing off £500 to depreciation reserve, carrying forward the balance of £162. The number of passengers carried during the half-year was 899,346. The meeting is on the 26th inst.

CENTRAL LONDON RAILWAY CO.—At the half-yearly meeting on Thursday the report and accounts given in our last issue were adopted. Sir Henry Oakley, the Chairman, who presided, said that the undertaking had been completed by the construction of the line at Shepherd's Bush from the down road round the yard into the up road, so as to make a continuous working, and advantage had been taken of the opportunity to establish a station exactly opposite the entrance to the Franco-British Exhibition, which had been of the greatest possible use, and had earned its living most handsomely. The expenditure on capital account had been very small. On the line and station they had spent £58,650, and on additional generating plant £11,048. The financial position of the company was quite simple. There were powers for about £240,000 yet unexercised, and the expenditure on capital account was £113,000 in excess of their money. They had probably £50,000 more to spend, so that there were £145,000 of liabilities to be paid out of £224,000. They had, therefore, a margin of £81,000. Dealing with the revenue for the half year, the chairman briefly put the history as follows:—For the first four months, up to the end of April, there was a decline in the daily receipts and in the number of passengers. There is no doubt that this traffic was the short distance traffic, and the only way to meet it would have been, of course, to have rearranged their fares, but on considering it carefully the Board had determined to test the working for a year before making any alteration. On the opening of the exhibition on May 14th, however, passengers increased daily, and in six weeks they got 676,000 more passengers than in the corresponding period of last year. In reply to questions, the chairman said he was not in a position to state that there would be an exhibition at Shepherd's Bush next year, but they were given to understand that the promoters were endeavouring to arrange for its continuance next year in some form or another.

CHARING CROSS, EUSTON & HAMPSTEAD RAILWAY CO.—At the half-yearly meeting on Tuesday, Sir George Gibb, Chairman of the company presiding, the report and accounts given in our last issue were adopted without comment.

CHATHAM AND DISTRICT LIGHT RAILWAYS CO.—The result of the half-year's working to June 30th shows receipts amounting to £19,061 and expenses to £12,433. Deducting rent of Rochester Corporation lines, interest on debentures, interest on loans, &c., and expenditure on lines abandoned, there is a balance of £4,086, to which has to be added the balance brought forward from December 31st, 1907, viz., £348, leaving a balance of £4,434 available for distribution. The directors recommend a dividend of 5 per cent. per annum on the preference shares, carrying forward £1,494. The directors regret that, owing to continued trade depression in the Chatham district, the revenue for the half-year has been very disappointing. The Rochester Corporation extension lines to Strood Hill and Frindsbury were opened at Easter and leased to the company. Satisfactory arrangements were made for the supply of current for these extensions from the Kent Electric Power Co. During the half-year the loan of £2,500 from the company's bankers has been repaid. The directors will, as usual, provide for depreciation when the final accounts are made up at the end of the year. The meeting is on the 21st inst.

DUBLIN & LUCAN ELECTRIC RAILWAY CO.—The report for the June half year states that, after providing for debenture interest there is an available balance of £868, out of which the directors recommend the payment of the usual half-yearly dividend on the 5 per cent. preference shares, which will absorb £475, and that the balance of £393 be carried forward to next half-year.

EDMUNDSONS' ELECTRICITY CORPORATION.—The Directors' report for the year ended March 31st, 1908, states that the net profit after payment of debenture interest amounts to £2,610, which, with the sum of £17,807 brought forward from last year, makes a total of £20,417. The directors recommend that this amount should be carried forward to the next account. The loss on working the local authority undertakings has this year, in addition to the net amount of the urban company guarantee, been deducted from the gross trading profit and shown on the profit and loss account. The diminished return shown on loans and investments is entirely attributable to the fact that a much larger provision for reserve and depreciation has been made by the subsidiary companies, an additional amount of over £12,000 having been so set aside, of which over £10,000 is apportionable to the Corporation's holdings in these companies. The directors believe that this more liberal application of profits to these purposes is calculated to enhance the credit and strengthen the position of the Corporation no less than that of the subsidiary companies, whilst the money is equally available for capital purposes, whether it is so dealt with or whether it appears in the Corporation's accounts. Although not apparent on the face of the accounts, which can only reflect improvement in the accounts of the subsidiary companies to the extent to which those companies make larger dividend distributions, the directors are satisfied that the position is better than it was a year ago, and that there is evidence of its steady improvement. The gross profits of the subsidiary companies have increased during the year by £9,433, the amount expended on capital account during the year being £69,065. This compares with £92,760 for the previous year. The reduction of £40,926 in the item of investments and advances to subsidiary companies is accounted for by a reduction in the amount of the advance to the urban company consequent upon the issue of £75,000 debenture stock by that company. A sum of £1,491 has been added to the reserves, which now amount to £183,564. As the shareholders are aware, the report of the committee appointed at the last annual general meeting was adopted by the shareholders at the extraordinary general meeting held for the purpose in February of this year. The committee's report included recommendations for the appointment of the present board and for the creation of £200,000 prior lien debenture stock. The consent of the debenture stockholders to the immediate creation of £100,000 5 per cent. prior lien debenture stock was subsequently obtained, and that amount of stock has accordingly been created and recently issued. The proceeds of this issue are expected to provide for the Corporation's capital requirements during the next two years, and the directors believe that this provision will go far towards safeguarding the financial position of the Corporation. Mr. F. E. Gripper has resigned his position as managing director, and is now the general manager of the company. Mr. Stanley Beeton was appointed to a seat on the board in accordance with the recommendations of the committee above referred to, and the shareholders will be asked at the meeting to confirm

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this appointment. Mr. P. D. Tuckett retires by rotation and offers himself for re-election.

At the meeting on Thursday, the report of the accounts was adopted. The Chairman, Mr. P. D. Tuckett, said that the reduction shown in the trading profits for the year was accounted for mainly by the smaller turnover, and by the fact that the local authority losses had been charged directly against the profit instead of to reserve, as formerly. He believed that with care and prudence they would recover part of their money, and the directors were not going to jeopardise the future by reserving dividends unless the position warranted it. No doubt they had a long and uphill road to travel before they would be again in sight of dividends, but his opinion was that there was nothing to warrant the impression that the electric supply industry was retrograding.

GREAT NORTHERN & CITY RAILWAY CO.—The Earl of Lauderdale presided over the half-yearly meeting last week, when the report and accounts given in our issue for August 6th were adopted. The greater portion of the chairman's speech was devoted to the falling off in traffic, viz., 1,393,835 passengers, as a consequence of which the revenue had decreased by £5,364. He said this was due mainly to the competition of the London County Council electrified tramways and in some degree to the alteration of certain fares, as from November 1st, 1907, but the additional revenue from increased fares had undoubtedly compensated to a great extent for the heavy loss in passengers. Nearly half the loss of traffic had occurred between Highbury and Moorgate, where they had so far felt the tram competition most severely. The Board had done their best to meet this competition by speeding up the trains, and by running non-stop trains. Referring to the recent fire at the Moorgate Station of the City and South London Railway, the chairman stated that it was hard to find anything on their system that was combustible, and altogether it could be taken that they were practically immune from fire risks.

GREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY CO.—At the half-yearly meeting on Tuesday, Sir George Gibb, Chairman of the company presiding, the report and accounts given in our last issue were adopted. The Chairman said that this railway was not only a new undertaking, but was what might be called a new route, a condition which meant that traffic had to be developed and was longer in coming than over a route already served by other means of communication, but the growth continued for a longer period. This being so, he thought the growth of the traffic up to date had been unusually rapid. They were only in their third half-year, but had carried 17½ million passengers, which was an increase of 5½ millions compared with the corresponding period of 1907. The permanent way and car equipment was proving excellent, and he thought it was lasting better than on any other London railway with which he was acquainted. The total expenditure had been 4·81d. per car mile, including rates and taxes, or 1·03d. per passenger. They were able to declare a dividend of ¾ per cent. upon the whole of the paid up capital of the company.

GREAT WESTERN RAILWAY CO.—The report for the June half-year shows that the cost of electric train working has been £13,778, compared with £11,382 for the corresponding period of 1907. The total is made up as follows:—wages of train men, £1,669, electric current, £8,309, oil and stores, £981, repairs and renewals, £3,109. The train mileage of electric cars during the half-year was 189,161, compared with 157,958 for the June half-year of 1907. At the meeting on Tuesday the report and accounts were adopted.

LANARKSHIRE TRAMWAYS CO.—The result of the half-year's working to June 30th shows receipts amounting to £33,960 and expenses to £18,992. Deducting contributions payable to local authorities, interest on debentures, and interest on loans, there is a balance of £13,125, to which has to be added balance brought forward from December 31st, 1907, viz., £895, leaving a balance of £14,020 available for distribution. The directors recommend a dividend of 6 per cent. per annum for the half-year on the share capital issued prior to January 1st, 1908, and a dividend of 6 per cent. per annum on the new issue of 2,077 shares from date of payments of the instalments to June 30th, 1908, carrying forward £5,155 to revenue new account. The directors have pleasure in reporting that the traffic receipts have again been very satisfactory, exceeding by over £4,000 the receipts for the corresponding half-year of 1907. Although the expenses have been very heavy, owing to high prices for coal and legal charges in opposition to Parliamentary Bills affecting the company's interests, the profit available for distribution after reserving £1,117 15s. for contributions to local authorities, as compared with £621 10s. last year, is sufficient to pay a dividend at the rate of 6 per cent. for the half-year as against 5½ per cent. at June 30th, 1907, and to carry forward approximately the same amount. The directors will, as usual, provide for depreciation when the final accounts are made up at the end of the year. During the half-year the balance of the loan from the company's bankers, viz., £7,500, has been repaid. The 2,077 shares offered to the shareholders in February last were subscribed for in full. The proceeds have been utilised in constructing the two extensions referred to in the previous report and the purchase of seven additional cars. The directors regret that, owing to delays in passing the plans by the local authorities and late delivery of certain materials, the lines were not opened as early as anticipated. As the company's plant is already working at full load, negotiations are pending for the supply of current in view of the above extensions, which will obviate for the present further capital expenditure on power station plant.

LIVERPOOL OVERHEAD RAILWAY CO.—At the half-yearly meeting on Tuesday, the report and accounts, given in our last issue, were adopted. Sir W. B. Forwood, who presided, said that the company had, in common with others, felt the stress of the great depression in trade, yet it was difficult to see how the trade of the port at Liverpool could be conducted without their railway. So much so, in fact, that he often thought the company had a claim on the Dock Board of a subsidy. There was no prospect of it at present however.

LONDON, BRIGHTON & SOUTH COAST RAILWAY CO.—At the meeting of the London, Brighton & South Coast Railway Co. on Wednesday last week it was stated that the conversion of the lines between London Bridge and Victoria to electric traction was proceeding rapidly, and experimental running between Peckham Rye and Battersea Park would be commenced before the end of the year.

MIDLAND RAILWAY CARRIAGE & WAGON CO.—The accounts for the year to June 30th show a gross profit of £55,594. £4,000 have been set aside for depreciation, and £5,000 were absorbed by the interim dividends. The directors now propose to pay a dividend on the ordinaary shares at the rate of 7½ per cent., free of tax, and a bonus of 10s. per share free of tax. £5,000 are to be added to reserve fund (bringing this to £115,774), and £4,152 are carried forward.

NORTH-EASTERN RAILWAY CO.—The half-yearly report to June 30th shows that the number of car-miles travelled by the electric passenger trains of the company during that period was 1,840,161, against 1,861,415 in the corresponding period of 1907. The cost of the electrical energy purchased was £12,224, against £13,048 in the June, 1907, half-year, and the wages of trainmen amounted to £3,699, against £3,853.

NORTH LONDON RAILWAY CO.—At the half-yearly meeting last week it was stated that competition of the Great Northern and City Tube Railway and the electric tramways continued to increase, and no relief in this respect was to be anticipated.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—The transfer register and register of preference shareholders will be closed from August 18th to 31st, 1908 (both days inclusive) for preparation of warrants for the interim dividend for the half-year ended June 30th, 1908.

TYNESIDE TRAMWAYS & TRAMROADS CO.—The directors' report for the half-year ending June 30th, 1908, shows a surplus of receipts over expenses of £3,242, which, with the balance brought forward from last half-year makes a total available of £3,665, and after deducting interest on debentures, loans, &c., amounting to £1,209, there remains a balance of £2,456. This profit the directors propose to appropriate as follows:—Dividend on preference shares at the rate of 5 per cent. per annum (less income tax), £497; to the credit of reserve for renewals, depreciation, and other contingencies, increasing this to £5,500, the sum of £900; proportion of registration and formation expenses, £330; leaving to be carried forward to next half-year £728. The decreased profit for the half-year, as compared with the corresponding period of last year, is entirely consequent upon the reduction in receipts, amounting to £1,251, against which the reduction of running expenses is only £18. This falling-off in revenue is attributable to the smaller traffic on the company's lines, caused by labour troubles and the depression in trade which have been prevalent in the district during the period. Of the unissued preference shares, 27 were applied for and allotted during the half-year, and a further 50 have been applied for since June 30th, thus leaving 890 still unissued. The consols held in respect of Parliamentary deposits have been released and are now retained as an investment of the reserve fund.

YORK UNITED GAS LIGHT CO.—At the half-yearly meeting last week the Chairman stated that at the recent inquiry into an application by the York Corporation for borrowing powers for electrical extensions, it was brought out that the cost to the ratepayers of the public electric lighting was very considerably more than that of the displaced gas lighting. Wherever an impartial judgment could be brought to bear upon the merits of the rival illuminants it was conceded, said the Chairman, that gas was much more efficient and suitable for street lighting than electricity.

PARA ELECTRIC RAILWAYS & LIGHTING CO.—The annual general meeting was held in London last week. Sir W. Evans-Gordon, Chairman, who presided, said that the construction of the railways did not begin until August 15th, 1906, and the contractors, Messrs. J. G. White & Co., has been confronted from the outset with many difficulties. These had been overcome, however, and the whole system of about 35 miles of single track had been converted, and all the mules and horses had disappeared. The equipment consisted of 68 cars, in addition to a number of old cars converted for use as trailers. The report and accounts dealt with the year ended November 30th, 1907, and therefore covered the time when confusion and disturbances arising from the reconstruction were at their highest. The present company had only been in possession of the undertaking for two years, and the receipts for the year ended

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November 30th, 1906, amounted to £136,166, and in 1907 to £137,098, whilst from the lighting business the receipts had been £65,728 and £67,485 respectively. With regard to the supply of electricity, the demand had increased beyond the capacity of the company's station, and a new 450 kw. generating set was shortly to be installed. After full consideration, the directors had decided to replace the old overhead feeders by underground cables, and they believed that this outlay would be justified. On the past results of the undertaking, it was estimated that the gross receipts for the first complete year under electrical working to December, 1908, would be £220,000, from which would have to be deducted estimated working expenses of £132,000, these being taken at 60 per cent. of the receipts. After deducting London and general expenses, interest and redemption of debentures and preference share dividends, it was calculated that there would be £28,000 for depreciation, reserve and dividends on the ordinary share capital. The report and accounts were adopted.

NEW COMPANIES

CERTUS GEARLESS CO.—This company was registered on July 24th, with a capital of £25,000 in £1 shares, to acquire the assets and liabilities of the "Certus" (Gearless) Co., Ltd., to adopt an agreement with the said old company and the liquidator thereof, and to carry on the business of mechanical, electrical, sanitary, gas, and water engineers, makers of electrical tramcars, motor-cars, carriages, cycles, and other vehicles, manufacturers of engines, machines, &c. The subscribers are:—Sir James H. Renals, Bart., C. Nathan, A. C. Godwin-Smith, E. Gillett, D. C. M. Hume, J. W. M. Rogers. Minimum cash subscription, £6,400 The number of directors is not to be less than three nor more than seven; the first are the Right Hon. Earl of Kinnoull, D.L., J.P., Sir James H. Renals, Bart., and C. Nathan. Qualification, one share. Remuneration, £100 each per annum (chairman £150), and 10 per cent. of the profits available for distribution when 10 per cent. is paid, divisible. Registered office, 43-4, Great Windmill Street, W.

CORDOVA & NORTH WESTERN RAILWAY CO. (1908).—This company was registered on July 14th, with a capital of £100,000 in £10 shares, to acquire the concession from the province of Cordova for a railway from Cordova, passing by La Calera, along the River Primera to Dique de San Roque, through Cosquin, and thence to Cruz del Eje, and any branches or extensions thereof, to enter into a contract or contracts with any person or persons for the acquisition, completion, construction, and equipment of such railway, to enter into an agreement with the Cordova & North Western Railway Co., Ltd., to complete, equip, and work, by steam, electric, or other power, the said railway and any extensions or branches thereof, &c. The subscribers are: G. W. Grinnell-Milne, C. H. Sanford, G. Hannaford, T. Merrylees, A. Malden, G. Hassenden, and F. A. Kentfield. The number of directors is not to be less than three, nor more than six; the first are G. Grinnell-Milne, C. H. Sanford, and G. Hannaford. Qualification, 25 shares. Remuneration not more than £1,000 each per annum. The directors are specifically authorised to create £600,000 4 per cent. debentures. The amount which they may borrow on debentures or debenture stock, or otherwise, in addition to this £600,000, without the sanction of a general meeting, is left blank in the Articles of Association. Registered office, Salisbury House, London Wall, E.C.

COWEYS.—This company was registered on July 15th, with a capital of £6,000 in £1 shares, to adopt an agreement with L. E. Cowey, and to carry on the business of electrical, hydraulic, mechanical, manufacturong, civil, and mining engineers, founders, &c. The subscribers are: K. Houston, C. W. Inman, E. P. Barrington, B. B. Houston, W. P. Hunter, C. Brown, E. W. Church. Private company. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first. Registered office, 39 Victoria Street, Westminster.

"ELECTRICITY."—This company was registered on August 6th, with a capital of £1,000 in £1 shares, to acquire from C. A. F. Duranty the benefit of certain inventions relating to the production of electricity, and to carry on the business of electricians, engineers, suppliers of electricity for light, heat, power, or other purposes, &c. The subscribers are:—C. E. De Wolf, 27 Bidston Road, Oxton, shipowner; W. C. Bacon, 14 Cross Street, Manchester, shipowner; T. F. Harrison, 67 South John Street, Liverpool, shipowner; H. E. Fry, Godmanstone, Dorchester, gentleman; F. S. Watts, 7 Whittingham Avenue, E.C., shipowner; N. Denny, The Moat, Eltham, Kent, merchant; J. Rankin, 67 South John Street, Liverpool, shipowner. Private company. The number of directors is not to be less than three nor more than five; the first are C. A. F. Duranty and C. E. De Wolf, and the following nominees of C. E. De Wolf, viz.: W. C. Bacon, N. Dunn, and T. F. Harrison (all permanent). Table "A" mainly applies. Registered by Walker, Son, & Field, 61 Carey Street, W.C.

FOREIGN AND COLONIAL LIGHTING.—This company was registered on July 29th, with a capital of £30,000 in £1 shares, to carry on the business of engineers, producers of electric light or power, gas makers, and suppliers, &c. The subscribers are:—A. Herrmann, S. J. Wilkinson. Private company. The number of directors is not to be less than three nor more than five; the first are not named. Qualification, £250. Remuneration (except managing director), £150 each per annum (chairman, £200). Registered office, 58 Finsbury Pavement, E.C.

IRVINE GAS CO.—This company was registered in Edinburgh on August 1st, with a capital of £25,000 in £1 shares, to take over the business carried on by the Irvine Gas Light Co., and to supply gas, electricity, or other illuminant in the Burgh of Irvine. The subscribers are:—H. Lumsden, Castle Street, Irvine, solicitor; M. Watson, Bank Street, Irvine, cashier; R. Bremner, Bridgegate, Irvine, clerk; T. Miller, 15 Hill Street, Irvine, retired baker; B. Boyd, 170 High Street, Irvine, insurance agent; A. Walker, Bank Street, Irvine, gas manager; A. P. McLachlan, Seagate House, Irvine, solicitor. The number of directors is not to be less than five nor more than thirteen; the first are B. Boyd, A. Young, J. Gillies, R. Bremner, J. S. Gilmour, J. Johnston, A. R. Wilson, and M. Watson. Qualification 50 shares. Remuneration as fixed by the company. Registered office: 36 Cotton Row, Irvine, Ayrshire.

KITSON EMPIRE LIGHTING CO.—This company was registered on July 24th, with a capital of £100,000 in £1 shares (40,000 7 per cent. cumulative preference), to acquire from A. Kitson the benefit of certain patents and assets of the business carried on by him at 5 Hythe Road, Willesden, as the Kitson Light Foreign Supply Co., also to acquire from Empire Light, Ltd., of 100 St. Martin's Lane, W.C., certain patents for the invention known as the Empire Light, to adopt agreements: (1) with the said A. Kitson, and (2) with the said Empire Light, Ltd., and to carry on the business of manufacturers of lamps and stoves and other lighting and heating apparatus and plant, electrical, mechanical, and general engineers, &c. Private company, with three subscribers, viz.:—A. Kitson, 100 St. Martin's Lane, W.C., engineer; Scott Lings, 139 Cannon Street, E.C., merchant; and A. J. Hall, 19 Hammetton Road, Bromley, Kent, solicitor, taking one share each. The number of directors is not to be less than three nor more than seven; the first are A. Kitson (life director), and others to be appointed by the subscribers. The debenture holders have the right to nominate a director. Qualification (except debenture holders' director), £500. Remuneration (except managing directors), £50 each per annum (charge £200), and 5 per cent of the net profits available for distribution dividend.

LUX CANDLE CO.—This company was registered on July 14th, with a capital of £2,000 in £1 shares, to adopt an agreement with A. A. Barron, and to carry on the business of manufacturers of and dealers in electric candles, lights, and stoves, electric lighting and heating apparatus, batteries, dynamos, and switches, metal workers, electrical and general engineers, &c. Private company with only three subscribers, viz.: A. A. Barron, Cedarwood, Kidderpore Avenue, Hampstead, N.W., electrical engineer; A. Hooydonk, 11 Cork Street, W., decorative artist; and J. T. Brown, 29 Great Eastern Street, E.C., merchant, each taking one share. The first directors are A. A. Barron and A. Hooydonk. Remuneration, £50 each per annum.

NEWCASTLE-EMLYN AND DISTRICT ELECTRIC SUPPLY CO.—This company has just been registered with a capital of £2,000 in £1 shares, to generate, develop, and accumulate electrical power derivable from the falls of the River Tivy, and to carry on in Newcastle-Emlyn and adjoining districts the business of an electric light, heat, power, and supply company. The subscribers are:—T. J. Williams, J. R. Parkinson, W. Lloyd, A. P. Davies, J. E. Davies, W. E. Fuller, D. Jones. Minimum cash subscription, £1,300 The number of directors is not to be less than four nor more than seven; the first are not named. Qualification, £25.

PALVO CO.—This company was registered on July 30, with a capital of £3,000 in £1 shares, to adopt an agreement with H. Whitfield, and to carry on the business of dealers in dust-removing apparatus, electric or mechanical apparatus and other fittings, &c. The subscribers are:—H. Whitfield, Mrs. K. Whitfield. Private company. H. Whitfield is sole director. Qualification, 25 shares. Registered office, 10 Dane Street, Holborn, W.C.

SOLIUM ELECTRICAL CO.—This company was registered on July 28th, with a capital of £42,000 in 40,000 "B" shares of £1 each and 40,000 "A" shares of 1s. each, to carry on the business of manufacturers of and dealers in electrical, incandescent, filament lamps, electrical engineers and contractors, manufacturers of and dealers in electric, magnetic, and galvanic apparatus, &c., and to adopt an agreement with A. Hurter, J. McConnell, T. A. Hill, and E. Jardine. The subscribers are:—T. A. Hill, J. McConnell, J. W. McCraith, E. Harlow, A. Cherry, T. H. Smith, H. Atkin. Minimum cash subscription, £5,000. The number of directors is not to be less than three nor more than six; the first are T. A. Hill, J. McConnell, and E. Jardine. A. Hurter may, while holding 500 "A" and 5,000 "B" shares nominate a director. Qualification (except such nominee), £500. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

TANGITANA DEVELOPMENT SYNDICATE.—This company was registered on July 20th, with a capital of £2,000 in £1

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shares (500 "A" and 1,500 "B"), to seek and secure openings for the employment of capital in Morocco and elsewhere, to carry on business as prospectors, miners, explorers, concessionaires, engineers, manufacturers of electrical and mechanical appliances, to erect electrical, gas, steam, pneumatic, or other installations, plant, and accessories for the supply of electricity or other power, &c. The subscribers are:—A. D. Bredenberg, H. J. Jones, H. T. Cornwell, J. L. Morris, S. T. Niell, J. P. Roe, H. Inchvald. Minimum cash subscription, 100 shares of either class. The number of directors is not to be less than three nor more than seven; the first are A. D. Bredenberg and H. J. Jones (both permanent), and H. T. Cornwell. Qualification 50 "A" or 100 "B" shares. Remuneration according to profits. Registered office, 72 Victoria Street, Westminster.

UNDERWOOD (MANCHESTER).—This company was registered on July 20th, with a capital of £3,000 in £1 shares, to adopt an agreement with W. G. Underwood, and to carry on the business of electricians, electrical, telephonic, and telegraphic engineers, fitters, &c. Private company, with two subscribers, viz.:—W. G. Underwood, 435 Chester Road, Old Trafford, Manchester, electrical engineer; and T. N. Underwood, 435 Chester Road, Old Trafford, manufacturers' agent, each taking one share. The number of directors is not to be less than three nor more than five; the first are W. G. Underwood (permanent, subject to holding 100 ordinary shares), and others to be appointed at statutory meeting. Registered office, 34 Pall Mall, Manchester.

WESTERN SHERARDISING CO.—This company was registered on July 22nd, with a capital of £20,000 in £1 shares, to acquire an exclusive licence for the counties of Cardigan, Pembroke, Carmarthen, Radnor, Brecon, Glamorgan, Hereford, Monmouth, Gloucester, Wilts, Somerset, Dorset, Devon, and Cornwall, to treat articles by certain processes for depositing metals on metals, known as the "Sherardising" and analogous processes, to adopt agreements: (1) with P. Dawson, and (2) with the Sherardising Syndicate, Ltd., and to carry on the business of galvanisers, zinc workers, steel and iron masters, blenders of alloys, &c. The subscribers are:—P. Dawson, R. Dawson, F. P. Bailey, C. E. Wilkey, W. J. Newall, J. W. Hinchley, W. K. Porteus. Minimum cash subscription, 5,000 shares. The number of directors is not to be less than three nor more than five; the first are W. J. Newall, W. W. Underwood, and P. Dawson. Qualification (except first directors), £100. Remuneration £50 each per annum, and 10 per cent. of the surplus profits remaining after 10 per cent. is paid, divisible. Registered by A. E. Hills, 6 King's Bench Walk, E.C.

YORKSHIRE CABLE CO.—This company was registered on July 28th, with a capital of £5,000 in £1 shares, to carry on the business of electricians, engineers, contractors, and manufacturers or producers and workers of and dealers in electricity, electric wires, cables, dynamo and instrument wires, &c. The subscribers are: R. R. Stell, J. A. Stell, Mrs. S. J. Stell, W. J. Stork, W. Morgan, J. H. Haley, and O. Morgan. Private company. The first directors are R. R. Stell, J. A Stell, and W J. Stork. Registered by Jordan & Sons, Ltd., 116-17. Chancery Lane, W.C.

CATALOGUES AND PAMPHLETS RECEIVED

ELECTRIC COOKING APPLIANCES.—The latest catalogue from Simplex Conduits contains particulars of a number of forms of electric heating and cooking apparatus for domestic use, a branch of work to which the company has paid a good deal of attention of late. The kettles range from a cheap form of tinplate kitchen kettle to ornamental drawing-room tea-kettles on wrought-iron stands. Several useful patterns of water and milk heaters are included, and some attractive designs of hot-water cans, some of which are fitted with regulating switches so that they can be used either for boiling or for keeping water hot. Apparatus for the table is represented by a Russian coffee machine and a hot-water urn, hot dishes and hot plates, and a charming design of antique brass egg-boiler. Other apparatus includes glue-pots, sealing-wax heaters, sterilisers, curling tongs heaters, shaving pots, flat-irons, and saucepans.

ELECTRICAL SUPPLIES.—A very complete catalogue of electrical supplies has been brought out by Messrs. Ward and Goldstone, of Manchester, which contains particulars of a long range of articles manufactured at their large new works at Springfield Lane, Salford. The first section of the list deals with fuses and distribution-boards, and attention should be drawn to several improved patterns of replacement fuse carriers. There are also a number of ironclad fuses, some of which are combined with the firm's "Dutton" ironclad switch. Water-tight and other plain fittings for mills, factories, &c., are listed, many of them suitable for metal filament lamps, and a full line of interior conduit material is included. In the section devoted to switches, plug lamp-holders, &c., we notice a special form of cord-grip designed to protect the flexible where it leaves the lamp-holder. Prices are included of carbon and metal filament lamps and a special design of auto-transformer for enabling low voltage lamps to be used on ordinary circuits. Other items comprise fans, motor starters, porcelain insulators, and stage lighting apparatus, and long sections are devoted to cables and wires, bells and accessories, and high-class electric light fittings respectively.

ENGINEERING LITERATURE.—Messrs. Crosby Lockwood & Son send us the first number of a quarterly circular of engineering and technical literature, classified under subjects, published at their recently opened technical book-room in Victoria Street. The circular contains particulars of a number of important books on engineering, science, and technology published during the past three months in England and in America, and it will be repeated every quarter.

FLAME ARC LAMPS.—The Union Electric Co. are issuing to non-technical consumers a very attractive coloured mail card representing an "Excello" lamp surrounded by moths and butterflies, with the inscription, "It always attracts."

OUTSIDE FITTINGS.—A new leaflet from the Edison & Swan United Electric Light Co., Ltd., illustrates a series of shop window and street lamp fittings, consisting of strongly-made carriers with half-clear, half-opal reflecting globes and three light tale fittings.

PREPAYMENT METERS.—The Rochdale Electric Co., Ltd., have sent us a pamphlet describing the latest form of the Watson prepayment meter, which is of the clockwork-driven discontinuously integrating pattern of very ingenious construction. Since the original appearance of this meter some improvements in detail have been made, chiefly with a view to rendering it impossible to affect the reading by tampering with the meter. Two of these meters are on view at the Franco-British Exhibition. One is for continuous current with a capacity of 6-8 c.p. lamps for penny-in-the-slot, and the other for alternating current with a capacity of 10-8 c.p. lamps for shilling-in-the-slot. The latter meter is fitted up with 10 lamps and 10 switches for demonstrating purposes.

SWITCHGEAR AND ACCESSORIES.—Mr. P. F. Brittain, who holds the sole agency for the Universal Electric Manufacturing Co., of Peckham, is sending out an abbreviated list illustrating some of the specialities of the company. A representation of one of the sub-station switchboards which the firm have supplied to the Franco-British Exhibition is included, and particulars are given of a number of special patterns of chopper switches, bridge and switch fuses, ironclad fuse boxes and boards, battery switches, complete choking coils, street posts, brackets, and pillars, and cable sockets and boxes.

TICKET PUNCHES.—British Insulated and Helsby Cables, Ltd., have issued a leaflet descriptive of the Mallins' patent magnetically locked ticket punch, which is in extensive use on the Liverpool tramway system. The punch is provided with a removable circular cover to which a locking bolt is attached. A slight circular motion applied to the cover enables this bolt to shoot into a suitable hasp, thus effectually locking the cover to the body of the punch. The cover can now only be unlocked by the application of a specially designed and powerful electro-magnet. If any attempt is made to pick this lock a shutter descends inside the punch, and the word "caught" appears at a window provided in the cover. The number of tickets punched is accurately recorded by a reliable self-setting veeder conveniently fixed inside the case.

WATERTIGHT AMMETERS AND VOLTMETERS.—A new list has been issued by the Union Electric Co. of ammeters and voltmeters in watertight cases, constructed and tested so that they will work under actual pressure conditions. These instruments are manufactured by Messrs. Hartmann and Braun, of Frankfurt. The movements included one of the electromagnetic moving coil hot wire types, and these are contained in a large variety of designs of cases constructed of various materials, and finished in different ways, to comply with the requirements of a great variety of conditions of practical working.

NEW PUBLICATIONS

"Science Abstracts." July. Section A.: Physics; Section B.: Electrical Engineering. (London: E. & F. N. Spon, Ltd.) 1s. 6d. each.

"A Handbook of Electrical Testing." By H. R. Kempe. Seventh Edition. (London: E. & F. N. Spon.) 18s.

"High Speed Dynamo Electric Machinery." By H. M. Hobart and A. G. Ellis. (London: Chapman and Hall). 25s. 6d.

Strike.—The employees of the Metropolitan Amalgamated Carriage & Wagon Co. at Wednesbury are out on strike, in protest against the dismissal of one of the workmen. They have taken advantage of the opportunity to put forward some alleged grievances, and now ask for a 10 per cent. advance of wages. The Chairman of the company declines to treat with the men until they have all returned to work, but the latter regard this as a means of shelving the difficulty until certain large contracts now in hand are completed. They have therefore decided to continue the strike. About 1,200 men are affected.

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ELECTRICAL ENGINEERING

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SUMMARY

CONSIDERABLE losses have been made on the undertaking of the Acton Urban District Council, who convert and distribute a supply bought in bulk from the Metropolitan Electric Supply Co. The accountant has issued a special report on the subject, in which he states that the more electricity the Council supplies the greater will be its deficiency. (Page 274.)

IN response to complaints by the municipal authorities of Ealing, Col. Yorke made another inspection of the track of the London United Tramways last week, but complaints are again being made that the inspection was insufficient, as the Borough Surveyor was unable to keep pace with Col. Yorke during his walk over the track. The Colonel broke all records by inspecting 2 miles 10 yds. of track on foot in 27 minutes. (Page 274.)

TESTS of a 5,000-6,000-kw. Willans-Siemens' turbo-alternator at Manchester, showed steam consumptions below 16 lbs. per unit, with steam at 190 lbs. with 100° F. of superheat, and a vacuum of 27 ins. (Page 274.)

A NOTABLE example of the applications of electricity in the shipbuilding industry is found in the electrical equipment of Messrs. SWAN, HUNTER & WIGHAM RICHARDSON'S shipyards. Considerable use of electric cranes is made in the large roofed-in sheds, where steamships of very large size, such as the *Mauretania*, can be built. Electric power is also used to a very large extent in driving special plate-punching machines and other appliances, about the yard, many of which were specially designed for electric driving. Electric power has been in use at the Walsend yard since 1893. (Page 275.)

WE are able to publish a full list of all the firms who have, up to the present, notified their intention of exhibiting at the Manchester Electrical Exhibition in October. (Page 279.)

THE inauguration of the public electricity supply at Arbroath, Scotland, took place yesterday. The history of the undertaking dates back to 1899, when the first Provisional Order was obtained, but no supply was obtainable until this year. The steam-driven station has at present a capacity of 450 kw., but extensions will be necessary in the near future. The supply is continuous current at 500 and 250 volts. (Page 280.)

AN article by Mr. C. C. MONCKTON gives some interesting results of the working of the Trinidad-Tobago wireless telegraph system. (Page 281.)

ONE of the Papers read before the recent Convention of the American National Electric Light Association was by Mr. P. D. WAGONER, and dealt with the use of tungsten lamps in series for street lighting. Compara-

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tive tables of costs of various forms of street lighting under American conditions are given. (Page 283.)

A Paper by Mr. W. W. Freeman, read at the Chicago Convention of the American National Electric Light Association, contains an interesting review of the effect of the introduction of metal filament lamps on the electric lighting industry. (Page 284.)

An armature coil winding machine, which is in extensive use, and which obviates the necessity for separate formers for each sized coil is described. (Page 285.)

Under Electrometallurgy and Electrochemistry an abstract is given of a long Paper by E. Stassano upon the treatment of iron and steel in the electric furnace. Figures of costs are gone into, and a description is given of the author's rotary furnace, examples of which are to be found in quite a number of steel works on the Continent. (Page 286.)

Prof. Carus-Wilson has sent in an addition to his reply to the discussion of his lecture on "Rail Corrugation," delivered before the Tramways and Light Railways Association on July 10th last. In a written communication to the discussion, Mr. F. Bland calls attention to the corrugations which have appeared on the tyres of the wheels on the Helsingborg tramways, and a communication from Mr. W. F. Ireland relates to the effect of the conical surface of the tyres. (Page 287.)

Illustrations are given of some new wall plugs recently introduced, on page 288.

An elaborate system of high pressure water supply for fire protection is being laid down in New York; the mains are fed at pressures up to 300 lbs. per sq. in. by powerful centrifugal pumps, driven by 800 b.h.p. induction motors at various pumping stations. (Page 289.)

A Paper read before the National Electric Light Association, and purporting to be a general review of the progress made in the electrical industry during the year 1907, gives some interesting information relating to the state of the industry. Of particular interest are the various methods of charging for electrical energy; those in vogue in Montreal especially are worthy of attention. Miscellaneous information with regard to the progress in the lighting industry and also concerning the testing of meters, and the lighting of advertising posters, is given. (Page 289.)

A Paper by Mr. W. L. Waters, read at the recent Convention of the American Institute of Electrical Engineers at the Atlantic City, dealt with recent developments in single-phase generators, and showed how the two principal difficulties in their design of single-phase generators of large pole pitch, namely, in the results of pulsation in the armature reaction and the mechanical stresses on the end connection of the armature coils, can be overcome by the use of copper dampers and substantial supports for the end connections. (Page 291.)

A Paper by Mr. W. F. Long, read before the Cape Town section of the Institution of Electrical Engineers, contains some notes on the electric lighting of main and side streets in Cape Town by means of flame arcs and metal-filament lamps. A comparison of cost was also given between the latter and incandescent gas lighting. (Page 293.)

The patent specification of H. A. Mavor for the speed control of a polyphase induction motor, effected by arranging for the primary member to rotate in either direction, was published at the Patent Office on Thursday last. Among the other specifications published is one by R. Lenner for a limit switch for small house-lighting installations, and another by H. G. Reist for an improved method of ventilating the core bodies of electrical machinery. Siemens Brothers' Dynamo Works and J. Birrer have one relating to the construction of the rotating field systems of turbo-alternators. A specification by Dr. R. Goldschmidt describes an alternating current generator with a short-circuited rotor and neither brushes nor slip-rings, and another by G. Siebt relates to improvements in wireless telephony. Two other patent specifications abstracted refer to the manufacture of an insulating material from peat, and to flexible supports for metal filaments respectively. (Page 294.)

The works of Messrs. Ernest Scott & Mountain, near Newcastle, are chiefly devoted to the manufacture of electrical machinery for mining purposes. As will be seen from an illustrated description of the works in this issue practically the whole of the machinery is electrically driven. Power is taken from the mains of the County of Durham Electrical Power Distribution Company. (Page 295.)

Under Electrical Science in the British and American section, notes are given on recent work regarding radium emanations. In the Papers abstracted in the Continental section, Kreusler describes the magnetic and electric properties of absolutely pure iron; Reboul investigates the "electrocapillarity" of metals immersed in gases; and Mercadier announces an extension of his system of monotelephonic transmission. (Page 297.)

The new Queen's Road tramway extension in Belfast, which has been constructed by the Harbour Commissioners to facilitate access to the shipbuilding yard, was opened last week. The final surplus on the last year's working of the Belfast Corporation tramways amounted to £4,306, after a contribution of £8,962 to the General Purposes fund of the Corporation. The working expenses averaged 4·94d. per car mile.—The accounts of the Blackburn undertaking shows a net profit of £1,144, and the tramways accounts a profit of £804. The adoption of the trackless trolley system has been proposed in the suburbs of Dublin.—A conference is to be held between a number of local authorities in order to consider the present condition of the permanent way of the London United Tramways Co., which is alleged to be very unsatisfactory.—A new development has occurred in the Haslingden tramway negotiations owing to the discovery that the Parliamentary powers, although permitting the working of tramways, do not empower the construction of a generating station. The Corporation are appealing to the Board of Trade. It has been decided not to employ the Dolter system for the projected Hythe tramways.—The Portsmouth Electricity accounts record a payment of £2,000 towards the rates and £335 carried to reserve. The total cost per unit, including all capital charges and provision to reserve, was 2·64d. per unit. (Pages 299-300.)

Local Government Board inquiries have been held at Salford (£15,281) and Tonbridge (£4,200). For the information of wiring contractors we give particulars of a large number of buildings about to be erected in London and the provinces. (Page 301.)

A number of tenders have been received for arc lamps at Gravesend, but owing to the amount somewhat exceeding the Engineer's estimates, a decision of the matter has been deferred. A large contract has been given by the Canadian Government for the construction of overhead lines in connection with one of the Niagara power schemes. (Page 302.)

At the meeting of the Metropolitan District Railway Co. last week, Sir George Gibb stated that the Company was now in a much sounder position than it had been. The number of passengers carried during

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the period under review had increased by 16½ per cent. over the corresponding half of 1907. The net result of the half year's working was a deficiency of £8,951, as compared with the figure of £18,035 for the corresponding half of 1907. At a meeting of debenture holders of Messrs. Willans & Robinson, it was decided to sell the Company's leasehold interest in the Queensferry works. It was announced at the meeting of the Loch Leven Water & Electric Power Co. that considerable progress was being made with the scheme, and that the production of aluminium at Loch Leven would commence some months earlier than had been anticipated. (Pages 302-303.)

We publish this week a full list of the firms who have notified their intention of exhibiting at the Electrical Exhibition to be held in Manchester in October. The total number is 177, which just exceeds the numbers represented at the exhibition at Olympia in 1905. There can thus be little doubt that the success of the exhibition will be assured, as although the expenses will be far heavier this time owing to the necessity of erecting a special building for the occasion, it is but reasonable to expect that a large number of firms who are still hesitating will now decide to take part as soon as they see how many of their trade competitors are already on the list. It must also not be forgotten that the Olympia exhibition realised a handsome surplus, and that from the purely financial point of view the results depend as largely on the number of visitors attracted to the exhibition as on the number of exhibitors. From the standpoint of the exhibitors themselves, this latter consideration is the most important, quite apart from whether the exhibition itself pays its way, and the task of making the show attractive is one to which the individual exhibitor contributes as much as, if not more than, the organisers. We believe that all the firms on the list have taken up the matter whole-heartedly, and that they will spare no effort in displaying to the very best advantage all they have to interest the electrical public. Among the absentees a few of the larger electrical firms are to be noticed, and this is a matter for regret as we cannot but think that it is false economy to abstain from taking part in a representative exhibition of this nature; as we have said, there is reason to hope that at least some of these firms will change their minds. It was feared at one time that the firms of the Cable Makers' Association would abstain from exhibiting altogether, but this fear has not been realised; the British Insulated & Helsby company are on the list, and it is not improbable that more will follow suit, especially as there are several non-Association firms there. The electrical fittings makers are not present in force, but doubtless many are exhibiting through local wiring contractors and wholesale agents, several of whom have already applied for space. The same applies to a number of other manufacturers who will be represented by their district agents.

Attention of electrical engineers has been called to the deplorable balloon accident at the Franco-British Exhibition last week by the suggestion which has been freely made, that the fire was possibly of electrical origin. From the remarks made by the coroner at the opening of the inquest on Tuesday, it appears that he considers that sufficient evidence will be available to ascertain the cause of the gas having become ignited. In order to guide the jury, however, before evidence was heard—a somewhat indiscreet proceeding in this case—he told them that there was no reason to suppose that anyone had been smoking in the marquee in which the explosion occurred, and that there was no suggestion of sparks from any factory in the neighbourhood, yet, of course, it was an undoubted fact that something must have ignited the gas, and he took the jury to view the tent and its surroundings "to see the electric wires, and to learn whether there was a short circuit or sparking." The coroner also stated, however, that, so far, there seemed to be no negligence attached to anyone. The inquiry is adjourned until September 2nd, and we await the further proceedings with interest. In the meantime, we would suggest that electrical experts be employed to view what is left of the tent, &c., and of the electrical installation to settle if possible the question as to whether the cause of ignition was "electrical." This may not be difficult. It has been stated that a fan driven by an electric motor in the marquee itself was actually employed to ventilate the enclosure, and to remove any gas from it, and that the commutator of this motor was exposed. This has still to be proved by evidence, and if it is proved to be a fact we shall have to express our disagreement with the Coroner's view that there was no negligence. To employ a commutator type of motor in a tent close to a bag containing a large volume of hydrogen gas would be absolutely foolhardy.

During last week a condition of affairs occurred at Covent Garden market that is apt to recur at occasional intervals. A cold June, followed by a sufficiency of rain, and three weeks' of hot weather, from the middle of July to the first week in August, combined to produce simultaneously unusually heavy crops of vegetables, with the result that the supply far exceeded the demand, and phenomenally low prices were reached, which more than counterbalanced any advantage that the market gardeners may have obtained by the healthy output of their fields. This recalls one of the reasons why the application of electricity as a stimulant to plant growth should receive continued attention. The late Prof. Lemström pointed out that not only does the electric discharge produce a greater output per acre of land cultivated, but it has the additional effect of hastening the ripening of the crop. Mr. Newman has confirmed this in his experiments, and its commercial value is one that is of the utmost importance. In advancing by a few weeks the time at which the various vegetables are ripe for picking, their market price may be doubled or trebled, and this effect has a far greater worth to the grower than a fairly large percentage increase in the productiveness of his ground. We would refer all those who are interested in this subject to Sir Oliver Lodge's communication, published in our issue of July 16th, which calls attention to the fact that the application of electricity as an aid to agriculture has passed beyond the stage of a scientific experiment, and has reached a point where useful commercial results are obtainable. He describes

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Mr. Newman's large-scale experiments carried out under practical working conditions. The installation amounts to very little more than the erection of a network of wires over the field at a height at which they will not be disturbed, and arrangements for keeping these wires continuously charged at a high electrical pressure. The pole-work, &c., is of a simple character, and, although the electrical generating machinery and its accessories are of necessity more complicated, when it is once fitted the subsequent supervision and maintenance is a comparatively small matter.

HEAVY LOSSES ON THE ELECTRICITY UNDERTAKING AT ACTON

THE position of the electricity undertaking at Acton is giving considerable concern to the Urban District Council, who have apparently been unsuccessful in their other branches of municipal trading as well. The *Times* published on Tuesday a *résumé* of the accountant's statement on the accounts, in which it is said :—"The electric light undertaking showed a loss, there being a deficiency for the year of £2,934. The total cost to the Council of each unit, exclusive of loan charges, was 3·48d., as against 3·76d. in the preceding year, and the Council is in this position that the more electricity it supplies the greater will be its deficiency; this has resulted in gas being substituted for electricity in the streets. The total debt on capital account in connection with this undertaking was £58,011."

We have applied to the Town Clerk for a copy of this report, but he has not seen his way to send us one. We have already summarised in our issue of July 23rd a previous statement issued by the accountant, and we have this before us, together with some notes upon it made by Mr. Blair, the Electrical Engineer, and a copy of the accounts themselves for the year ended March 31st last. Electrical energy is bought "in bulk" from the Metropolitan Electric Supply Co., and is converted by the Urban District Council, and retailed to consumers. It appears that the total sum arrived at by adding the cost of conversion and distribution to the amount paid for the units "in bulk" and the capital charges far exceeds the revenue from current sold. We are endeavouring to obtain some further figures, and to check some items in the accounts which are not very distinctly rendered, and hope to present our readers with an analysis in our next issue.

COL. YORKE'S INSPECTION OF THE EALING TRAMWAYS

THERE have for some time been disputes over matters connected with the tramways between Ealing Town Council and the London United Tramways Co. It will be remembered that there was considerable opposition to the Parliamentary sanction of the tramways to the district, and although ultimately this was withdrawn, the terms of settlement were not regarded as satisfactory to either party. Since 1901, when the tramways commenced running, there have been frequent complaints from the local authority with regard to the conduct of the trams, and the tramway company have been accused of laying insufficiently heavy track, upon which they are running cars of excessive weight. Not only has the noise made by the cars been objected to repeatedly, but it is alleged that these heavy cars with top covers frequently sway in such a manner as to endanger the safety of the public. Representations to the Board of Trade with regard to the unsatisfactory condition of affairs have several times been made, but it is stated that in several of these cases the tramway company have temporarily patched up the track before the arrival of the inspector. The attitude taken by the tramway company is that the track is in perfect order and that the safety of the public is in no way in danger, and they deny that temporary repairs have been made just before Board of Trade inspections.

Col. Yorke, the Chief Inspector to the Board of Trade, has recently carried out three inspections, but the Ealing authorities have complained that these examinations of the track were not sufficiently thorough. The third inspection took place last week under somewhat amusing circumstances. It appears that Col. Yorke first of all inspected the lines by driving along the road in a motor-car belonging to Sir Clifton Robinson, but not accompanied by the Corporation officials. This procedure was not approved of, and on account of a protest Col. Yorke visited Ealing again by appointment, and met the Mayor and other officials, saying that he had come to inspect the line again on account of their complaints, and was ready to go over the entire length of the track. The following amusing account of what actually occurred at this juncture is contained in the *Morning Leader* :—

"Without more ado, the gallant officer—who, though elderly, is a tall, spare, and able athlete—moved off down the track as though he were late for the last train, but would catch it or die. The surprised officials panted after the fast and long-striding colonel, but soon saw (for it was a proper August day) that they would not be in at the finish. For the Mayor of Ealing, as his interested burgesses lining the pavement soon regretfully observed, came down very soon to his first speed, and then reversed his gear. The surveyor, who has seen fifty years' municipal service, but is still hale and a good sport, though his beard is white, tried hard at first, but got off the track like his chief and waved adieu to the rapidly diminishing colonel. But he provided the officer with a time-keeper. He sent a tram after him, and somebody with a stop-watch. The colonel did the first mile in 14 minutes with ease. The full course is two miles ten yards, and getting near the end the colonel sprinted, fair heel and toe, and did the balance in 13 minutes. He was followed closely by two perspiring tramway officials. But the colonel was as fresh as when he started."

Although comparisons are made between the ages of some of the Corporation officials and Col. Yorke, it may be remarked that the hero of what has been described as an "Olympic" inspection is over sixty years of age.

When the Colonel returned by tramcar to the Town Hall and again met the authorities, they were in a great state of indignation. The surveyor again complained that the inspection was quite insufficient, but in reply Col. Yorke at once offered to go over the line again, that is to say between the Town Hall and Hanwell boundary, and, proceeding to mount a tramcar which had just stopped opposite the Town Hall, he said, "Come along, we will get into this car." The surveyor, however, refused to traverse the line with Col. Yorke in a car, although he said he was prepared to walk with him as far as was deemed necessary. Col. Yorke, however, declined to accede to this, and, after some further conversation, it is reported that the Mayor has forwarded an official protest to the Board of Trade.

TESTS ON A 6,000 KW. WILLANS-SIEMENS TURBO-ALTERNATOR

BY the courtesy of Mr. S. L. Pearce (City Electrical Engineer, Manchester), and of Messrs. Willans & Robinson, we are able to publish some of the results of the tests of the 6,000 kw. Willans-Siemens turbo-alternator, which was put into operation at the Stuart Street works of the Manchester Corporation last May. The tests, made last June, show that the steam consumptions at full load were practically the same as the guaranteed figures, in spite of the fact that doubt had been expressed in some quarters whether the results promised would be obtained in actual practice. Owing to the machine having been originally specified for a 5,000 kw. normal load, the guarantees were at this rating and also at 25 per cent. overload. The machine was made, however, in order to run continuously at 6,000 kw. The guarantees were: at 5,000 kw. 16·03 lbs. of steam per unit generated; and at 6,250 kw. 15·85. These figures apply to steam at 190 lbs. pressure, with a superheat of 100° F., and a 27 in. vacuum. This vacuum is the highest that it will be possible to run at regularly owing to the high temperature of the cooling water. [It will be remembered that the Manchester Corporation are now making arrangements for a better water supply—ELECTRICAL ENGINEERING, Vol. III., p. 752.] The actual steam consumption was below 16 lbs. per unit at loads above 5,000 kw., the curve reaching a minimum of 15·84 at 5,650 kw.

A full description of the machine appeared in our issue of May 14th last (ELECTRICAL ENGINEERING, Vol. III., p. 735), but for convenience we repeat a few of its leading characteristics.

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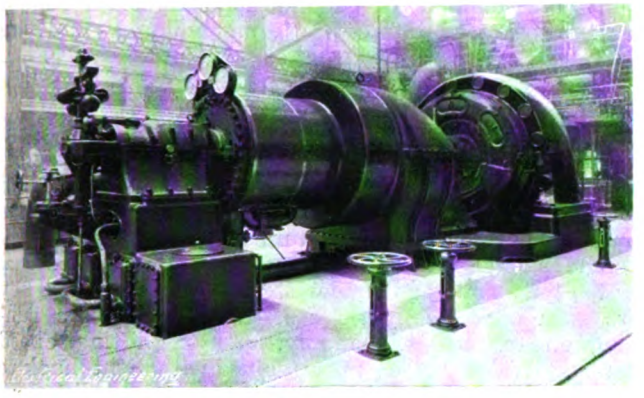
A general view of the set is shown in the illustration below. A feature is the comparatively small length of the machine: its overall length is only 36 ft., and the overall length of the turbine and alternator is



General View of Willans-Siemens 6,000-kw. Alternator.

46 ft. 3 in. The diameter and the high-pressure expansion chamber is 34 in., the intermediate pressure 51 in., and the low pressure 77½ in. The length of the low-pressure blading is 8 in. The diameter of the turbine shaft is 11 in., the weight of the rotor 13 tons, and the total weight of turbine and alternator 158½ tons.

The machine is totally enclosed, and air is forced into the stator at a pressure of 3 in. of water, passes through the stator and rotor, and out again through the hollow feet of the stator to an exhaust duct which leads outside the engine-room. A small house has been built outside the generating station to accommodate the motor-driven Sirocco-blower, which is capable of forcing 21,000 cub. ft. of air per minute through the alternator. Air is drawn into the fan-room through a dust-filter consisting of zigzag screens of woolly cloth mounted on a bamboo frame. The fan is driven by a 23 b.h.p. motor.

The following are the leading specified particulars with regard to the alternator:—

Output.—Normal full load output, 7,060 k.v.a. or 6,000 kw. with a power-factor of 0·85.

Generator supplies three-phase current at a pressure of 6,500 volts between phases, and a frequency of 50 cycles per second, when running at 1,000 r.p.m.

Overload.—The machine is capable of dealing with overloads of 15 per cent. continuously, 25 per cent. for 1½ to 2 hours, and 50 per cent. for ¼ hour.

Temperature Rise.—At normal load the machine is rated for a temperature rise not exceeding 45° C.

Excitation.—The generator is excited at 200 to 225 volts from the station direct-current bus-bars.

The alternator is of the salient pole type, there being six poles of round section, each pole being a separate casting. The field windings are of flat copper, insulated with presspahn between turns, and pressed together with a pressure of 100 tons. The stator of the machine consists of open slots with former-wound coils, there being four slots per pole per phase. The condenser is placed immediately beneath the turbine. It is of the "Contraflo" type, with a cooling surface of 10,500 sq. ft. Its air-pump is driven by a 50 h.p. motor, and the circulating pump by a 250 h.p. motor.

THE APPLICATION OF ELECTRICITY TO A GREAT SHIPBUILDING INDUSTRY

Electrical Equipment of Messrs. Swan Hunter & Wigham Richardson's Shipyards

THE name of Messrs. Swan Hunter & Wigham Richardson, Ltd., has been prominent in the mind of the technical public ever since the great engineering triumph of the construction and launch of the *Mauretania* was accomplished, although previously to this the history of the firm represents a no mean series of pioneering successes. From the first this firm, or combination of firms, adopted their own methods of tackling shipbuilding problems, with the result that their yards are probably the finest in that centre of shipbuilding industry, the Tyne, and enable them to turn out the largest boats now afloat in remarkably short time. The equipment of these yards affords a remarkable example of the applications of electric power to shipbuilding, and by the courtesy of the firm we are able, in the following article, to present a few notes on the electrical plant installed and the method of supply.

It should be said at once that electricity was adopted for lighting at the Wallsend yard as long ago as 1882, and for power in 1893. To understand the system adopted in the yards, it must be remembered that the operations of the Newcastle-upon-Tyne Electric Supply Co., Ltd., have, within recent years, developed from the generation and distribution of electricity through a comparatively restricted area to a system of power supply in bulk over the major portion of the two counties. For the first few years of supply a 240-volt direct-current system was sufficient and the earlier portion of Messrs. Swan Hunter's shipyards and lighting are fed from this source. Lately, however, a three-phase supply has been obtained, being transformed down from a pressure of 6,000 volts to 440 volts, and circuits carrying about 400 amperes each have operated motors for various purposes running at a frequency of 40 cycles per minute. The whole of the shipyard machinery, with one or two unimportant exceptions, is electrically driven, over 5,000 h.p. of motors and lighting being installed. For the purpose of supply three sub-stations are in operation, one being situated at the Neptune Works, Walker (the first yard supplied from outside mains), another near the Dry Dock Department, and a third at Wallsend. The two former are interconnected on the distribution side, and it is possible that this system of linking may be extended. As an example of the fluctuating nature of the load, it may be mentioned that the starting, stopping, or reversing of a single plate roll means an average instantaneous alteration of load of 50 h.p.

The main purposes for which the supply is used are for operating the various machines in the joiners' workshops and the engine shops, direct driving many of the shipyard tools, driving hydraulic pumps and air-compressors, operating overhead cranes in the engine works and shipyard, driving the service pumps for drawing water from the river for yard purposes and into the testing tanks, lighting the yards with arcs and the offices with incandescents, and operating a recently-installed dry-dock pumping equipment. Roughly speaking, direct current is used for these purposes, with the exception of the joiners' machines, the yard water service pumps, the dry-dock pumps, the overhead cranes in the new Neptune shipyard, and a large air-compressor recently installed in the Wallsend sub-station. In addition, when a boat is being equipped a direct-current 240-volt service is taken on board the

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vessel, from which portable electric drills, deck planers, and temporary shop lighting are operated. A direct-current voltage of 480 is only used in the case of the overhead cranes in the engine works, the remaining direct-current motors being 240 volts compound-wound giving variable speed by shunt regulation; while in the oldest sheds some cranes erected in 1892, and which were operated by steam-driven generator sets, are still worked by two of the old Clarke-Chapman generators, running at 110 volts and direct coupled, one at each end of the shaft of a 150 h.p. three-phase motor. As this service was only remodelled four years ago, full credit must be given to these pioneer machines for thirteen years' good service, as the only alteration made electrically was to substitute a compound winding for the separately excited shunt winding, to further fit them for crane service.

The cable system throughout the yards is nearly all an overhead protected or insulated wire distribution, partly of bare copper but mostly either on wooden poles or insulators, so far as outdoor work is concerned, as the wires are likely to be fouled by constructional iron-work on the jibs of the locomotive cranes used throughout the yards. In the shops the cables are rubber covered and mounted on porcelain insulators. Where it is necessary to use underground cables, these are laid solid in bitumen.

The largest and most modern sub-station is that situated at the east end of the Wallsend yard, inasmuch as in addition to the 240-volt direct-current supply it contains a high-tension chamber separated off from the rest of the building by expanded metal partitions and containing six oil-cooled Berry transformers, each of 200 kw. capacity, connected in star on their primaries and in mesh on the secondaries so as to form two sets of converting systems from 6,000 to 440 volts. In order to supply the pneumatic system in this part of the shipyard, an Alley & McLellan air compressor, capable of giving 1,200 cubic feet of air per minute at a pressure of 90 to 120 lb. per square inch, is direct coupled to a 260 h.p. three-phase slow-speed B.T.-H. motor running at 170 revolutions per minute, and, in addition, there are two 250 kw. B.T.-H. motor-generators for supplying the direct-current energy. The switchboard is provided with duplicate bus-bars, and means are provided for placing any circuit or any machine on either of them. If required, the whole lighting and power output of the station can be united by combining the bus-bars.

The roofed-in sheds in which the *Mauretania* was built are familiar in general appearance to all our readers who are interested in shipbuilding, and are partially illustrated in Fig. 1, showing prominently one of the overhead cranes, and incidentally showing the *Mauretania* in course of construction. These sheds are in duplicate, 680 feet long and 110 feet high from ground to crane-rails, and 90 and 100 feet wide respectively. Their overhead electrical equipment consists of four cranes capable of lifting 5 tons normal load single purchase, and 10 tons maximum with double purchase, and four smaller ones capable of lifting 3 tons normal and 6 tons maximum under similar conditions. They are each operated by three series-wound motors running on the 240-volt supply, and the lifting speed varies between 140 feet per minute with light hook to 70 feet per minute with full load. The controllers are

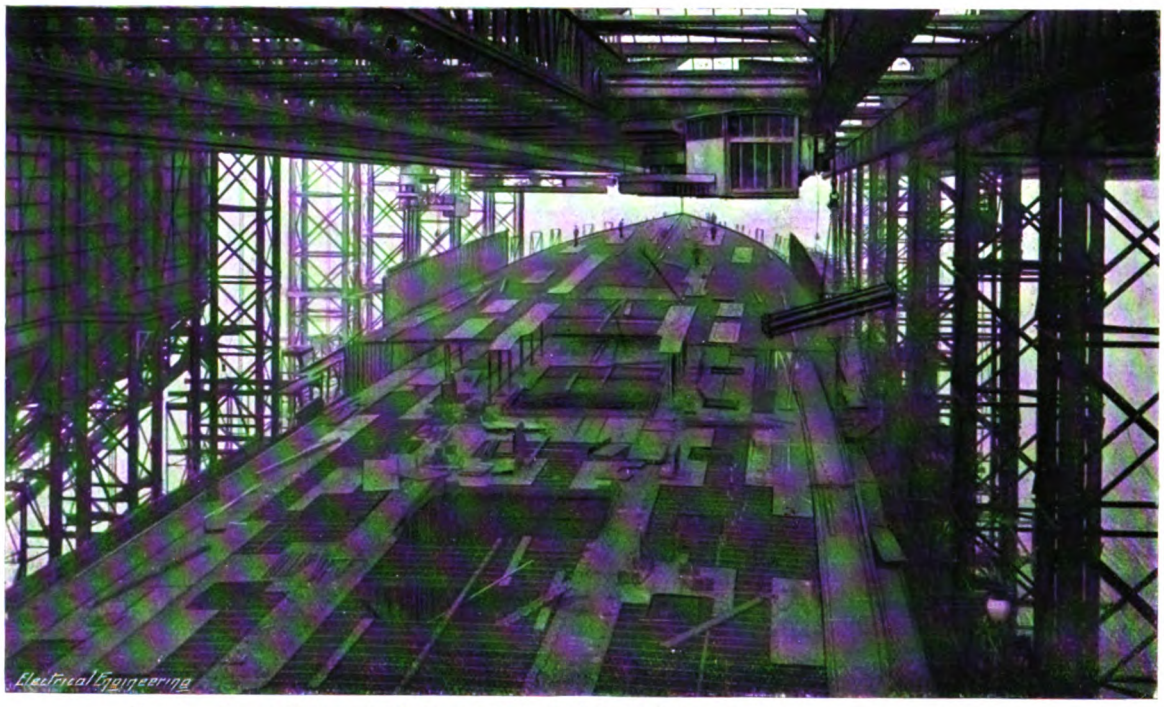

Fig. 1.—Large Roofed-in Shed showing R.M.S. "Mauretania" in course of Construction.

placed in a cage containing the driver, suspended beneath the running rails near the end of the revolving jib, so that the driver has an almost uninterrupted vertical view of his work. The cranes can be transported from one set of rails to another by means of a large transporter running across the end of the sheds, and their normal position when a shed is working full is to have three small cranes, one at each side and one on the centre set of rails, with two of the larger cranes running on the intermediate tracks. Five cranes can therefore be working at various parts of a vessel at one time. At the Neptune works a new set of sheds, 400 feet long, has been erected which are not roofed in, and in this case two cantilever cranes for the outside berths and two inner cranes are employed. These are each capable of lifting three tons. They are operated by means of three-phase current slip-ring motors, the rotor resistances being sufficiently large to carry their full current continuously in order to give variation in lifting speeds. The lift of about 80 feet is accomplished at about 70 feet per minute with light hook, and a slip of about 11 per cent. being found with full load.

The heavy duty required from the plate punching,

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bending, shearing, straightening, and joggling machines in a large shipyard renders independent electrical drive almost without exception necessary, and we illustrate one or two typical machines installed at Messrs. Swan

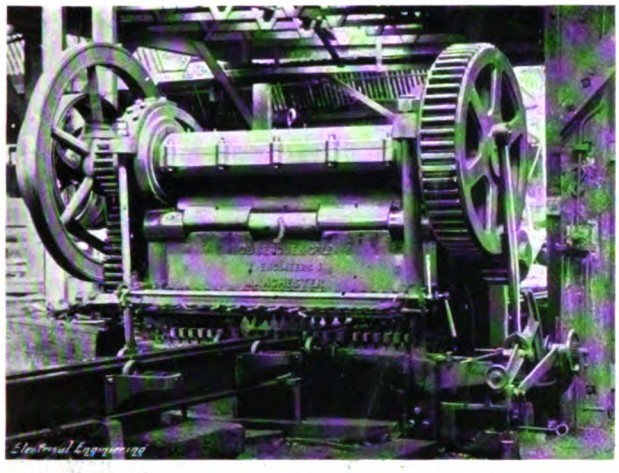

Fig. 2.—Electrically-driven Multiple Plate-Punching Machine.

Hunter & Wigham Richardson's shipyards. The first (Fig. 2) is a massive De Bergue multiple plate-punching machine capable of dealing with plates 7 feet wide and up to 45 feet long. Unfortunately, owing to the comparative insignificance in size of the motor as compared with the machine, the former is lost to view, but is located at ground-level at the side of the main upright of the machine to the left of the picture, being geared to the punch through a double set of spur-gearing. The number of punches on the machine is twenty-eight; it is designed to punch 1-inch holes through plates $\frac{7}{8}$-inch thick when cold, but the h.p. of the motor is only 20. The punches are arranged in four sets, and an interlocked controller is arranged so that not more than one set of punches operates at once. Moreover, in order to obtain graduation of power required, each set has three different lengths of punches, so that they do not all come into operation on the iron at the same time. We also illustrate a machine for countersinking the holes in plates (Fig. 3), in which the arrangement of the motor drive into a long shaft having a keyway into which fits a sliding bevel wheel for transmitting the powers to all positions will be noticed, and an electrically-driven plate-punching machine. The method of drive shown here is adopted by this firm for all forms of tools of this class. The motor is direct-coupled to the driving spindle of the mechanism, the shock of intermittent work being largely taken up by a heavy flywheel revolving in conjunction with the compound-wound motor (Fig. 4). Another interesting machine in the yard, not illustrated, is a set of plate-bending rolls by Messrs. J. Bennie & Sons, of Glasgow, capable of bending plates up to 2 inches thick and 36 feet long to a minimum radius of 2 feet, and operated by a 60 h.p. motor. In these yards hydraulic rivetters and pneumatic caulking tools are extensively used. The former are operated at a pressure of 900 lb. per square inch from three-throw hydraulic pumps operated through gearing by 40 h.p. Silvertown motors.

For the service of the boiler-shop an air-and-water pumping plant is installed, consisting of two sets of three-throw hydraulic pumps each operated by a 60 h.p. three-phase motor. These, together with the 40 h.p. motors referred to above, are automatically started and stopped from the accumulator by means of a hydraulic cylinder operating on a rack and wheel attachment on the controller. There is also an auxiliary hydraulic pump of 30 h.p. The compressed air supply is taken care of by a 60 h.p. three-phase two-speed motor having an automatically operated starter and controller.

One of the newest and most interesting portions of the equipment is an excellent dock-pumping installa-

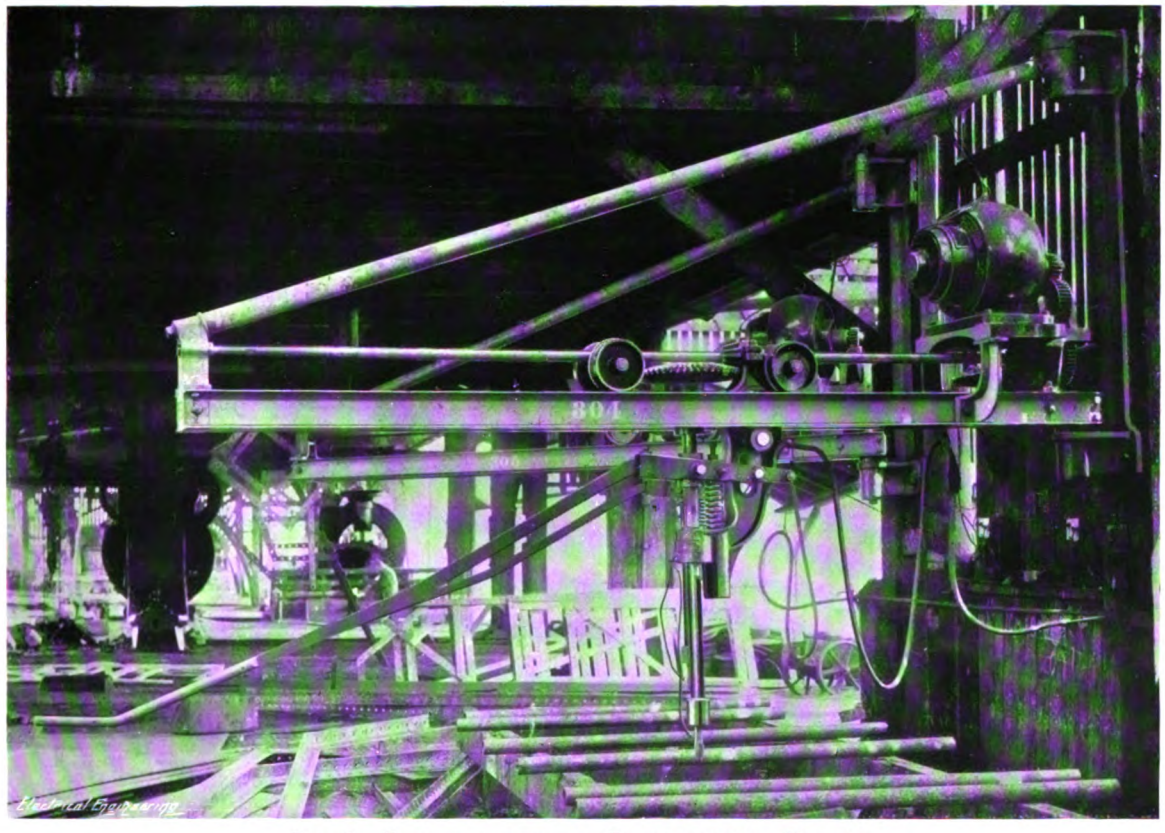

Fig. 3.—Electrically-driven Countersinking Machine.

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tion which has just replaced a steam equipment for emptying a dry dock 550 feet long by 74 feet wide, and being filled at spring tide to a maximum height of 26 feet 6 inches over sill. The pump-house is below ground, measuring 56 feet by 27 feet by 20 feet. It contains all the hydraulic arrangements, but not the two main motors, these being of the B.T.-H. three-phase vertical-wound rotor induction type, and housed in a superstructure on the quayside. The motors, which are of 220 h.p. each, running at a speed of 386 r.p.m., are direct-coupled through vertical shafts to Worthington centrifugal pumps, having a 36-inch delivery each and capable of emptying the dock in 2½ hours maximum time. No regulation is found to be necessary to avoid an overload on the motors at times of approximately equal heights of water inside the dock and in the river, the pumps being perfectly self-regulating. The outlets of the pumps are, however, fitted with sluice valves, which for ease in handling

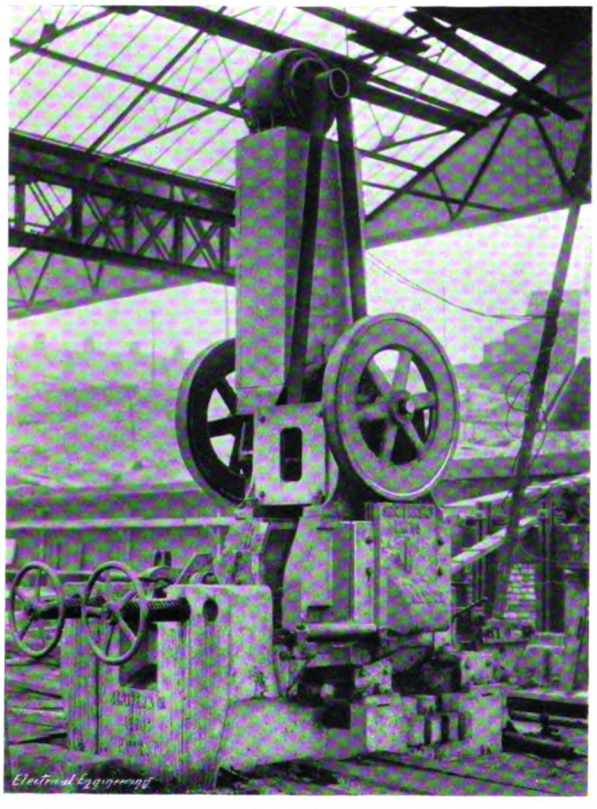

Fig. 4.—Electrically-driven Plate-Punching Machine.

are operated hydraulically. For this purpose a 15 h.p. induction motor operates the hydraulic pump, and pressure is applied either on the top of or under a piston on the sluice-valve spindle by valves situated in the pump-house switch gallery. In order to keep the dock dry against leakage after it has been pumped out by the main sets, a drainage pump with 8-inch delivery pipe is installed, direct driven by a 46 h.p. induction motor running at 480 r.p.m. This set is also used for pumping water into steamer tanks such as those of oil-tank boats when these have to be tested. In order to induce this pumping set to start work again after losing its water, as may frequently occur, a small Reavell four-cylinder air pump, giving 20-inch vacuum, driven by a 3 B.H.P. motor, is employed to suck the water through the pump when necessary. The whole of the switchgear for these motors is situated on a switch gallery at one side of the pump-house at a height rather above the spring-tide level in the dock outside, in order that under no conditions can it be flooded. The main motors are each controlled by a three-phase B.T.-H. oil break switch and a tramway type controller for inserting starting resistance, while the leakage pump is fitted with a standard B.T.-H. starting compensator. This plant has ousted two marine-type boilers and two steam-driven pumps of like capacity. The end of the dock is protected by a floatable caisson, and the pumping arrangements for this are at present steam driven. It is intended, however, to change these over in favour of electricity in the near future.

Messrs. Swan Hunter & Wigham Richardson keep an electrical shop for carrying out all works repairs, such as rewinding stators and rotors, and also for installation work on board the ships they build. An instance of the ingenuity of the department was shown when the electrical equipment of an enormous floating crane (which recently lifted the *Turbinia* bodily out of the water and deposited it in dry dock) came to be considered. A 60-volt generator was required on board for running arc lamps for night working. One of the old 110-volt dynamos from the early equipment of the works was taken; the field coils were connected in parallel, its armature kept as before, and coupled direct to a small steam engine running at 400 r.p.m. It is now running as well as ever under its new duty. Another instance is a home-made "conduit" arrangement used as an alternative to the overhead double trolley collector usually employed for the locomotive jib cranes which carry the huge plates to and from the plate-racks for storage. Owing to the increased height and outreach of the newer cranes it was found impossible to adopt the overhead system, and a device consisting of porcelain insulators with grooved tops in which the bare wire conductors rest was made. The trolley picks up the wires from these supports as it passes, running free of the insulators. Protection from contact by people passing is afforded by inclined boards, forming a species of slot system.

In conclusion, we must express our acknowledgment to the management and staff of Messrs. Swan Hunter & Wigham Richardson, Ltd., for their courtesy in placing sources of information at our disposal and giving us facilities for viewing their extensive yards.

Another Exhibition.—We have received notice of an exhibition which it is proposed to hold in October at Olympia, under the name of the Ideal Home Exhibition. Sections are to be devoted to electric and other forms of lighting, as well as cooking and heating. As the date clashes with that of the Manchester Electrical Exhibition, and also in view of the fact that a number of electrical firms are exhibiting at the Franco-British Exhibition, it is hardly to be expected that the electrical industry will be well represented.

Blankenese-Ohlsdorf. Single-phase Railway.—According to the *Elektrotechnische Zeitschrift*, some trouble has been experienced in the working of this railway. It is stated that the difficulties are due to imperfections in the constructional details of the electrical equipment, in particular of the insulation of the high-tension conductors, and not to any shortcomings of the single-phase system. The service is being dealt with at present by both steam and electric trains, and, of course, is not so good as when only electric trains were in use. The work on the cables and overhead conductors is being carried out at night, and it is expected that complete electrical working will be resumed on October 1st of this year.

Wireless Telephony.—According to the daily papers, some French naval engineers have been attempting to establish wireless telephonic communication between Paris and Dieppe, a distance of ninety miles. It is stated that several set phrases spoken into the transmitter at Paris were distinctly audible in the receiver at Dieppe. Details of the system employed are not given.

The *Matin* states that a wireless telephonic message was received fairly clearly at the Eiffel Tower station from a station at Pointe du Raz in Finisterre, some 500 kilometres from Paris. From Rome comes the news that successful experiments have been carried out by Prof. Majorana at Monte Mario, speech being transmitted distinctly at a distance of 60 kilometres.

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THE MANCHESTER EXHIBITION: LIST OF EXHIBITORS

THE following is a complete list of all the firms who have notified their intention, up to the present, of exhibiting at the Manchester Electrical Exhibition in October:—

Adam's Manufacturing Co., Ltd., 106 New Bond Street, W.
Aërators, Ltd., Prana Sparklet Works, Upper Edmonton, N.
Aëro Automatic Fire Alarm Co., 66 Cheapside, E.C.
Clement Allen, 36 Wilmslow Road, Rusholme, Manchester.
Arcalia Electrical Manufacturing Co., 504 Stockport Road, Longsight.
Aron Electricity Meter, Ltd., 80A Salusbury Road, Kilburn, N.W.
H. Ashton, 8-10 Bull's Head Yard, Manchester.

Babcock & Wilcox, Ltd., 14 Deansgate, Manchester.
W. H. Bailey & Co., Ltd., Albion Works, Salford, Manchester.
W. J. Bates & Co., Victoria Iron Works, Denton, Manchester.
W. Batty & Sons, Ltd., 7-9 Market Street, Manchester.
Beanland Perkin & Co., School Close Works, Leeds.
Berry, Skinner & Co., 78 Upper Thames Street, E.C.
R. W. Blackwell & Co., Ltd., 14 Gt. Smith Street, S.W.
G. M. Boddy & Co., Newington Works, Liverpool.
G. Brady & Co., 49 Pott Street, Ancoats, Manchester.
Bray, Markham & Reiss, Ltd., Canada Chambers, Spring Gardens, Manchester.
British Insulated & Helsby Cables, Ltd., Prescot, Lancs.
British Westinghouse Electric & Manufacturing Co., Ltd., Trafford Park, Manchester.
T. W. Broadbent, Ltd., East Parade, Huddersfield.
Browett, Lindley & Co., Ltd., Patricroft, Manchester.
F. W. Brown & Co., 3 Cross Street, Manchester.
Brown, Boveri & Co., Ltd., Caxton House, Westminster, S.W.
Bruce, Peebles & Co., Ltd., Basildon House, Moorgate Street, E.C.
Bullers, Ltd., 6 Laurence Pountney Hill, Cannon Street, E.C.
Bullough's Adjustable Rail Joint Support Co., Ltd., Central Buildings, John Street, North, Liverpool.

Calmon Asbestos & Rubber Works, Ltd. (& Check Fire Door Co.), 1-3 Trinity Place, Tower Hill, E.C.
Le Carbone, 17 Water Lane, Gt. Tower Street, E.C.
Chamberlain & Hookham, Ltd., Solar Works, Birmingham.
Chorlton & Knowles, Mayfield Press, Boardman Street, Manchester.
Chas. Churchill & Co., Ltd., 6 Oxford Street, Manchester.
Climax Fire Extinguisher Co., 11 Exchange Buildings, St. Mary's Gate, Manchester.
Clipper Belt Hook Co., 251 Deansgate, Manchester.
J. Collier & Co., Warwick House, 29 King's Street, W., Manchester.
Concordia Electric Wire Co., Ltd., 64 Salusbury Road, Kilburn, N.W.
Congdon & Muir, 42 Deansgate, Manchester.
Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, Bridge Street, S.W.
Crossley Bros., Ltd., Openshaw, Manchester.
Crypto Electrical Co., 155-157 Bermondsey Street, S.E.
Cunliffe & Croom, Ltd., Broughton Iron Works, Manchester.
Cutler, Wardle & Co., Ltd., 35-37 Dickinson Street, St. Peter's Square, Manchester.

T. H. & J. Daniel, Ltd., 22 Henrietta Street, E.C.
Dey Time Registers, 100B Queen Victoria Street, E.C.
Diesel Engine Co., Ltd., 179 Queen Victoria Street, E.C.
D.P. Battery Co., Ltd., Lumford Mills, Bakewell, Derby.
Drake & Gorham, Ltd., 66 Victoria Street, S.W.
Dryden & Co., Grimshaw Street Foundry, Preston.
John Dugdill & Co., Failsworth, near Manchester.
D. N. Dunlop, Westinghouse Co.'s Publishing Department, Westinghouse Works, Trafford Park, Manchester.

Electrical Engineering, 203-6 Temple Chambers, E.C.
Electrician, 1-3 Salisbury Court, E.C.
Engineer, 33 Norfolk Street, Strand, W.C.
Electrical Review, 4 Ludgate Hill, E.C.
Electrical Engineer, 139-140 Salisbury Court, Fleet Street, E.C.
Electrical Times, 8 Bream's Buildings, Chancery Lane, E.C.
Electrical Magazine, Bazaar Buildings, Drury Lane, W.C.
Electrical Field, 30-31 St. Swithin's Lane, E.C.
Electric Journal, 17 Bouverie Street, E.C.
Ebonestos Manufacturing Co., 127 Pomeroy Street, Old Kent Road, S.E.
Eckstein, Heap & Co., Waverley Mills, St. Simon's Street, Salford.
Edison & Swan United Electric Light Co., Ltd., 36-37 Queen Street, E.C.
Electric & Ordnance Accessories Co., Ltd., Cheston Road, Aston, Birmingham.
Electrical Power Storage Co., Ltd., 4 Great Winchester Street, E.C.
Electrical Press, Ltd., 37-8 Strand, W.C.
Electromotors, Ltd., Openshaw, Manchester.
Elliott Bros., Century Works, Lewisham, S.E.
Emmott & Co., Ltd., 65 King Street, Manchester.
F. Ernst & Co., 31 New Bailey Street, Manchester.
E. M. Evans & Sons, 18A-18B Fountain Street, Manchester.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick, W.

Falk, Stadelmann & Co., Ltd., 83-87 Farringdon Road, E.C.
John Faulkner, 13 Strangeways, Manchester.
Ferranti, Ltd., Hollinwood, Lancs.

Galloways, Ltd., Knott Hill Iron Works, Manchester.
General Electric Co., Ltd., 67-71 Queen Victoria Street, E.C.
Gilbert Arc Lamp Co., Ltd., Chingford, Essex.
Glyco Metal Co., Ltd., 8-9 South Parade, Manchester.
Goodalls, Weaste, Manchester.
E. Green & Sons, Ltd., 2 Exchange Street, Manchester.
J. & H. Grevener, Eldon Street House, E.C.

Hacking & Co., Lord Street, Bury.
J. Halcrow (Nuremberg Engine Co.), 18 Coleman Street, E.C.
J. P. Hall & Co., Blackriding Ironworks, Werneth, Oldham.
G. Harland, Bowden & Co., 196 Deansgate, Manchester.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E.
Heatley & Gresham, Ltd., 110 Cannon Street, E.C.
Hebblewaite Bros., Ltd., Huddersfield.
Alf. Herbert, Ltd., Machine Tool Makers, Coventry.
Jas. Hodgkinson (Salford), Ltd., Ford Lane Works, Broad Street, Pendleton, Manchester.
Hoffman Manufacturing Co., Ltd., Chelmsford.
J. Hopkinson & Co., Ltd., Britannia Works, Huddersfield.
Howard Asphalt Troughing Co., Ltd., Trafford Park, Manchester.
J. Howden & Co., 105 Scotland Street, Glasgow.
W. R. Howell & Co., 42 Theobalds Road, W.C.

International Electric Co., 55 Redcross Street, E.C.
International Time Recording Co., 151-5 City Road, E.C.

J. Lomax Kendal & Co., Ltd., 4 John Dalton Street, Manchester.
Kennedy Bending Machine Co., 34 Norfolk Street, Strand, W.C.
Geo. Kent, Ltd., 199 High Holborn, W.C. (In charge of J. Pythia, Throstles Nest House, Congleton.)
Alex. Kenyon & Co., Victoria Bridge, Manchester.
J. Kerr & Co., 62 King Street, Manchester.
Key Engineering Co., Ltd., 38 Deansgate, Manchester.
Kirkpatrick & Rastall, 16 Barrack Street, Hulme, Manchester.

Lancashire Dynamo Co., Ltd., Trafford Park, Manchester.
Lancashire Electric Power Co., 196 Deansgate, Manchester.
J. E. Lea, 28 Deansgate, Manchester.
Liverpool Electric Cable Co., Ltd., 292A Vauxhall Road, Liverpool.
Ludw. Loewe & Co., Ltd., 30 Farringdon Road, E.C.
Luke & Spencer, Ltd., Broadheath, Manchester.
Lyle Trading & Manufacturing Co., Ltd., Temple Bar House, Fleet Street, E.C.

R. W. McDermott, Old Street, Ashton-under-Lyne.
Manchester Corporation, Electrical Department, Town Hall.
Percival Marshall & Co., 26-9 Poppin's Court, Fleet Street, E.C.
B. & S. Massey Steam Hammer Works, Openshaw, Manchester.
Matthews & Yates, Cyclone Works, Swinton, Manchester.
Mayer & Schmidt, Offenbach on Main, Germany.
Mirrlees, Bickerton & Day, Ltd., Scotland Street, Glasgow.
Mirrlees, Watson & Co., Ltd., Hazel Grove, near Stockport.
Mitcham Electric Fan Co., Ltd., 6 Broad Street Place, E.C.
Morgan Crucible Co., Ltd., Battersea Works, S.W.
Morton & Co., 8-9 The Arcade, Lord Street, Liverpool.
J. Musgrave & Sons, Ltd., Globe Iron Works, Bolton.

Nalder Bros. & Thompson, Ltd., 34 Queen Street, E.C.
National Gas Engine Co., Ltd., Wellington Works, Ashton-under-Lyne.
National Telephone Co., Ltd., 102 Portland Street, Manchester.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.

O'Brien & Co., 5 Brazennose Street, Manchester.
Oliver Arc Lamp, Ltd., Cambridge Place, Burrage Road, Woolwich, S.E.
Oliver Machinery Co., Ltd., 201-3 Deansgate, Manchester.

Parmiter, Hope & Sugden, Hulme Electrical Works, Manchester.
C. A. Parsons & Co., 65-7 Prudential Buildings, Park Row, Leeds.
F. Pearn & Co., Ltd., West Gorton, Manchester.
Pearson & Co., 51 Moseley Street, Manchester.

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Phillips Commutator Grinder Co., Ltd., 95 Cannon Street, E.C
Pinchin, Johnson & Co., Ltd., 26 Bevis Marks, E.C.
Pollock & McNab, Ltd., Machine Tool Makers, Bredbury, near Manchester.
Post Office, Manchester.
Power Plant Co., Ltd., Temple Bar House, Fleet Street, E.C.
Premier Accumulator Co., Cattlemarket Road, Northampton.
Premier Electric Lamp Co., Huyton Quarry, near Liverpool.
Chas. Price & Son, Broadheath, Manchester.
Price's Patent Candle Co., Ltd., Belmont Works, Battersea, S.W.
Jas. Proctor, Ltd., Hammerton Street Iron Works, Burnley.
Rapid Magnetting Machine Co., Ltd., 18 The Crescent, Birmingham.
Hans Renold, Ltd., Progress Works, Brook Street, Manchester.
A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.
J. Rhodes & Sons, Grove Iron Works, Wakefield.
J. Richards & Sons, Ltd., Broadheath, near Manchester.
Ripolin, Ltd., 35 Minories, E.C.
Robertson Electric Lamps, Ltd., Brook Green Works, Hammersmith, W.
Thos. Robinson & Sons, Ltd., Railway Works, Rochdale.
Ronald Manufacturing Co., Milner Works, Barnsbury Street, N.
A. Ross, Hotchkiss & Co., Ltd., 1 Glengall Road, Old Kent Road, S.E.
Sanders, Rehders & Co., Ltd., 108 Fenchurch Street, E.C.
Schaffer & Budenberg, Ltd., 11 Whitworth Street, Manchester.
J. Shaw & Son, Ltd., Albert Works, Huddersfield.
Siemens Bros. Dynamo Works, Ltd., 196 Deansgate, Manchester.
W. Sisson & Co., Ltd., Gloucester.
Small Power Dynamo & Motor Co., Old Lane, Openshaw, Manchester.
Smith, Frederick & Co., Wire Manufacturers, Ltd., Anaconda Works, Salford, Manchester.
Standard Machine Works, Ltd., Dame Agnes Street, Nottingham.
G. A. Steinthal & Boydell, Ltd., 18 Cooper Street, Manchester.
J. Stubbs & Co., Mills Street Works, Ancoats, Manchester.
Sunbeam Lamp Co., Ltd., Park Road, Gateshead-on-Tyne.
Supplies, Ltd., Parr Street, Liverpool.
Synchronome Co. (F. Hope-Jones), 32-34 Clerkenwell Road, E.C.

Taylor, Garnett, Evans & Co., Ltd., Blackfriars Street, Manchester.
Taylor, Tunnicliffe & Co., Ltd., Eastwood, Hanley, Staffs.
Bertram Thomas, Worsley Street, Hulme, Manchester.
Dr. Heinr Traun & Sons, 8 Redcross Street, E.C.

Union Electric Co., Ltd., Park Street, Southwark, S.E.
Union Standard Machine Co., 165 Queen Victoria Street, E.C.
United States Metallic Packing Co., Ltd., Soho Works, Bradford.

J. Bennet von der Heyde, 6 Brown Street, Manchester.

H. Wallwork & Co., Ltd., Roper Street, Manchester.
Walsall Hardware Manufacturing Co., Hatherton Street, Walsall.
Whipp & Bourne, Switchgear Works, Castleton, near Manchester.
L. E. Wilson & Co., 20 Cross Street, Manchester.
Worthington Pump Co., Ltd., Queen Victoria Street, E.C.

SUB-STATION :—
General Electric Co., Ltd., Manchester.
Ferranti, Ltd., Hollinwood, Lancs.
Bruce, Peebles & Co., Ltd., Basildon House, Moorgate Street, E.C.
British Westinghouse Co., Ltd., Trafford Park, Manchester.

ARBROATH ELECTRIC LIGHT AND POWER SUPPLY

THE public supply of electricity in Arbroath was officially inaugurated yesterday by the ceremony of opening the new electricity works. The resident population of this rising town, which is situated on the north-east coast of Scotland, some 17 miles distant from Dundee, is about 23,000; and, as there are several factories on the outskirts of the town, a public electricity supply was much to be desired.

As long ago as 1899 a Provisional Order for Electric Lighting was granted to the Corporation, and schemes for a small generating station were prepared. These schemes, however, were not proceeded with, and the question was not revived until 1904, when an agreement was entered into with the Empire Electric Light & Power Co. for the transference of the Order. Owing to the failure of that company, however, the Order was revoked by the Board of Trade in the following year.

A few years after this, Mr. G. Balfour, now chairman of the Arbroath Electric Light & Power Company, Ltd., made an offer to the Corporation to obtain a new Order. An agreement was concluded, and the Order was obtained at the end of July, 1907. Although two years were allowed for the commencement of the work, it is now only one year since the Order was confirmed, and the works are busily employed. It is interesting to note that the capacity of the present station is three times that of the station contemplated by the Corporation in their previous scheme. Moreover, there is sufficient space on the site to more than double the capacity of the station; and, as there is every reason to expect that extensions will soon be necessary, one end of both the engine and boiler rooms is temporary, and is constructed of corrugated iron sheeting on a steel framework.

The works are situated close to the harbour, and adjoin the dock branch of the Caledonian Railway. A siding will ultimately be constructed. The building is of brick; the engine-room measures 45 feet by 35 feet, and the boiler-room 50 feet by 45 feet. There are also a battery room and a pump room. A building which already existed on the site was found to be quite suitable for use as offices. The engine room is built in bays with brick piers supporting a gantry running the full length of the room, and carrying a 10-ton travelling crane. The brick chimney shaft which has a total height of 125 feet, is lined up to 47 feet above the ground level, and has an inside diameter of 5 feet 6 inches. The chimney was built by the Alphons Custodis Co., of London. The flues have been arranged, and space has been left for the construction of an economiser when required. The boiler plant consists of two Babcock & Wilcox water tube boilers, each capable of evaporating 7,500 lbs. of water per hour, and producing steam at a pressure of 160 lbs. per sq. in., and superheated to 480° F. Both boilers are fitted with chain-grate stokers, and the usual mountings, including duplicate feed valves. The steam piping is arranged above the boilers, and is all of mild steel with wrought flanges. Both exhaust and circulating pipes are of cast iron. Circulating water is obtained from the Brothock Burn, a river adjacent to the works.

There are two steam feed-pumps; a main pump supplied by Messrs. J. G. Weir, of Glasgow, and an auxiliary pump, horizontal duplex pump, manufactured by the Worthington Pump Engineering Co. Each of these pumps has a capacity of 1,800 gallons per hour. The feed water is treated by a purifying plant supplied by the Paterson Engineering Co., and the pump exhaust is utilised to heat the supply. A hotwell tank of 1,000 gallons capacity is also provided.

The principal generating set consists of a 300 kw. 500-volt continuous-current dynamo coupled to a triple expansion vertical reciprocating engine running at 375 r.p.m. The second set is a 150 kw. continuous-current dynamo direct-coupled to a compound engine running at 435 r.p.m. The dynamos, which are compound-wound, and are fitted with commutating poles, were supplied by Messrs. Thomas Parker, Ltd., of Wolverhampton. The engines were supplied by Messrs. Belliss & Morcom. These sets can generate at from 480 to 560 volts, and can withstand 20 per cent. overload for two hours. Messrs. Thomas Parker, Ltd., also supplied the two-machine 15 kw. balancer, a 28 kw. reversible booster, and a Tilney regulator.

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The battery consists of 260 cells of the Electrical Power Storage Company's make, with lead-lined boxes, and arranged in two tiers. The total capacity of the battery is 600 ampere hours, and it is capable of delivering 400 amperes for one hour. The switchgear, instruments, and meters are carried on a white marble switchboard supplied by the British Thomson-Houston Co. Circuit-breakers are provided in each pole of the machines, and there are two sets of bus-bars with selective switches, by means of which a supply can be given at either 500 or 250 volts if necessary.

The cable network consists of Callander cables, laid solid except for a short length of cable over Brothock Bridge, which was drawn through a conduit built into the bridge during the recent reconstruction. There are three concentric feeder cables, the largest of which runs out to the factory district, and is intended to deal with the power load. This is of 0·6 + 0·6 + 0·1 sq. in. section, and is 720 yards long. Two other feeders of 0·25 and 0·15 sq. in. section respectively make up the total length of feeder cable to 1,600 yards. There is also 1,600 yards of three-core pilot cable. The distribution network is chiefly made up of three single cables of 0·1, 0·1, and 0·05 sq. in. section respectively, but there is a 0·6 sq. in. distributor in the power district. A special 0·22 sq. in. distributor supplies the arc lamps in the main thoroughfares. There are about 6,000 yards of three cable distributors.

The main streets are lit by 20 Crompton Blondel flame arc lamps of about 1,500 c.p. each. These are supported on ornamental cast iron pillars. Two 50 candle-power Osram lamps are fixed to each pillar for use when the arc lamps are extinguished. The lamps are controlled from switchboxes in the bases of the columns.

The supply has been well taken up by the residents and some of the factories, and there is every reason to expect that the undertaking will be well supported.

The contractors for the works, equipment, underground mains, and the public arc lamps were Messrs. J. G. White & Co., Ltd., and all the work was carried out in accordance with the plans and specifications of Messrs. Hawtayne & Zeden, the consulting engineers, to whom we are indebted for particulars.

THE WIRELESS TELEGRAPH SYSTEM BETWEEN TRINIDAD AND TOBAGO

By C. C. Monckton (Electrical Adviser to the Government of Trinidad)

COMMUNICATION between the islands of Trinidad and Tobago by means of radio-telegraphy has been open to the public since January, 1906, and some instructive results have been obtained from observation of the working of the system. The station at Trinidad is situated adjoining the North Post outlook for signalling incoming vessels to Port of Spain harbour; it is about 650 feet above sea-level, and a telephone line connects it to the exchange of the Commercial Telephone Company at Port of Spain, about seven miles distant. A line from this exchange is taken to a room in the Public Works Office, from which messages are sent and received.

The station at Tobago is on a hill 450 feet high, 58 miles from North Post, and about half a mile from the capital, Scarborough. On three sides of the aërial are the ruins of an old French fort, and one of these ruins has been utilised for the radio-telegraph apparatus. A telephone line runs to a small Government exchange in Scarborough.

At each station the apparatus is the same; the original transmitting sets installed consist of 3 b.h.p. Petter oil engines, driving 1½ kw. Lodge-Muirhead alternators, the current being raised to a high pressure by transformers made by the same firm.

During the first year duplicate sending apparatus was installed at each station, consisting of a 1¼ b.h.p. Petter oil engine driving a Newton dynamo used for charging a battery of ten chloride accumulators, from which power is taken when required to a Sullivan induction coil.

This last-named plant is now always employed except once a month, and it has been found suitable to communicate with a ship 200 miles distant. For longer distances the more powerful plant is used.

The accumulators are charged once a week, and the apparatus is always ready for signalling. The only trouble experienced with this smaller plant has been with the accumulators, the specific gravity gradually falling. The writer found on his last visit to the Colony that this was due to absorption of moisture by the acid of the accumulators due to the extremely humid atmosphere. The cause being found, the remedy was simple: during the rainy season liquid has to be syphoned off every few weeks, and acid added to the cells. The chlorine from the sea atmosphere has not at present affected the cells, which, during the year and a half of working, have shown no signs of deterioration.

The oscillators consist of "carpet" aërials of about 5,000 sq. ft., placed at a mean height of 65 feet from the ground. With the high-power apparatus two ¼-inch sparks in series are used, whilst for ordinary routine work with the induction coil a single ¼-inch spark is generally employed. The induction coil is rated for 10 amperes, but generally about 3 amperes at from 12 to 16 volts are employed. To signal 200 miles it is necessary to increase this to 7 amperes at 20 volts, using two ¼-inch sparks.

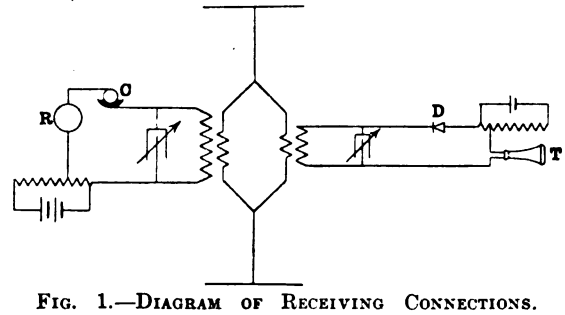

Fig. 1.—Diagram of Receiving Connections.

During the first two years the receiving was done solely with the Lodge-Muirhead steel-mercury coherer and recorder, but for the last six months other detectors and sound reading have been used in addition for practice. The arrangement of receiving circuits at present adopted is shown in Fig. 1, except that a looser coupling is employed with the telephone; it will be seen that the microphonic or lead-peroxide detector *D* and telephone *T* take the place of the coherer *C* and recorder *R*.

When the writer was last in Trinidad the American fleet of warships approached Port of Spain, whilst their transport with the most powerful signalling apparatus was in the harbour, about five miles distant. The wave-length of this ship was measured as 550 metres, and, when it was signalling with full power, it

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was found impossible to receive readable signals at North Post from Tobago using the induction coil, even after altering the wave from 530 to 512 metres, and increasing the current to 7 amperes. Two other ships with waves of 510 and 500 metres respectively (as measured by the writer) could be picked up separately, though they were signalling at the same time, when they were 50 miles distant, and these did not interfere with the signalling from Tobago. As the North Post station does not possess a means of quickly altering the wave-length of the primary receiving circuit, this was kept constant and only the secondary was altered. The primary of the receiving transformer consisted of a single turn of wire, six inches in diameter, fixed in position, and the secondary coil was placed so that it could slide along the axis of the two coils. With the capacity in this secondary receiving circuit of 0·001155 mf. good signals could be received from the ship with a wave-length of 500 metres, to be cut out when the capacity was increased to 0·001165 mf. Signals from the second ship, wave-length 510 metres, were received when the capacity was still further increased to 0·001175 mf.; from the sound it would appear as if one of the ships were sending with an induction coil, the other using a transformer. When the American

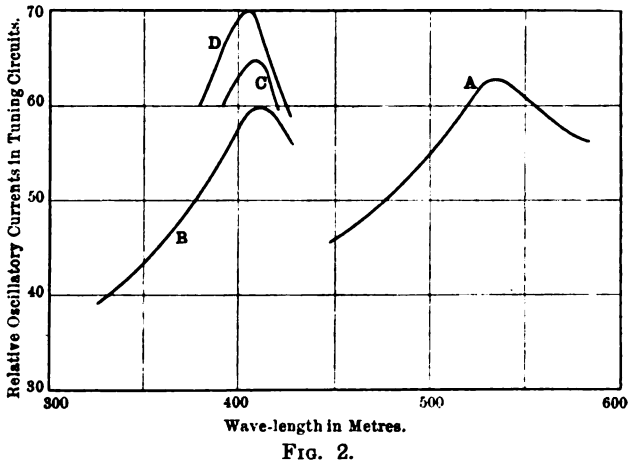

Fig. 2.

fleet was from 10 to 20 miles away the signals from the radio-telephone apparatus were apparent by a wavy line on the recorder and a buzz in the telephone, but the primary receiving circuit was too much out of tune to enable articulate sounds to be distinguished.

Considering the claims of absence from interference, when the lower capacity is raised, the writer decided to try this arrangement experimentally, but unfortunately he was only able to give a couple of hours to this work.

As even these preliminary experiments are of interest the results are given. In Fig. 2, A is the resonance curve under normal conditions of working, using a 5/16th inch spark, and with the induction coil taking 5 amperes with 10 volts across its terminals. A rough skeleton aërial was made 5,000 sq. ft., and raised above the earth so that the two carpets would be approximately parallel. As the aërial is on the slope of a hill, one side had to be raised 20 ft., whilst the other end was only raised 2 feet; the adjustment of the induction coil was not altered, but it now took 3½ amperes at the 10 volts, and the resonance curve *B* was obtained. The induction coil was then readjusted to obtain the best spark, and curve C was obtained, the coil taking 2 amperes at the same voltage. The earth capacity was next raised so as to be 4 ft. from the ground at the top end of the hill, keeping the other side as before; the curve D was then obtained with the same current. Raising the carpet another 2 ft. did not materially alter the readings. From these preliminary trials it is obvious, if a simple Hertz oscillator be employed, that by raising the earth capacity, larger oscillatory currents can be obtained with less power than with the lower capacity lying on the ground.

In the first trials of the system between Trinidad and Tobago, great difficulty was experienced from breaking down of the insulation of the oscillator, both at the mastheads and at the entry of the wires into the apparatus room. It is of much greater importance to keep good insulation with the simple Hertz form of oscillator, as developed by Lodge,

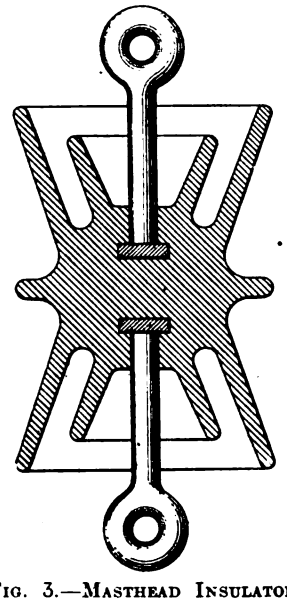

Fig. 3.—Masthead Insulator.
[From "Radio-Telegraphy," by C. C. Monckton (Constable).]

than with an aërial coupled to a closed type of vibrator; but complete success has been reached, even in the humid atmosphere of Trinidad, by using highly vitrified porcelain. The masthead insulators designed by the writer are of the form shown in Fig. 3. Using these insulators it is never found necessary even to lower the aërial for cleaning purposes; in fact, no attention is now required to be given to the aërial. The leading-in insulator now consists of an ebonite sheet

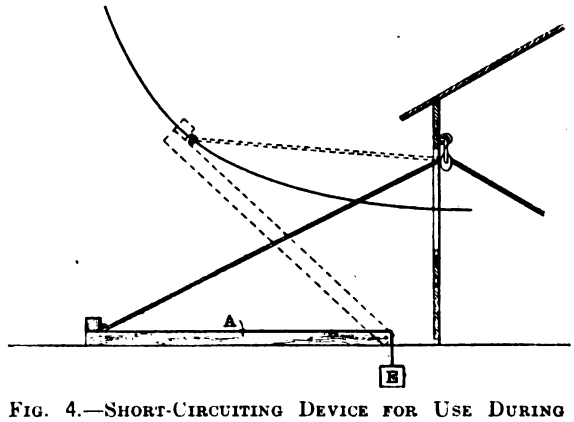

Fig. 4.—Short-Circuiting Device for Use During Thunderstorms.
[From "Radio-Telegraphy," by C. C. Monckton (Constable).]

which in itself is found useless, but it is separated from the building by porcelain rods.

The station at North Post has been struck by lightning on one occasion four times within ten minutes. The spark-gap is in a separate room from the rest of the apparatus, and the knobs had been brought together, whilst the wires had also been removed from the induction coil, so that the damage done was a slight fusing of the wires in the spark room. On the last stroke the aërial broke away at one of the masthead insulators. The writer has now adopted the method

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illustrated in Fig. 4 to short-circuit the spark-gap during severe storms. The rod *A*, to which is fixed a copper strip, can be raised as shown by the dotted lines, so as to short-circuit the leads into the apparatus house.

From the experience of the Trinidad-Tobago working, the cost of oil for the engines for a station working up to, say, 150 miles without much signalling, would be £10 per annum, whilst for depreciations, repairs, and renewals about £100 should be allowed. In out-of-the-way places it is necessary to have two operators at each station to provide against illness, though only one is required to work the apparatus. The total annual cost of each station in the Trinidad-Tobago system is now £450 per annum; this allows for two operators at each station, labourers, messengers, supervision of the Public Works Department, and telephone rental. The average time for a message of twelve words to be transmitted from Port of Spain to Scarborough, including telephoning twice at both islands to avoid mistakes, is 20 minutes. The advantages of radio-telegraphy in the tropics is apparent from the fact that in this system the telephone causes more delay than the radio-telegraph.

AMERICAN VIEWS ON THE COMMERCIAL POSSIBILITIES OF METAL FILAMENT LAMPS

A PAPER entitled "The Status and Commercial Possibilities of High-Efficiency Lamps" was read by Mr. W. W. Freeman at the recent convention at Chicago of the National Electric Light Association. It was not the intent of this Paper to treat the lamp situation exhaustively or in detail, but merely to outline the principal characteristics and commercial values of the different lamps. The leading types of metal filament lamps now commercially available in America were classified as follows:—

Tantalum.—Efficiency, 2·0 watts per candle-power. Sizes, 40, 50, and 80 watts. Probable useful life double that of carbon lamp.

Tungsten—Efficiency, 1·25 watts per candle-power. Sizes, 40, 60, and 100 watts. Probable useful life double that of carbon lamp.

The Paper continues:—All of the above types of lamp produce a whiter light than the carbon lamp, and the equality of the light is generally regarded as superior. The filaments of the tungsten and tantalum lamps are much less sensitive to voltage fluctuations than the carbon lamps, and their candle-power performance is practically constant throughout life. The tantalum lamp, however, is best adapted to direct-current operation, the life being considerably shortened on alternating current.

The tungsten filament when not heated is very fragile, and the lamps must be handled with great care. Even with every possible precaution, the breakage in deliveries promises to be substantial for some time, at least, and this factor must not be overlooked in making calculations as to probable costs. The first lamps had to be used vertically, but, with reasonable care, it seems practicable to use the present lamps (except 100 watts) in any position. On account of the intensity of the light, it is desirable to use frosted-tip lamps with suitable glass shades almost invariably.

Figures are then given to show the saving that can be obtained in an installation of an aggregate of 2,400 c.p. by replacing 150 16-c.p. carbon lamps with equivalent lamps of higher efficiency. The cost for 800 hours is given as $720 for the carbon lamps, $460·8 for the tantalum lamps, and $288 for the tungsten lamps (assuming current at 12 cents per kw.-hour).

These reductions in prices represent a saving to the consumer in the cost of electric service through the use of the new lamps, provided he can so distribute them as to make them equally effective in illumination with the units previously used. This will often be impracticable, and perhaps possible only in exceptional cases where large units were formerly used or rearrangement of outlets is easy. In many, if not most, cases, the natural result from these lamps will be that the customer will obtain increased illumination at relatively, but not actually, reduced cost.

In regard to the policy which central stations should adopt, it seems to the writer that every improvement should be encouraged and offered to the public upon reasonable terms at the earliest moment practicable, and that the first reliable information concerning lamp developments should reach consumers through the lighting companies. If they do not promptly give their customers the facts, others will make erroneous and extravagant statements which will lead to misunderstanding and dissatisfaction.

It is evident that tungsten, or even tantalum, lamps cannot be thought of for free renewals, because of their extremely high cost. Furthermore, in any plan of distribution, the very limited supply must be recognised. In the United States in 1907 the demand for incandescent lamps exceeded 80,000,000 lamps, of which 20,000,000 were for increased business. To date, only about a half million domestic tungsten lamps have been manufactured, and, with the utmost factory expansion possible, not over 2,000,000 such lamps will be produced this year, or 2·5 per cent. of the lamp demand of 1907. While the supply of these lamps will increase rapidly, it is certain to be a matter of years before they can be obtained in sufficient number to largely displace the carbon lamps.

While it might seem that the natural demand for these lamps should come first from present customers, it must be recognised that the difference in the unit sizes and the substantial charge that must be made for the lamps, as compared with the free renewal policy with carbon lamps, common in the United States, will tend to retard the substitution of these high-efficiency lamps for the less efficient lamps, especially where small units are now used. In new work, however, where the wiring can be arranged especially for the new units, they can be used at once to great advantage, and in competition with the large gas units they should prove very effective.

The tantalum lamps appeared to possess great advantages until followed so closely by the tungsten lamps. Being a smaller lamp, both in bulb size and candle-power, than the present tungsten lamps, they can, of course, be used in many places where tungsten lamps are impracticable and where a more efficient lamp than the carbon lamp is desirable. It seems probable that if the tantalum lamps are to attain much use at present their sale must be pushed by the companies at prices involving a modest charge over the carbon lamps, say 25 cents each. With the life promised, companies can afford to put out these lamps in lieu of free carbon renewals with such an excess charge, and they will prove distinctly profitable to customers upon such a basis.

When we consider the tungsten lamps there ought to be no question of the demand, even at relatively high cost prices, and the expressions of opinion of scores of companies, show conclusively that the companies are well aware of the effective use to which they can be put in competition with other illuminants. At last it seems reasonable to believe we have an incandescent-lighting unit that can compete successfully with gas on even terms as to cost.

The only fear expressed from any source is that the demand for tungsten lamps from present customers may equal or exceed the present possible supply, and that the first effect of their introduction will be loss of revenue without compensating gains. The writer does not share this fear, but believes that tungsten lamps can be made immediately and increasingly useful to every company. The sizes of the units and other limitations previously referred to will necessarily offer restrictions in substitutions for other lamps in present installations. Furthermore, customers who are satisfied with their present electric service will not rush to purchase even high-efficiency lamps at $1·00 to $2·00 each in place of free carbon lamps, and there is no occasion for companies trying to persuade present customers to change to the new lamps. Such customers are entitled to a fair announcement about the types of lamps available to them and an opportunity to purchase them at reasonable and non-discriminating prices. Then the lighting company should feel free to bend all its energies unhesitatingly to securing new business and increasing old business, in both of which tungsten lamps can be used at once with very pronounced success.

While, doubtless, there will be instances where customers now using the larger incandescent lighting units can, and will, substitute tungsten lamps promptly and, as a result, obtain as good, or better, lighting service for much less money, yet for every such case there should be found scores of customers who are willing to pay something more than they are now paying in

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order to obtain a great deal more light. There are also hundreds of stores in every city, the tenants of which are now using electricity sparingly in conjunction with gas, where all the lighting business should be secured with tungsten lamps without increasing the investment of the lighting company on account of services already installed. Possibly, however, the most inviting field for immediate exploitation of the large tungsten units is in competition with the hundreds of thousands of large gas lamps now in use and which type of lamp, in the opinion of the writer, can be rendered practically obsolete through intelligent campaigning with tungsten lamps.

The latter part of the Paper contained a collection of replies from the officials of a large number of American supply authorities to a series of questions on incandescent lamp practice. One of the questions was:—"What effect do you believe the commercial advent of the tungsten and other high-efficiency lamps will have upon the electric lighting industry, and what is your idea as to the best way of meeting the situation likely to ensue?" The replies to this question disclose a remarkable unanimity of sentiment. While there are a few who are fearful that the tungsten lamp will reduce their revenues and play havoc with them generally, the large majority of those who have expressed themselves seem to agree that the tungsten lamp will prove of immense benefit to the industry, as supplying a vehicle which for the first time will permit of real competition, as far as price is concerned, with gas and gasolene, and which, from its high efficiency and economy, will raise the standard of lighting, so that not alone will more customers be secured, but present customers will rather utilise this lamp to secure more light for the same money than the same light for less money.

STREET LIGHTING WITH METAL FILAMENT LAMPS IN SERIES

A PAPER was read by Mr. P. D. Wagoner at the Chicago Convention of the National Electric Light Association, dealing with use of tungsten lamps in series for street lighting.

In the early days of arc lighting the need of a smaller unit for lighting suburban and residential districts was keenly felt. To meet this demand the series incandescent system was developed, being first used in about 1880, at which time the lamps were used on circuits with open-arc lamps supplied with direct current from dynamos. Various methods of regulation were introduced from time to time, including the constant-current transformer, which was developed and placed on the market about 1902.

In the early history of series incandescent lighting, the life of the units that were used was approximately 150 hours, with an efficiency of 4 watts per candle-power. Improved manufacture of these lamps brought the figures to 3·5 watts per candle-power. This efficiency was obtained about 1885. The life of the 3·5-watt lamps at that time was from 200 to 300 hours, but, in the later development, reached an average life of 600 to 1,000 hours. For many years the latter figures remained unchanged, and the advocates of series incandescent street lighting were compelled to face the obstacle of comparative low efficiency. Only in recent years has the development of the tungsten lamp at 1·25 watts per candle placed the series incandescent system on a basis to compete effectively with other systems of street illumination.

Indications of most satisfactory tungsten life have been obtained in actual practice, and it would seem reasonable to expect an average life of 1,500 hours at 1·25 watts per candle. The initial efficiency seems to be maintained pretty generally throughout the life of the lamps, while with the carbon lamp it decreases from 25 to 50 per cent.

Generally speaking, there are two types of street lighting. The one employing a lighting unit of high candle-power, and the other a unit of low candle-power. There are sections of a city, such as alleys, residence and suburban districts, which may be more or less shaded by trees, and where the houses may be a considerable distance from the street, where the arc is not the ideal illuminant. Should a unit of high candle-power, such as the arc, be used in such a locality, the cost of illumination would be such as to necessitate a wide spacing of the lamps, resulting in illumination of widely varying intensity. It is in such places that the use of the tungsten lighting unit becomes important—in fact, a necessity. The introduction of the tungsten lamp permits of increasing the intensity of uniform illumination of such an installation without increasing the cost of energy above that of a system using carbon-filament lamps. The practical operation of such a system is simplicity itself, as the arcs for high intensity and incandescents for lower intensity may be operated in series on the same circuit.

Considered as a mere source of light, the series arc lamp is of higher efficiency than the tungsten lamp; but this fact does not necessarily mean higher illumination efficiency. As illumination varies inversely as the square of the distance from the source of light, and since, therefore, the intensity of illumination falls off very rapidly as the distance from the source increases, there are many cases in which a more uniform and, therefore, more satisfactory illumination can be obtained by means of incandescent lamps placed at closer intervals than by arcs of greater total light flux placed at longer intervals.

In the case of an arc lamp hung in the middle of a 30-ft. suburban road, its rays of maximum intensity being (in case of the magnetite or luminous arc) about 10 degrees below the horizontal, a large portion of the light will be wasted beyond the fences in the surrounding fields, where it is of no value whatever. The lighting of intermediate districts, between the principal business districts and the outlying districts, depends upon local conditions. In the residential section of cities having wide streets and long blocks, it may be found economical to place arc lamps at intersections of the streets and light the intervening spaces by incandescent lamps.

The Paper then proceeds to give some particulars of the system, and details the various sizes for which the constant-current transformer for series incandescent lighting has been standardised.

It is stated that lamps of 32, 40, and 60 candle-power have already been standardised. Higher candle-powers will probably be added later, as various arrangements for the suspension of the lamps have been devised. The ideal arrangement is to suspend the lamp in the centre of the street, though this is seldom practical. More often the poles are placed on one side of the street or an equal distance apart diagonally across the street; the lamps themselves being suspended by a suitable bracket attached to the pole, so as to project several feet over the edge of the curb, minimising the shadows from foliage, &c. This arrangement is not practicable with the ordinary Welsbach street lamp. As to the height of suspension, this depends to some extent upon the intrinsic brilliancy of the unit and the distance between units. In the carbon-filament lamp the height is usually from 10 to 12 ft., but with the tungsten, where the higher candle-power will be more popular, it should be higher;

Lamp.	Tungsten Incan.		Gem Incan.	Carbon Incan.	Nernst Horiz.	Welsbach Single.	Magnetite Arc.
Rated mean horizontal candle-power	40	40	40	40	—	60	575
Candle-power—10 deg. below horizontal (service conditions)	46	46	46	46	35	56	600
Watts consumption	50	50	108	140	115	—	304
Gas consumption—cub ft. per hour	—	—	—	—	—	3	—
Life-hours	1000	1500	1000	1000	600	500	—
Number of lamps per mile to give minimum illumination of 0·0 4 foot candle	60	60	60	60	69	68·5	16·7
Watts per candle-power 10 deg. below horizontal	1·09	1·09	2·35	3·04	3·28	—	0·50
	$	$	$	$	$	$	$
Renewal costs, each	1.35	1.35	0.585	0.585	0.40	0.35	—
Renewal cost per year of 4000 hours	5.40	3.60	2.34	2.34	2.67	2.80	6.75
Rate							
Energy costs per light-year of 1000 hours at different rates per kw. hour 1c.	2.00	2.00	4.32	5.60	4.60	—	12.16
2c.	0.00	4.00	8.64	11.20	9.20	—	24·32
5c.	10.00	10.00	21.60	28.00	23.00	—	60.80
10c.	20.00	20.00	43·20	56.00	46.00	—	121·60
Gas at 40 cents per 1,000 ft.	—	—	—	—	—	4.80	—
Gas at 81 per 1,000 ft.	—	—	—	—	—	12.00	—
Lighting and extinguishing per lamp per year at 2 cents per day	—	—	—	—	—	7.30	—
Total cost of energy and renewal per lamp per year of 4,000 hours at above rates of energy	7.40	5.60	6.66	7.94	7.27	—	18.91
	9 40	7.60	10.99	13.54	11.87	—	31.07
	15 40	13.60	23.94	30.34	25.67	—	67.55
	25.40	23.60	45.54	58 34	48.67	—	128.35
Gas at 40 cents per 1,000 ft.	—	—	—	—	—	14·90	—
Gas at 81 per 1,000 ft.	—	—	—	—	—	22 10	—
Total cost per mile—1-cent energy, 40-cent. gas	444.00	336.60	399.60	476.40	501.63	1020.85	315.80

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probably from 15 to 18 ft. In all cases the lamps should be suspended at such a distance above the sidewalk or roadway as to avoid the rays shining directly in the eyes of a person approaching, but not so high that tree foliage will intercept the light rays.

There are two general forms of reflectors used with series incandescent lamps for street lighting. These include an old type, somewhat resembling an inverted cone. The lower surface is of white enamel or other suitable white finish. The objectionable feature of this type of reflector is that practically none of the rays emanating from the lamp strike the reflecting surface; in other words, the reflector does not serve the purpose for which it is intended. A new type, known as the "radial reflector," has also been developed, which consists of a stamped fluted steel disc about 22 inches in diameter, the under surface of which is finished in white enamel. This reflector serves as a protection for the lamp, directs the rays in the proper direction, and increases the effective illumination by about 20 per cent. The reflector is practically indestructible, and is made in one piece.

A table, comparing various systems of street lighting, is given on the opposite page.

In this table the life of the Welsbach mantle has been taken at 500 hours. However, there are certain authorities that give the average life of the Welsbach mantle at 300 hours. In the above comparisons the costs of poles and wires in the electric systems and posts and piping in the gas system have been disregarded, on account of the widely varying values, which are necessarily dependent upon local conditions; however, gas piping would ordinarily be more expensive than wiring for the electric system. For the same reasons, interest and depreciation have been disregarded, also labour of renewals except in the case of magnetite arcs, where renewal charges include trimming, electrodes, globes, tube renewals, and repairs.

In each of the installations the spacing of the units has been made such that the minimum illumination will be 0·006 ft. candle, even should alternate lamps be extinguished; with all lamps burning the minimum illumination—that is, the intensity midway between the lamps—would be about 0·024 ft. candle, which is ample.

ARMATURE COIL WINDING

IT has long been recognised that the accepted method of winding armature coils upon wooden formers is not only cumbersome but expensive, both in time and material, on account of the very high cost of having a separate wooden former for each separate coil. In practice it is found that these formers have to be continually repaired. Research has constantly been made in this direction, and one of the results was the recently published method evolved by Mr. Creedy for winding coils for semi-enclosed slots. In view of the importance of the subject it is interesting to examine the latest type of machine which has

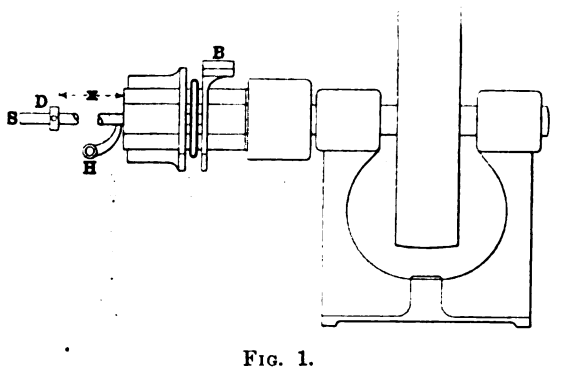

FIG. 1.

been produced for armature coil winding, and for this we are indebted to the Saxon Engineering Co., Ltd., of Stoke-on-Trent.

At a period when this firm was itself manufacturing dynamos the difficulty in former winding mentioned above presented itself to them as one which could be overcome, although there was at the time no satisfactory adjustable machine on the market. As a result, Mr. Cramp, of Manchester, and Mr. E. G. P. Bousfield, a director of the company, evolved the winding machine in its present state. This machine is perfectly adjustable in each dimension, and can therefore be used for winding any size of coil to the utmost nicety within certain

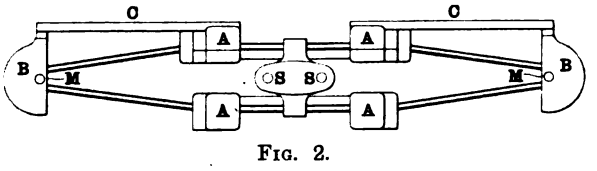

FIG. 2.

ranges. Moreover, when the coil is wound it can be "formed" with one movement of the machine so as to have the kinks at right angles to the coil in the most approved style.

Fig. 1 shows a side elevation of the machine as constructed by this company. It consists of a spindle carrying at one end a pulley and on an extension the adjustable device which is about to be described. Fig. 2 shows the end elevation, and Fig. 3 a plan of the device, also showing diagrammatically the course of the coil which is being wound upon it, this travelling along the path *BAA—BAA*. The fourth illustration shows Fig. 3 with the sliding head extended, and one is able at once to trace the familiar shape of a former wound coil as extended from the plain winding above traced. The machine consists of four slides *A*, which are adjusted by means of set screws, so that the outside measurement across each pair of slides is equal to the length of the winding which is enclosed in the iron of the armature. Two other slides *B* are connected to arms *C*, and are adjusted so that the distance from the outer edge of *A* and the inner edge of *B* is equal to the length of the coil which is required on the outside portion of the opened-up coil, as shown in Fig. 4. A collar *D* on one of the slide rods *S* (Figs. 1 and 4) is adjusted so that the distance of travel of the sliding head is equal to the distance between the two portions of the coil which are included in the iron of the armature. The slots in the slides *A* and *B* are opened or closed by means of set screws or movable washers between the plates respectively, so

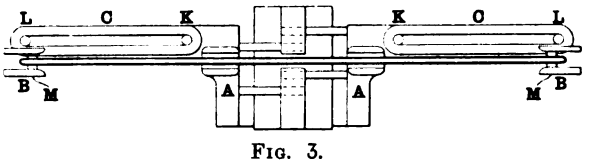

FIG. 3.

as to give the required thickness of coil, and the machine is then ready for winding the coil.

One end of the wire is fastened with a single twist to the screw provided on the machine for that purpose, in order to fix it to the machine in such a way that it will not slip off at the commencement of the winding. The machine is then rotated, and the wire guided through the slots till the required number of turns have been made. When this has been accomplished, the steady pins *KK* and *LL* are removed, leaving the arms *C* and slide *B* free to move about their centres, and by means of the handle *H* the whole of the movable block is drawn forward till the collar *D* stops further movement, giving

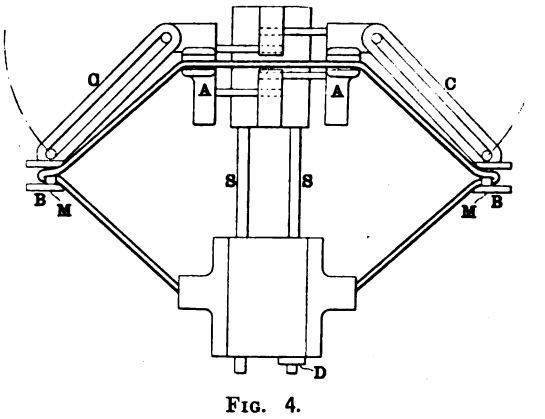

FIG. 4.

the coil the required shape. After binding with tape or other material, the coil is ready for removal from the wing nuts at the end and slipping off the guide plates *B*, after which the wing nuts can be replaced for another coil.

There are now two forms of machine in use. In the smaller and original machine the winding gear, together with head stock

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and pulley, is practically as illustrated. The sizes of coil wound by this machine are 5 in. long by 3 in. broad up to 17 in. long by 10 in. broad, or slightly over, and wire up to a size of 14 L.S.G. can be taken. Among the users of this machine may be mentioned Messrs. Mather & Platt, Ltd., the Lancashire Dynamo & Motor Co., Messrs. Campbell & Isherwood, Messrs. the Electric Ordnance & Accessories Co., Ltd., Messrs. McWhirter & Sons, Glasgow, De Beer Consolidated Mines, Ltd., South Africa, the Electrotechnische Industrie of Holland, the Sunderland Forge & Engineering Co., Ltd., and other firms.

The second machine, which was designed at the request of the Admiralty, has a precisely similar winding appliance, except that it is on a larger scale, and will take coils from 6 in. long by 3 in. broad up to 21 in. long by 12 in. broad, carrying wire up to 8 L.S.G. It is, however, very much more complete in its arrangement, as it stands on its own bedplate, with back gear for giving four useful speeds, and has a friction clutch for stopping or starting the machine instantaneously, and guide pulleys for taking the wire direct from the rotating arm. The machine is patented in Germany, France, and the United States as well as in this country.

It will be seen that for simplicity of operation and certainty of action, the machine described above marks a distinct step in the economical production of electrical apparatus.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

ERNESTO STASSANO contributes an article to *Electro-chemical and Metallurgical Industry* of August upon the "Treatment of Iron and Steel in the Electric Furnace." He refers to previous articles which have appeared upon the subject in which the difficulties of reduction in the electrical furnace have been accentuated. Stassano states that he has overcome these difficulties, and says that the treatment of iron ores and iron agglomerates has passed the scientific experimental stage, and has taken its place in the industrial arts. He shows that a maximum consumption of 4 h.p.-hours is quite enough to produce the same results in an electrical furnace as 1 kg. of coal in a blast furnace, and if that energy is produced by water-power, the cost is 29s. 2d. per h.p.-year, or about ½d. per h.p.-hour, and with fuel at 16s., the electric furnace is on terms of equality with the blast furnace; fuel in this country, however, is very much less than 16s. per ton, although in Italy it may be 16s. or more. The furnace should fulfil the following conditions. (1) The chamber in which the electrical energy is transformed into heat, and in which the metallurgical process takes place, should be protected from the atmosphere. (2) The heat should be generated from the electricity at the highest temperature possible. (3) The whole apparatus in which the various operations are carried out should be designed and built so as to work continuously at full charge.

He then describes his well-known rotary furnace consisting of a sheet-iron cylinder with a conical roof lined on the inside with refractory material. The chamber for melting the metal is also in the form of a cylinder, and is provided with a fire brick cupola. Openings are provided for the electrodes, which are arranged to project towards the centre of the furnace, ends being at such a distance apart that arcs are readily formed and at a convenient distance from the bottom. The electrodes are externally protected by means of water-cooled cast-iron cylinders fitted to the exterior of the furnace. The movement of the electrodes is controlled by guide-rods outside the furnace. A metallic rod is fixed to the end of the carbon electrodes, the end of which is connected to a flexible cable, which passes below the furnace to the current supply. At the top of each of the water-cooled cylinders for protecting the electrodes a small hydraulic-pressure cylinder is provided, the piston rod of which is connected with the metallic rod of the electrodes, and thus the movement of the electrodes is controlled, and the distance between their terminals within the furnace is regulated. The lower part of the furnace is surrounded by an L-shaped rail of cast-iron, which rests on the inclined top of the pit-wall, and thus forms the support of the furnace. The longitudinal axle of the furnace is, therefore, inclined by a certain angle from the vertical. The furnace is revolved by means of gearing at the bottom. At the head wheel insulated copper rings are attached, which, by means of copper bars and elastic cables, transmit the current to the electrodes. The current is supplied from the generator to a series of brushes disposed round the top of an iron support in the middle of the pit. A distributing valve is placed on the top of the stationary iron support, which distributes the water for the pressure regulators and the cooling cylinders protecting the electrodes. The metal is discharged from the bottom of the melting chamber, and opposite to it another opening is left for charging. In the centre of the brick cupola an exit is provided for the gaseous products of the reactions. Through this exit the gases escape into a metal tube shut by a sand valve and leading to a vessel filled with water from which they may escape into the open air or can be used otherwise. This arrangement prevents any entering of air from the atmosphere into the melting chamber; neither can air get in on opening the charge hole, since the pressure inside is higher than outside, on account of the higher tension of the gases at the elevated temperature inside.

Although the arc temperature is very high, yet this electrical furnace will not overheat the charge in a detrimental way. Indeed, the chief characteristic of this furnace is that it is an air-tight chamber with a thermic source in its centre, radiating heat at a very high temperature. Evidently the temperature of the chamber will increase and tend to reach gradually that of the arc, but will not reach it. Experience shows that if the right proportion is used between the charge capacity of the melting chamber and the quantity of heat produced, the operation proceeds satisfactorily without overheating the charge. It seems clear, therefore, that refined iron may be obtained *from ore directly* in this furnace if it is charged with iron ore mixed in the right proportion with a reducing agent and fluxes able to transform the gangue into slag of a suitable composition to absorb the impurities of a single operation. Such a charge will be gradually heated out of contact with air. The flux cannot absorb oxygen, and maintains its quality also at an elevated temperature, so that it is able to react when the right temperature has been reached. Among the different oxides contained in commercial iron ore, that of iron is the first one which is reduced. The remaining oxides (SO_2, MnO, MnO_2, CO, MgO, &c.) are, therefore, left without reducing elements, and hence forced to pass, with the assistance of the flux, into the slag. In the same way, if pig-iron or iron scrap is used, mixed with the slag-forming materials, the pig-iron and impure iron may be successfully refined in the same furnace.

This furnace can be used for the extraction or iron directly from ore as the refining of pig-iron and raw iron. As the design and operation of the furnace exposes the material to the most elevated temperature in a neutral atmosphere, it is easy to produce iron of the finest and purest quality. As the atmosphere in the furnace is chemically neutral, and the operation may be carried out at will for any length of time, the metal may be almost completely freed from all impurities without the risk of oxidation. Stassano considers that the electric furnace can be as well used for the direct extraction of malleable iron directly from the ores as for the purification of pig-iron, scrap iron, or steels; the furnace is thus very valuable in a country lacking in fuel, but which is rich in water-power. The furnace may also be used as a valuable auxiliary in the ordinary iron and steel industry where blast furnaces, open hearth furnaces, and Bessemer converters are employed. Modern engineering industry requires special iron and steel for high-speed tools, and these cannot be chemically manufactured by ordinary metallurgical operations, but for this class of work the electric furnace is of the very greatest value. It would, therefore, appear that the electric furnace has come upon the scene in time to help or act as an adjunct to the old iron and steel industry, because its particular properties permit of the refining of material which has been manufactured by the older processes. At Turin the Stassano furnaces in the artillery shop are usually treating pig-iron and scrap iron, the product being generally manufactured to produce mild steel castings for railway wheels, automobiles, and for general mechanical purposes. In the article tables are given which show the efficiency of the furnace and the energy consumption, and make clear that up to a certain point the larger the furnace the greater the efficiency. For example, if steel is refined in a 220-h.p. furnace, it is found that 1·26-kw. hours were required per kilog. steel, whereas with a 100-h.p. furnace the energy required for the same production of steel was 2·3-kw. hours. The operating expenses for electric furnace work are low. The consumption of electrodes, expenses for repairs and insulation, and salary expenses are low, as experience has shown. During the long operation in artillery works and in Stassano's steel works, the consumption of electrodes was not more than 10 kw. per ton of metal. The expense for lining per ton of metal was on the average about 8s. 3d., except in rare special cases, where it rose to 11s. 5d. to 12s. 5d. per ton. With regard to wages, three men are quite sufficient for a furnace of 300 h.p., and five men, at the utmost six, can attend to a furnace of 1,000 h.p. when working with cold material, while for refining steel or reducing ore four men will be sufficient. The first furnace of the kind was erected at the artillery works of Turin. It consists of a 200-h.p. furnace operating on a three-phase current supply by the Societa Ellettricita Alta Italia. This furnace was first worked in the spring of 1903, and it has since then been kept in regular operation, about 2½ tons of steel being produced daily. The second plant was installed at Stassano's steel works in Turin. The installation consists of two 100-h.p. furnaces, which are generally used for experimental work, two 200-h.p. furnaces, one tilting and the other rotary, and two furnaces, one stationary and the other rotary, having a capacity of 1,000 h.p.

At the Bonner Fräser Fabrik in Bonn, Germany, a 200-h.p. rotary furnace has lately been installed, which is supplied by a three-phase current from the Berggist-Brühl electricity works, where the power is obtained from steam engines. The current is brought in at 5,500 volts, and by means of a transformer situated near the furnace it is reduced to 100 volts between phases.

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TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION

Communications to the Discussion on Prof. Carus-Wilson's Lecture on Rail Corrugation

THE lecture on "Rail Corrugation," delivered by Prof. C. A. Carus-Wilson on July 10th at the last meeting of the Annual Congress of the Association, was discussed on Friday, July 24th, and a full report of the discussion was given in ELECTRICAL ENGINEERING, July 30th, page 173. An abstract of the lecture was given on page 107 of ELECTRICAL ENGINEERING for July 16th. It will be remembered that the lecturer stated that in his opinion corrugation was due primarily to the wheels running on unequal diameters, this causing skidding of the smaller wheel. This skidding, if grit was present on the rail, became intermittent, the period between the skids depending on the limiting twist of the axle.

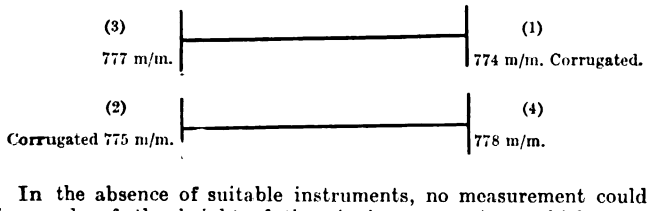
The discussion was opened by Mr. H. M. Sayers, who expressed the opinion that intermittent slipping would have the same effect as the intermittent skidding described by the lecturer. Such intermittent slipping could be caused by the sudden rise of motor torque when two or more notches of the controller were passed over without a pause. Mr. J. R. Salter suggested that the molecular change in the iron rails due to magnetisation might have some influence. The importance of ensuring uniform flange pressure was emphasised by Mr. J. S. Warner. Mr. S. Sellon objected to the tyre section shown by the lecturer, and called attention to the wear which must take place on the flange and rail-head before check-cutting can occur. He did not think unequal diameters essential for the production of intermittent skidding. The corrugations on the old Brixton cable tramway lines were put forward by Mr. J. Welling in support of Prof. Carus-Wilson's theory. Prof. Carus-Wilson replied very completely to all the questions put, but has sent in the following written communication with regard to his reply to Mr. S. Sellon:—

Prof. CARUS-WILSON (communicated): With regard to Mr. Sellon's criticism of my Fig. 2 (see ELECTRICAL ENGINEERING, July 16th, p. 107), he says, "by the time the wheel has arrived at that stage in which he has shown it the other rail is (worn) down in proportion." I think this explains where we differ. Mr. Sellon takes no account of the fact that along with the check cutting on the one wheel there is always a thinning down of the flange on the other wheel, so that the rail has not to be worn away "in proportion" to the cutting of the check. It is this thinning of the flange that makes check cutting on the straight possible, and justifies the practical accuracy of Fig. 2.

The following written communications to the discussion have also been received.

Mr. FRED BLAND (Tramways Department, Edgar Allen & Co., Sheffield) wrote as follows: As a manufacturer without an "axe to grind," or even a grinder to sell, I have taken considerable interest in this subject, but have no theory to put forward. I wished to place before the members an interesting addition to this subject, obtained during a recent visit to the Continent, one, I believe, that has not been touched upon as yet. The fact in question is the corrugations upon the tyres of the tramcar wheels of the Helsingborg tramways, which are plainly to be seen upon the tread of the tyres. The following information with regard to one car with such corrugated wheels may be of interest:—

(1) The diameter of the wheels and the relation to each other stand thus:—



In the absence of suitable instruments, no measurement could be made of the height of the single corrugations which were noticed several times, and which in this case were especially strong. This corrugation on the diagonal wheels was found in several cases, but also upon three wheels of one car, and upon four wheels of another car. The corrugation takes place upon the smallest wheel of the same axle, and in relation to both axles upon diagonally situated wheels.

(2) On the opposite wheel no corrugation was found, in spite of an exact and careful examination, whereas, as stated above, upon one car corrugations exist upon three wheels, and upon all four wheels on another car.

(3) The corrugations first occurred on a curve of 200-m. radius, which was run over quickly, and upon this spot the under surface was very bad, and although all sorts of trials were made, the lie of the rails could not be improved, and the corrugation was very strong.

(4) They think there is a possibility that on this spot the corrugation took place upon the wheels, and these transferred the corrugations to other portions of the track, and they draw this conclusion from the fact that the first corrugation was noticed after 1½ year's wear, and now for the first time after about five years' corrugations have occurred upon the greater part of the remaining track.

(5) Further observations are now being made as to the increase, or otherwise, of these corrugations.

(6) The corrugations on the tyres correspond exactly with the corrugations on the rails in form and length, and are distributed at about 7—8 c/m. distance from summit to summit on the circumference, and the cars which run with corrugated wheels make a peculiar buzzing noise when running quickly.

(7) The tyres are Krupps' steel, of at least 80 kg. per square mm., and are twisted off in the middle after running 50,000 kilometres.

(8) The rails are Phœnix rolling—section 25 B—tensile strain 70 kg. per square mm., and at least 45 per cent. carbon.

(9) Brakes shoes are ordinary gray iron, but in their opinion these are not a contributory cause; "flats," caused by careless breaking, were often noticed on the tyres at first, but not for the last three years, and they do not think that the "flats" on the tyres led to corrugation.

I have to thank Mr. t'Serstevens, the Secretary of the International Tramway Association (of which I have the honour of being a member), for the details, which I believe will be given at the forthcoming Tramway Congress at Munich in September, in connection with the Commissioners' Report upon Corrugation.

Mr. W. F. IRELAND (Rolling Stock Superintendent, L.C.C. Trams.):

The wheels as arranged on the model truck, *i.e.*, with one running on its flange, produce in effect a conical roller. This obviously will not roll in a straight line without the smaller end slipping on its path, but would run perfectly on a curve, the radius of which is identical with that of the natural rolling circle of the cone. Would not the reason for the accentuated slip, which is shown in the Professor's model to be due to energy stored up in the spring when track is sanded, be largely responsible for wear of the check, and not a result of it? It will be obvious that if a pair of wheels be considered as a cone, forced to travel in a rigidly defined path, which does not conform to the natural rolling curve of the cone, its axis will never be at right angles to its forced path when rolling; therefore, the flanges of the wheel would be constantly slipping on the check of straight track, as occurs on the inside rail of a curve track.

Professor Carus-Wilson says the flange cannot come into contact with the check until considerable wear has taken place. I cannot agree with this statement, as it will be readily seen that, given the condition of wheels or track to produce what is virtually a cone-shaped roller of a pair of wheels, check-cutting can be produced without wear having taken place, as, for instance, if tyres of different diameters are fitted to a pair of wheels, that pair of wheels will travel sidewise along the track and produce check-cutting and slip simultaneously. The effect of a cone being forced to roll in a straight line is to produce positive slipping points at the larger end, the intervals of which depend largely upon the coefficient of adhesion between the cone and the path and the strength of the cone to resist torsion. Therefore, with a low coefficient of adhesion the intervals are short and scarcely discernible, but with high coefficient of adhesion the intervals will be longer and dependent upon the torsional resistance of the axles. Are the intervals of slip, or pitch of corrugations, longer where smaller diameter axles are used? This should be so if both wheels are acting to produce corrugations on one rail only, in virtue of their different diameters at the running surface producing a conical roller similar in effect to the Professor's model when the brass strip is placed under the flange. Are any cases of corrugation known where the rail-

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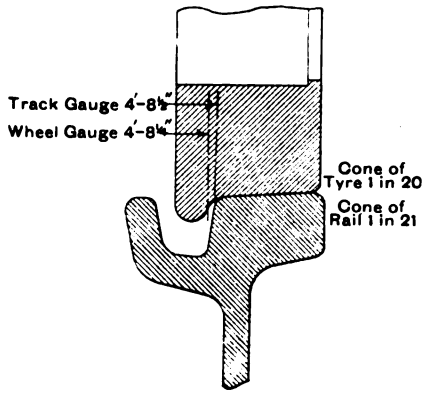
head and tread of wheels are flat? Burton-on-Trent have a flat-headed section of rail and flat-tread wheels. If these rails do not show signs of corrugations on straight track, have they done so after wheels with conical treads have been run over them, as, for instance, after the Midland Railway Co.'s cars



Sketch showing Relative Positions of Standard Tyre and BSS4 Track Rail. Half-size

obtained running powers over the Burton system? If the action of a cone forced to run in a straight path—when by reason of some defect, either in the rail-head or the wheels, the pair of wheels form the cone—tends to cause corrugations, these corrugations would, of course, only be formed on one rail by any particular pair of wheels, and the reason for both rails being corrugated would be accounted for by other pairs of wheels forming corrugations in the opposite direction.

Is it not reasonable also to conclude that *each wheel*, owing to the shape of the tread and its path (*i.e.*, the head of the rail, being conical), naturally desires to follow a circular path, but is forced to follow a straight one by the resistance of the axle, and should produce exactly similar effects on each rail simultaneously without reference to any torsional elasticity of the axle, just as the *pair of wheels* forming a cone does on one rail, and having regard to torsional elasticity of the axle. If this is so, would not the axle be subject to a constantly changing bending moment, and have some bearing on the question of broken axles? It is noteworthy that nearly all axles which have broken in London have done so at a point where this bending moment would be a maximum, *i.e.*, close to the outside of the wheel-boss, and not at a point where torsional stress would be a maximum, *i.e.*, the inside of the wheel-boss on that side of the axle on which the motor is suspended.

I should be glad if an explanation can be given as to the reason for both rail-head and wheel-tread having almost exactly similar inclination (see sketch of wheel and rail opposite). Assuming for the moment that wheel and rail perform the function of a rack and pinion, where the rack is stationary and the pinion rotary, would any sane engineer make the teeth with an inclination of 1 in 20 and expect to get equal wear over the whole face of the teeth?

Now, if one cone, as represented by the pair of wheels, having different diameters at their running surface, can produce corrugations on one rail, why should not each wheel do likewise, seeing that about two inches of the running surface is also a cone? Take, for instance, a wheel which has a diameter at the throat side of the tread is 30 in., and an inclination of 1 in 20; the diameter at the outside of the tread 2 in. wide will be 29·8 in. Every revolution of this wheel at the 30-in. diameter has travelled a distance on the track of 94·248 in., while the outside of the tread will only have travelled 93·620 in., *i.e.*, a difference, of, say, ⅝ in. per revolution. The question is now—What becomes of this ⅝ in.? Presumably the whole of the tread is equally loaded, and slip under these conditions would appear to be inevitable. I am not prepared to say that this is the cause of corrugations, but it is remarkable that where the inclination of the wheel tread and rail are similar, the wear of the rail is wavy in form and of a more pronounced nature than where considerable differences of inclinations occur, as where some cars have their wheels worn more or less flat. I have in mind the Council's subway tracks, where all the wheels were turned to exact diameters, and the inclination to gauge, the trucks built perfectly square, the cars suspended on swing bolsters and with centre-bearing swivels well lubricated; corrugations appeared within a few days of running, certainly before any wear of the check was discernible. The track in this case is laid on wood sleepers and is more or less flexible; therefore the weight on the wheels would tend to cause the rail to set itself to the inclination of the wheel-tread (after the manner of a self-aligning bearing) more readily than is the case where the rail is laid on a solid concrete foundation. It will no doubt occur to some that if slip goes on at each wheel-tread the effect would be such as to produce such minute waves as to be scarcely worthy of consideration, because the effect is not apparently accumulative to the same extent as where the pair of wheels form the cone in which the accumulation takes place in the form of torsional stress in the axle, but I think perhaps accumulation takes place in the form of bending stress of the axle in the form sometimes seen in a line shaft where heavily loaded in the centre between bearings.

RECENT WALL PLUGS

We are able to illustrate a few of the newest additions to the long series of wall and floor sockets and plugs which have been brought out from time to time by Messrs. A. P. Lundberg & Sons, and are described in a new list which they are just issuing. Fig. 1 shows the intermediate of the three sizes known as "Dot," "Universal," and "Magnum," of a design of plug the interior of the large size of which is seen in Fig. 2. The bases are of vitreous porcelain, and their covers are attached by means of the contact sleeves themselves. Their simple construction enables the price to be kept low. Both these and the ordinary plugs can be arranged with hollow-tube prongs and pin contacts in the sockets for heating circuits in order not to be interchangeable with those belonging to the lighting circuits. A special pattern of flush floor socket, with or without hinged brass lid, is another feature of the list, and also a sunk pattern, to which a brass cap flush with the floor may be screwed. This is particularly intended for dining-rooms which may occasionally be used for dancing. There are also a number of neat designs of semi-flush wall sockets projecting only a short distance from the wall, and these can be supplied without the ornamental fronts to firms who prefer to fit their own decorative designs. We have already described and illustrated Messrs. Lundberg's so-called "clincher" pattern of connection (Electrical Engineering, July 2nd, page 41). Fig. 3 shows a very compact form of plug for use where space is limited. With the exception of the last named, practically all these fittings can be supplied with three contacts instead of two for special purposes.

Fig. 1.—New Pattern Connection with Fibre in Ebonite Disc Cord-grip Plug.

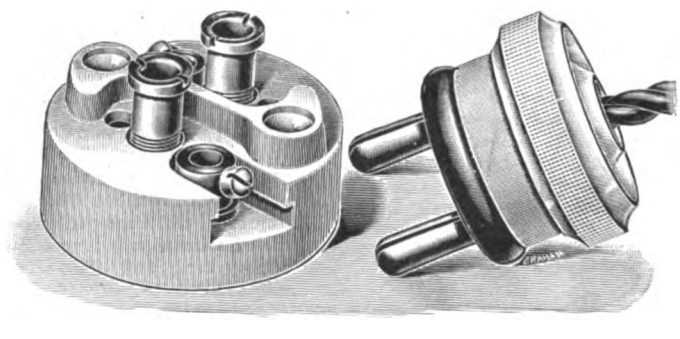


Fig. 2.—Interior of New Pattern Plug.

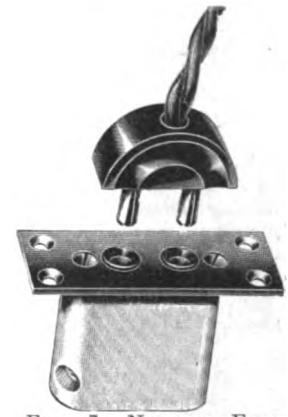


Fig. 3.—Narrow Form of Flush Connection.

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ELECTRICALLY-DRIVEN FIRE PUMPING STATIONS IN NEW YORK

A DESCRIPTION of the high-pressure system of water supply for fire protection, worked by electrically-driven pumps, which is being installed, is given in the *Electrical World* (New York). The present scheme includes four pumping stations, two in Manhattan and two in Brooklyn. One of these is already available for use, and the others are nearing completion. The pumps are operated by induction motors, and the aggregate rating of the set already installed is 15,000 h.p.

The high-pressure service in Brooklyn serves an area of 1,360 acres, and, when the system is in full working order, any one of the 700 special hydrants will be able to supply water at a pressure sufficient to throw it upon flames beyond the reach of ordinary fire engines. With the eight pumps at the two pumping stations at work, 48 streams of water may be concentrated at any part of the system with a pressure between 200 lb. and 150 lb. per sq. in. The pumps can force streams of water 700 ft. up through standpipes of high office buildings, &c. About 22 miles of special mains have been already laid.

The main pumping station in Brooklyn is at Joralemon and Truman Streets, near the East River. This station is nearing completion, and will contain five multiple-stage centrifugal pumps directly coupled to 800-h.p. three-phase induction motors. The other station, at St. Edwards and Willoughby Streets, is completed. The equipment consists of three Worthington centrifugal pumps, each of which is driven by an 800-h.p. induction motor. Current is obtained through special duplicate feeder cables from the Gold Street station of the Edison Company at 6,600 volts, which voltage is applied directly to the terminals of the motors.

Three cables run from the Gold Street station of the Edison Company to the Joralemon Street pumping station, and every precaution known has been taken to render the service reliable. The service is further safeguarded by the interconnections between the Gold Street and the Bay Ridge stations of the Edison Company, and between the storage batteries connected to the system. These connections afford a guarantee of almost absolute continuity of service; but in case of some unforeseen catastrophe by which both these sources of supply might be cut off, there are cable connections with the power stations of the Brooklyn Rapid Transit Company and also with the system of the New York Edison Company, so that the city may draw its electrical energy from any one of all the large generating stations in Brooklyn or from any of the stations of the New York Edison Company in Manhattan. By the terms of the contract the Edison Electric Illuminating Company must install and maintain sufficient electrical machinery, cable, &c., to permit the starting of any three motors in one pumping station simultaneously whenever required.

A special system of telephones connects the pumping stations and the power stations. The pumps are required to take full load in about one-half minute's time, so that when a fire is reported, the pressure on the mains will be high enough for all requirements by the time the firemen reach the scene and attach the hose. By means of the telephone connections available, the firemen can have the pressure increased or diminished as required. The contract price for the electricity supplied by the Edison Electric Illuminating Company is $3,660 per month as a readiness-to-serve charge, and $0.015 per kw.-hour for all energy used.

The Manhattan system comprises about 63 miles of mains varying in diameter from 12 to 24 in. Two pumping stations are provided: one near the Gansevoort Market on the Hudson River, and the other at the corner of Oliver and South Streets, near the East River. Each station will contain five pumping units, and have space reserved for three additional units.

The pumps are of the horizontal, multi-stage centrifugal type, each pump having six stages and being able to deliver 3,000 gals. of water per minute against a discharge head of 300 lb. per square inch, when operating at 750 r.p.m. with a suction lift not exceeding 20 ft. The pumps are designed so that the discharge pressure can be varied between 100 lb. and 300 lb. by means of a special regulating valve. The pumps are of Allis-Chalmers make, and each is direct-connected to its motor by a special flexible coupling. The motors are designed for operation on three-phase, 25-cycle, 6,600-volt circuits like those in the Brooklyn stations. In starting, an iron grid resistance is connected in the secondary circuit, and gradually cut out by means of a hand-wheel on the motor panel. When the resistance is cut out, the rotor is short-circuited by means of solenoids, controlled from the main motor panel through auxiliary switches. The controllers and motors are so designed that the pumps can be brought to full speed from standstill in approximately 30 seconds An interlocking arrangement is provided so that the motor cannot be connected to the line when the rotor is short-circuited The rates charged by the New York Edison Company on condition that the entire equipment in both stations shall not be operated simultaneously is $24 per year per kilowatt rating of motors connected as a readiness-to-serve charge, and $0·15 per kw.-hour for energy used. The electric energy for driving the motors is taken from the mains of the New York Edison Company, the current being at a potential of 6,600 volts. Each pumping station is connected to the Edison generating station by two three-phase cables, in addition to two reserve feeders from Edison sub-stations.

In order that there may be no delay occasioned by priming the pumps when they are to handle salt water, three motor-driven vacuum pumps are provided. A system of signal boxes has been so designed that a fire in any part of the district can be watched from at least one telephone box, and orders readily transmitted to the engineer at the pumping station in regard to the requisite pressure and the quantity of water required, as well as to use of fresh or salt water.

Special precautions have been taken in laying the water mains to avoid liability to freezing, and during the winter, water will be pumped slowly through the pipes from one station to another at intervals.

PROGRESS OF THE ELECTRICAL INDUSTRY

An American View

AMONG the Papers read in the month of May, before the thirty-first Convention of the National Electric Light Association at Chicago, was one by T. C. Martin, representing the report of the Association's "Committee on Progress." Referring first of all to the growth of the industry in America, the report says that the year 1907, which began with evidences of splendid prosperity on the part of every well-managed supply company, ended in gloom, with output lessened, income diminished, and every effort strained in the direction of economy and restricted expenditure. There are, however, already marked signs of recovery, and the consumption of electrical energy has regained in large measure the lost ground of the past six months.

Number of Stations in Operation.—The total number of American stations up to April, 1908, would appear to be 5,037, or, including 396 Canadian and 62 Mexican, a total of 5,495 for the North American continent. The number of stations in Germany up to April, 1907, is 1,526 (see ELECTRICAL ENGINEERING, Vol. III., page 554), and of this number 1,025 are under State or municipal control. In the United States, the opposite is the case, the stations in four cases out of five being under private control. The large power loads obtained in Germany are remarkable, considering the small size of most of the stations. According to the latest statistics for France, there were on January 1st, 1906, no fewer than 1,413 generating stations, over two-thirds of which were partly water-power stations. Of these 831 stations were purely water-power stations. The report then gives at length the terms of the agreement between the Paris Municipal Council and the Electric Lighting Companies with regard to the future of the electricity supply in Paris. These were given fully in ELECTRICAL ENGINEERING, Vol. I., pp. 543, 950, and Vol. II., p. 743. The statistics for England, says the report, are of interest, more particularly because they fail to show the power of expansion so manifest in the American and German data. The connections to the mains reached a total of 1,100,000 kw. by the end of 1906, two-thirds of which was under municipal control.

Rates and Regulations.—No questions during the past year have occupied greater attention on the part of electric light and power companies than those which concern relations with the municipality or the State, and which have to do with the control of public service corporations by boards or commissions. Incidentally, there have been decisions of importance by these bodies and by the courts affecting rates. One of the most

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interesting cases is that in which the Wisconsin State Railway Commission has dealt with the application of the La Crosse Gas and Electric Company for the power to charge higher rates for electrical energy than had prevailed. The Commission agreed that the net earnings were not enough to meet ordinary depreciation charges, much less any interest on the investment, and allowed the revision of charges. Again, as a result of a recent controversy between the Minneapolis General Electric Company and the officials of that city, several expert investigations were made, and the correctness of the theory of readiness-to-serve charges in connection with electric light and power business was upheld. That is, the rates given to any individual customer should be dependent upon the fixed charges on the investment necessary to serve him, plus operating expenses, rather than on the average expenses of serving all classes of customers. Rates have been readjusted or modified in one or two of the leading cities in America during the past year. The rates to be charged by the Commonwealth Edison Company of Chicago have been fixed by the Chicago City Council for the period between August 1st, 1909, and July 31st, 1912, as 6½d. per kilowatt-hour up to the equivalent of 30 hours' use of the consumer's maximum demand, and 3½d. per kilowatt-hour for all energy in excess of that. A discount of one halfpenny per kilowatt-hour from the primary rate is to be allowed on all bills paid within ten days.

The Union Electric Light and Power Company of St. Louis has recently put in force a new system of rates which differs considerably from the typical systems in use. The fundamental principle of the system is that the customer's rate is based on the minimum monthly guarantee he is willing to make per horse-power or per 50-watt lamp connected. For example, the customer having less than 100 lamps pays 6d. per kilowatt-hour if he guarantees only 5d. per month per lamp. If he guarantees 33d. per month per lamp he need pay only 4d. per kilowatt-hour. By guaranteeing 23d. per month per lamp the customer gets a rate of 5d. per kilowatt-hour. The rate is also made lower as the number of connected lamps increases. For example, a customer guaranteeing 5d. per month per lamp and having less than 100 lamps pays 6d. per kilowatt-hour. This is reduced by steps until for 3,000 lamps or over the rate is 3d. per kilowatt-hour, with a 10d. per month per lamp guarantee. For the 23d.-per-lamp guarantee the customer with less than 100 lamps pays 5d. per kilowatt-hour, while the customer with 3,000 lamps pays 2·6d. per kilowatt-hour.

All these rates are subject to further discounts based on hours' use and quantity. The discount made according to the equivalent daily hours' use of the entire connected load starts with a 6 per cent. discount for a kilowatt-hour consumption equivalent to 1 hour's use per day of the connected load, rising by steps to 25 per cent. discount for a kilowatt-hour consumption equivalent to 18 hours per day of the connected load. There is also, in addition to this, a discount based on the amount of the bill, which is from 5 per cent. on bills of under £2 to 56 per cent. on bills of over £1,800 per month. The power rates are on the same plan. A 1-h.p.-motor customer pays 5d. per kilowatt-hour if he guarantees 4s. per month per horse-power. If he guarantees £1 10s. per month per horse-power he pays 2½d. per kilowatt-hour. The rate also depends on the horse-power connected.

New Central-Station Work.—It cannot be said that anything particularly new has occurred in central-station design and construction during 1907. Perhaps the most striking novelty has been the completion by the Patapsco Electric and Manufacturing Co. of its new dam and power-house in one, on the Patapsco River, about 15 miles below Baltimore. The plant is unique in that it is placed entirely within the dam itself, and is thus completely under water. (This power-station was fully described and illustrated in Electrical Engineering, Vol. II., p. 472.) With regard to power-transmission, attention may be called to the 100,000 volt transmission system of the Grand Rapids-Muskegon Power Company for light and power. Since the early part of 1907, 35 miles of steel tower line have been built for operation at this pressure, using the new suspended type of insulator. Five of these insulators, hanging horizontally one above the other in series, are used to insulate the line. Each porcelain suspended insulator is 10 in. across, and the rated voltage that it will withstand is 23,000 per "link." (See Electrical Engineering, Vol. II., p. 948.)

Advertising Signs.—The streets of the leading cities in America are still brilliant with electric signs, and attention is now being directed to the lighting of posters. In Chicago, Kansas City, and Indianapolis a large advertising concern has begun to sell day and night service, purchasing energy from the local supply companies, and charging the customer for the total cost of the poster-board and lighting. Experiments have been made with flame arcs in Chicago. One 450-watt flame arc has been found more than sufficient for 25 ft. of board. At the corner of Broadway and Thirty-fourth Street in New York City there is a poster board provided with fourteen 55-volt 12 amp. flame arc lamps, burning two in series. The lamps burn from sunset to midnight, and the effect is very striking.

Testing of Meters.—In Massachusetts and Wisconsin, customers of electric light companies may have their meters tested by applying to the Board of Gas and Electric Light Commissioners. The fees are paid by the applicant unless the meter is found to register too fast, when the company pays the fees, and is ordered to correct the meter. Five per cent. variation either way is allowed. In New York, under the old laws, every meter in the city was supposed to be tested. Now, however, meters are tested on application only, 4 per cent. being the maximum variation from the standard allowed. By the provisions of the Canadian Law, a meter must be tested and stamped every five years. Only 3 per cent. variation is permitted.

Metal Filament Lamps.—A statement from the Muncie, Ind., Electric Light Co., covering last year, indicates a remarkable substitution of the tantalum for the carbon lamp in a short time. According to the manager, there are 10,000 tantalum lamps now in use out of a total of 32,000 16-c.p. lamp equivalents connected. Appreciation is further attested by the fact that each lamp was sold at 2s. 6d., and that few converts returned to the old carbon-filament lamp, which they could obtain at about 8d. Over 250,000 tantalum lamps had already been put into service in the United States by September last, and considerably more would be in use had the manufacturers been able to supply the demand more rapidly. On direct current the average life of the tantalum lamp is over 700 hours for the smaller size, and 1,000 hours for the larger size lamp. The life for alternating current appears to be reduced on 25 cycles to about two-thirds, and on 60 cycles to about one-half of the direct-current life. The point in rates, where it is economical to use high-efficiency lamps, can be determined with the aid of the following:—For the same illumination, the Gem graphitised carbon filament saves 20 per cent., the tantalum 33 per cent., and the tungsten 60 per cent. in energy over the 3·1 watt carbon-filament lamp.

Arc-Lighting Progress.—The most interesting and novel feature of arc work is the new Jandus "regenerative" enclosed flame arc just brought out in England (this arc lamp was fully described in Electrical Engineering, Vol. III., p. 299). Returning from a trip to Berlin, Germany, this year, Mr. L. J. Auerbacher stated that practically all the commercial arc lighting in Berlin is accomplished by flame arcs. There are a few open arcs still used, but no enclosed arcs. As to the large practical use of the magnetite arc, the experience at Jackson, Mich., may perhaps be taken as average and typical. Three years ago, when the lamp was introduced, 300 were put up on the streets of that city. There was trouble with spattering from one of the electrodes, but after a solid copper electrode had been used the globe breakage was no greater than with other arcs. The cost of electrodes, including the copper blocks and magnetite sticks, was a little less than the cost of carbons for enclosed arcs, and the lamp burned as long between trimmings. It was found to take 320 watts for 4-ampere lamps, as against 525 for the lamps displaced. Owing to the excellent distribution of the light, print of a given size could be read twice as far away from a magnetite lamp as from a 525-watt carbon arc.

Increase in Power Loads.—There have been some notable examples of sale of electrical energy in bulk during the past year. Thus the New York Edison Co. has had contracts for the supply of several thousand kilowatts for the construction work on the New York Central terminal; Chicago has had a kindred experience with the railroad lines; and Boston has followed suit. The most striking example of this development has been the completion of the electrically-operated, high-pressure water systems in New York and Brooklyn for fire protection. The prevention of the overlapping of the lighting and motor loads has been successfully accomplished at Montreal by the adoption of the Gossler system. At present the Montreal Heat, Light & Power Co. has connected to its system the equivalent of 450,000 16-c.p. lamps, about 37,000 h.p. in motors, and upward of 1,000 appliances for heating, cooking, refrigerating, and so forth. The company serves upward of 13,000 electricity consumers. The company's motor rates are of particular interest in view of the success that has been attained in the broadening of the load curve. Non-peak power users are encouraged by a special concession, as will be seen by the following brief *résumé* of the rates at present in force. The services are classified as follows: (1) Unlimited day service, 10 hours straight, 7 a.m. to 6 p.m. (2) Unlimited day and night service, 24 hours, continuous. (3)

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Limited day service (off-peak), from 7 a.m. to 6 p.m. throughout the year, except between 4 and 7 p.m. between September 15th and March 15th. (4) Limited day and night service (off-peak), 24 hours per day throughout the year, except between 4 and 7 p.m. between September 15th and March 15th. On the limited day service the reductions given by the company amount to 25 per cent. of the unlimited day rate. The same ratio of difference applies to the unlimited day and night service and the limited or off-peak day and night service. Three systems of charge, equalising one another under certain load factors, are in vogue, as follows:—(1) A straight flat rate per horse-power-year, varying according to the average maximum load as determined by test. (2) A readiness-to-serve charge, based on average maximum demand plus a meter charge per h.p. or kw.-hour, also varying according to demand. (3) A straight meter rate per kilowatt-hour or horse-power-hour, as the customer chooses, likewise varying according to demand.

It has been found that about 40 per cent. of the company's customers can cut off power at the time of peak load without detriment to themselves. Among the loads are 3,500 horse-power in cotton mills, which start at 7 a.m., instead of 8, and which allow half an hour for lunch, stopping work at 4.30. The operatives in many instances prefer to follow these hours and go home early than to begin later and close later. Among these off-peak customers are the various morning and afternoon newspapers, to which the company supplies upward of 400 h.p. Another class of customers is found in brickyards. These require entirely a summer service, and get about 50 per cent. of the regular rates on seven months' operation. These amount to 600 or 700 h.p., the motors being used to drive casting machines, mixers, and conveyers. Other non-peak users are the local water-power company, which uses 1,200 h.p. in pumping drinking water; the Railway Appliance Co., 500 h.p.; various woodyards and cement works. In the woodyards all the cutting is done during two or three hours of each day. From 5,000 to 6,000 h.p. will be used in the cement industry at Montreal this year. The non-peak rates are as yet given only to trustworthy customers consuming relatively large amounts of power. An installation of 20 to 25 h.p. would be about the limit below which the non-peak rate would not as yet be granted. Separate circuits are not run, and the time switch has not yet been applied to any extent, though it is being considered by the company.

Wiring.—The Commonwealth Edison Co., of Chicago, has now been wiring old houses located on its service lines on the instalment-payment plan since last summer. A regular schedule of costs per outlet and per lamp was drawn up for the use of solicitors. At Pueblo, Colorado, the engineer has wired up 1,200 residences, free of charge, in order to get their business. In the case of the majority of small residences in any city it is hopeless to expect that the owners or builders will go to the expense of employing special expert advice on the lighting. Yet it is in these small dwellings that economical and efficient arrangements are most important, both to the consumers and to the central-station company. If the electric lighting arrangements are not efficient, the company will lose this valuable class of business, which in the aggregate is one of the best classes of lighting load a central-station company can have, because of its size, stability, and comparatively good load factor, and because sooner or later it involves electric heating and cooking. But the owner or builder will not appreciate the importance of good design in the lighting, and will not pay for expert advice. It is therefore up to the central station authority, as the most interested party, to step in with such advice.

Prepayment Meters.—Another point that has not yet been very hard pressed is the use of prepayment meters. The prepayment meter appeals to the large class of people used to handling small quantities of money and to spending a little at a time, as they go along. For the central station this meter has the advantage of reducing the cost of collecting bills and keeping accounts. These meters can be adjusted for different rates per kilowatt-hour, so that when installed on the premises of a long-hour consumer he can be given the benefit of one rate. They can also be used for electric cooking circuits, where the customer wants to know his costs. For store window lighting the meters can be used as a time switch. Their cost is now only about 15 per cent. higher than a common meter of the same capacity.

SINGLE-PHASE GENERATORS

A PAPER describing modern developments in single-phase generators was read by Mr. W. L. Waters at the recent convention of the American Institute of Electrical Engineers at Atlantic City. The single-phase alternator has been in commercial use now for 20 years, and it may seem surprising that there should be new developments at this late date. However, single-phase alternators have been used in the past almost exclusively for lighting work, and in units of comparatively small output and low speed. Recently, on account of the adoption of single-phase current for traction work, an important demand has arisen for large high-speed, low-frequency, single-phase generators. It is in the design and manufacture of such units that the engineer has had to overcome new difficulties. In large, high-speed, single-phase generators for 15 and 25 cycles the difficulties met with are due almost entirely to the large pole-pitch and high armature reaction which it is necessary to adopt. A 500-kw., 60-cycle, 72-pole, single-phase generator would have a pole-pitch of about 7 in., while a 6,000-kw., 15-cycle, 2-pole machine would have one of about 120 in. It is easily seen that the design of these will be radically different.

These difficulties in single-phase generators of large pole-pitch are the result of pulsation of the armature reaction, and mechanical stresses on the end-connections of the armature coils. The pulsation of the armature reaction causes hysteresis and eddy-current losses throughout the machine, often resulting in dangerous heating and low efficiency. The mechanical stresses due to the current in the ends of the armature coils result in vibration and distortion of the windings, and often in damage to the insulation or complete destruction of the coils, these stresses being particularly serious in single-phase railway generators, on account of the sudden variations in load and numerous short-circuits to which these machines are subjected. As the effect of the mechanical stresses on the armature coils, and the losses due to the pulsation of armature reaction, practically increase proportionally to the square of the pole-pitch in generators of standard design, it is easily seen why these effects which were negligible in the old single-phase alternators of small pole-pitch have become quite serious in the modern turbine-driven generator. The seriousness of these difficulties when they were first met with was so great that even within the last two years responsible engineers have stated it was impossible to build satisfactory low-frequency, high-speed, single-phase generators of large capacity, and it is only by careful study and experimenting that the modern machine of this type has been developed.

Losses Due to Pulsation of Armature Reaction.—In a polyphase generator the armature current produces a magnetic flux which rotates synchronously with the field magnet. This magnetic flux, being of practically constant magnitude, causes very little loss in the iron of the magnetic circuit. On the other hand, the armature current in a single-phase generator produces a pulsating magnetic flux which is stationary in space. It is easily seen that this pulsating flux will cause hysteresis and eddy-current losses throughout the whole magnetic circuit. The exact effect of the armature reaction flux on the rotating magnets depends, of course, on the relative phase of the armature current and electromotive force—that is, on the power-factor of the load on the generator. When the power-factor is unity and the armature current is in phase with the electromotive force, the armature reaction flux is a cross-magnetisation; when the power-factor is zero and the armature current is 90° out of phase with the electromotive force, the armature reaction flux is a demagnetisation. In the special case in which the rotating field magnet is cylindrical, without projecting poles, the effect of the armature reaction flux on the magnets is, of course, more nearly independent of the power-factor of the armature current. But in any case this flux is a pulsating one, and there are important losses in the field magnets, due to their rotation through this pulsating cross-flux or demagnetisation flux.

An estimate of the combined losses in the armature and field magnets due to the pulsating armature reaction can be obtained in a number of ways. We can measure the increase of the power required to rotate the field magnets due to normal root-mean square current in the armature coils, with: (1) Direct current in the armature; (2) alternating current of synchronous frequency in the armature; (3) armature short-circuited and field excited. Or with the magnets stationary we can: (4) Send normal frequency alternating current through the armature and measure the losses by a wattmeter.

These methods must all be regarded as convenient tests which

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are found by experience to give a good indication of the magnitude of the losses. Method (4) has the additional advantage that we can vary the relative position of the armature reaction flux and the pole faces, and thus investigate the variation of the losses in a single-phase generator with the power-factor of the load.

The only exact methods of measuring the losses are: (1) As unknown losses in a motor-generator-method efficiency test, or (2) from a comparison of the temperature rise obtained on full load with that obtained with known losses. Unfortunately, both of these tests are difficult to make accurately, especially on a large machine, and probably in practice they do not give results which are any more accurate than the other methods. So at the present time we have to acknowledge that though we know a great deal about the relative values of the losses under various conditions, our knowledge of their absolute values are only approximate.

Pole-face dampers.—Losses caused by a pulsating flux in the magnetic circuits are due to: Hysteresis and eddy currents. And the relative magnitudes of the two depend on the amount of solid metal in the path of the flux. If the whole magnetic circuit is laminated, then the losses are practically all due to hysteresis. On the other hand, if we have solid cast-steel poles there will be eddy currents in these poles which will partly choke back the pulsation of the flux and the hysteresis loss will be reduced. But in this case there will be eddy-current losses in addition to the hysteresis, and the way in which the total loss is changed will depend on the proportions and design of the magnetic circuit. If we place a heavy copper damper in the path of the pulsating flux, this will provide a low-resistance path for the eddy currents, and the pulsating flux, and consequent hysteresis loss, will be reduced practically to zero, while on account of the low resistance of the damper circuit the eddy loss will not be appreciable. The way in which the losses and the pulsating flux vary according to the presence of eddy currents can be determined for any particular design by changing the thickness of the laminations, or changing to solid poles or dampers. It is usually found that the losses are greatest with heavy laminations or solid poles; that they are less for thin laminations, and practically zero when heavy low-resistance dampers are used either with solid or laminated poles.

The pulsation of the armature reaction flux can be damped out by covering the pole faces with a ⅜-in. copper plate. In practice, a copper damper usually takes a form similar to the squirrel-cage secondary of an induction motor. Heavy copper bars are dovetailed into the pole faces, and short-circuited at the ends by copper rings or discs.

The question of losses due to the pulsating armature reaction in a single-phase generator may be considered in another and possibly a simpler way. The single-phase pulsating field is equivalent to, and produces the same effect as, two rotating fields each of half its maximum value, one rotating at the same speed and in the same direction as the generator field magnet, and the other rotating at the same speed but in the opposite direction. The flux rotating synchronously with the field magnet, being constant in magnitude, causes very little loss. The flux rotating in the reverse direction causes losses throughout the whole magnetic circuit due to hysteresis and eddies. If we have a squirrel-cage damper enclosing the field magnets, this damper system acts in regard to this reverse rotating flux in the same way as the short-circuited secondary of an induction motor or transformer, a current is induced in the damper which produces a field that neutralises the rotating flux. The eddy and hysteresis loss in the iron of the magnetic circuit which would be caused by this rotating flux is thus eliminated, and the only loss is that due to the current circulating in the damper. If we make the conductors forming the squirrel cage of sufficiently low resistance, this damper loss becomes negligible, with the result that the entire loss due to the pulsating armature reaction of the single-phase generator is practically eliminated.

To show how serious this matter of losses becomes in two-pole single-phase machines without dampers, the table in the next column is given, showing the losses and full-load temperature rises on three turbo-generators, both with and without dampers.

It will be seen that in these three machines, operating single-phase, there is due to the pulsating flux an average loss of 3·5 per cent. and an average temperature rise of 125° C., without dampers; with dampers the average loss is 0·5 per cent. and the temperature rise 30° C. Figures are given only on comparatively small machines on account of the difficulty of measuring losses on large machines. But tests on larger generators up to 6,000-kw. capacity show that the improvement due to heavy copper dampers is even more striking in large machines than it is in small. So far as experience goes at the present time, it may be said that the use of such dampers is the complete solution of the difficulties due to pulsating armature reaction met with in large, low-frequency, two-pole, single-phase generators.

Mechanical stresses on armature coils.—That it was necessary mechanically to brace the end-connections of the armature coils on a direct-current machine subjected to sudden loads and short-circuits has been known for many years. But until quite recently additional supports for alternator armature coils were seldom provided. The reason for this was that as the continuous short-circuit current of an alternator is only about two or three times normal, it was not considered that the mechanical stresses on the ends of the small pole-pitch coils generally in use were sufficiently great to cause any trouble. Only during the last few years has it been demonstrated by experience that coil supports on large pole-pitch alternators are not only advisable but necessary, and that on account of the numerous short-circuits, they are particularly necessary on single-phase machines operating on traction circuits.

Two-pole, 25-cycle, single-phase generators. Same current per armature conductor one- and three-phase under all conditions and all losses in per cent. of single-phase rating.

Size.	Type field.	Three phase.		Single phase.			
		Without dampers.		Without dampers.		With dampers.	
		Loss	Temperature.	Loss	temp.	Loss	temp.
750 kw.	Solid	0·53	27°C.	3·75	95°C.	0·8	24°C.
1000 kw.	Solid	0·3	31°C.	3 0	122°C.	0·5	37°C.
1000 kw.	Laminated	0·2	19°C.	3·8	150°C.	0·3	18°C.

When an alternator is suddenly short-circuited, the first rush of current is limited only by the self-induction in circuit. In the case of an alternator of very low self-induction, this first rush of current on sudden short-circuit will be 15 or 20 times normal full-load current. As the mechanical stress on the end-connections varies as the square of the current, this means that the stress on the armature coils is 200 to 400 times normal. A 6,000-kw., 2-pole, 25-cycle, single-phase generator will have a pole pitch of about 100 in., and the length of the end-connection at one end of one armature coil will be about 180 in. We find that the mechanical stresses on the end-connections at one end of one armature coil of this machine on a sudden short-circuit is something like five tons; and we usually find that on low-frequency high-speed generators of large capacity the mechanical stresses on the end-connections at one end of one armature coil on sudden short-circuits are from 2 to 10 tons. When we consider that this comes as a sudden mechanical shock on the winding, we can realise the kind of coil supports that are required, and can understand the disastrous results sometimes obtained on short-circuits, when such supports are omitted.

We can see from these stresses that coil supports must be of metal of heavy cross-section. The objections to metal are, of course, those of insulation, but though coil supports of wood, porcelain, and similar insulating materials have been tried, it is easily understood that they have proved unsatisfactory on machines of large pole-pitch.

The two main difficulties met with in large low-frequency, high-speed, single-phase generators, which have been described above, can at the present time be regarded as having been successfully overcome. The use of heavy copper dampers on the pole faces and heavy bronze coil supports applied to the ends of the armature coils in such a way as to take directly the mechanical stresses which develop on short circuits, have now made such machines a practical success. Like every other new type of electrical machinery, the large turbine-driven, single-phase generator has had to go through a period of development, but at the present time it may be said that such generators for 15 and 25 cycle, and in units of 5,000 to 10,000 kw. capacity can be, and are, built with the same success as that obtained on standard slow-speed polyphase generators.

The German Patent Laws.—The revision of the German patent laws will be undertaken shortly. Definite proposals have already been made by certain industrial societies, and the Verband Deutscher Elektrotechniker has appointed a commission consisting of ten members, to consider the matter in the interests of the electrical industry.

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STREET LIGHTING IN CAPE TOWN

THE current issue of the Institution of Electrical Engineers contains an abstract of a Paper on electric street lighting by Mr. W. F. Long (Cape Town Local Section), which includes the following account of street lighting in Cape Town.

There is not a great deal of street arc lighting in Cape Town, but, with the exception of Darling Street, it is controlled either from the central power station or the accumulator station. A series of flame arc lamps has recently been installed in the Dock Road, and in view of the entire absence of flame lamps in Cape Town until these were installed, the author dealt somewhat fully with this installation. The lamps used are the now well-known Oriflamme type, manufactured by Messrs. Oliver & Co., of Woolwich, in which a magazine is provided by means of which the lamps are supplied with eight pairs of carbons, the second pair being automatically brought into action when the first pair are consumed, likewise the third pair when the second are consumed, and so on; the lamp is thus only trimmed after thirty-five hours' burning.

An inspection of the lamp will show that the feeding of the carbons from the magazine is accomplished by means of an endless chain revolved by a pawl and ratchet, the former being actuated by an electromagnet. This electromagnet is operated by a shunt coil, which is momentarily put in series with the shunt winding on the main coil of the lamp when it is time for the feed to take place. A novel feature in connection with this feeding coil is the switch, which, it will be noted, is an evacuated tube containing mercury and pivoted at its centre so as to allow of a rocking movement. On the arc reaching the position where feeding should take place, the tube is tilted sufficiently to allow the mercury to flow the whole length of the tube, to the ends of which are connected the feeding coil. The magnet then lifts, and, as before mentioned, works the pawl and ratchet motion, the lifting of the magnet itself rocking the switch back to the off position.

In spite of the fact that these switches are continually opening and closing the circuit, they last quite a long time, but eventually the glass is cracked through the continual mercury hammer, when, of course, the switch soon becomes useless, due to the loss of vacuum.

An unusual feature of the lamp is the low voltage required, the pressure across the terminals being only 34 volts, which allows of 11 lamps being burned in series across 440 volts. The normal current is 9 amperes; each lamp therefore consumes 306 watts, and the mean candle-power in the lower hemisphere is stated to be 1,300. As a matter of fact, it is found in Cape Town that these lamps give much better results with 10 amperes. The energy consumed on the circuit, including line resistance, is therefore 4,400 watts, giving a total candle-power of 14,300, and costing at the current price for street lighting in Cape Town 0·0016d. per candle-power per hour, including all labour and materials for trimming and general maintenance, together with interest charges on the capital expenditure in providing and installing the lamps. The lamps are placed in Hyde Park carriers on tapered steel poles placed in the centre of the roadway, the whole of the wiring being carried out by means of No. 4 S.W.G. bare wire carried on insulators attached to the poles.

Owing to the exceptionally long spans, 210 ft., and to the fact that at the time heavier poles could not be obtained for the ends of the line, it was not possible to run two wires of the above section on the lamp poles themselves; the return wire is therefore attached to the poles at the side of the road carrying the ordinary three-wire distribution system. In addition to the flame lamps, each pole also carries a double bracket fixed about 12 ft. 7 in. from the surface of the road, each bracket containing two 110-volt 25-c.p. tantalum lamps in series, which are, of course, wired on a separate circuit. The overhead wires in this case being No. 12 S.W.G. are attached by means of insulators to the sides of the Hyde Park carriers, so that the only wire causing a shadow with the arcs is the one No. 4, and this is said to be hardly noticeable. Both the arc and tantalum circuits are controlled direct from the generating station.

Turning now to the question of side-street lighting. Some twelve months ago a trial was made with 25-c.p. 110-volt tantalum lamps on an extension to the street-lighting system, and as the illumination required per pole was not to exceed 25 c.p., these lamps were installed by running series overhead wires between poles. The lamps proving very satisfactory and being seldom reported as not lighted, steps were taken to change the majority of the carbon filament street lamps for tantalums, so that now quite 80 per cent. of the street lighting is carried out in this manner. The 25-c.p. 110-volt tantalum lamps take on an average 0·2 of an ampere; a No. 14 S.W.G. bronze wire has ample carrying capacity as the series wire, even if, as in some cases, the lamps are a considerable distance apart. As an instance of the saving that can be effected by this lamp, continues Mr. Long, I should state that the cost of street lighting in Cape Town has been reduced this year by 33⅓ per cent., although some 300 additional side-street lamps and about 20 arc lamps have been erected, whereas the charge per unit for energy consumed for street lighting purposes has only been reduced by 12 per cent. The only personal experience he has had with Osram lamps for street lighting up to now was with two samples which were placed on a street-lighting circuit. These lamps were marked 110 volts 32 Hefner candle-power, and gave an initial candle-power on the photometer of 27 English candles with a consumption of 36·7 watts, or 1·2 watts per candle. A second test was made after 374 hours, when the figures were 25·1 c.p. at 1·5 watts per candle. A third test after 504 hours gave 23·5 c.p. at 1·6 watts per candle.

The Cape Town City Council has been successful in obtaining the street lighting of Woodstock in competition with the local gas company. The work in connection with this scheme is now in course of construction. The distributing system will be entirely overhead and carried out on a three-wire system similar to Cape Town, with 440 volts across the outers. The lamps to be erected comprise 300 in number, and will consist of two 110-volt 32-c.p. Hefner, Osram lamps, in series in one fitting. The energy required will be transmitted from the power station in Cape Town to the boundary of Woodstock and Cape Town by extending an existing 0·4 sq. in. concentric feeder; the feeder being also used for the supply of energy to private consumers until such time as the loads warrant the use of a sub-station. The overhead distributing system entails the use of some 300 poles and 35 miles of bare overhead wires.

The following particulars are useful as a guide to the possibilities of street lighting locally by means of metallic filament lamps as against incandescent gas. One suburban municipality is paying to-day £7 per 60-c.p. incandescent gas lamp per annum for 2,000 hours' burning. A recent quotation to another suburban municipality was £6 10s. per 55-c.p. incandescent gas lamp per annum for 2,000 hours' burning. The average various tests of gas mantles made in recent years prove that they take 0·1 cub. ft. of gas per candle-power per hour, which information, together with the above, gives the following comparative table for gas and metallic filament lamps :—

System of Lighting.	District.	Candle Power.	Charge per Lamp per Annum.	Hours Burning.	Cost per C.P. per Hour.	Energy Consumed. Gas Cub. Ft. Electricity Units.	Cost of Energy. Gas per 1,000 Cub. Ft. Electricity per Unit.
			£ s. d.		d.		s. d.
Incandescent ...	Sea Point ...	60	7 0 0	2,000	0·0140	12,000	11 8
Incandescent ...	Woodstock..	55	6 10 0	2,000	0·0141	11,000	11 9
Tantalum Electric	Cape Town..	25	2 18 2	3,000	0·0093	127	5½
Osram Electric	Woodstock..	50	5 10 0	2,000	0·0132	125	10½

The column "Cost of Energy," of course, includes both interest charges and maintenance. The Woodstock figure of 10½d. per unit is high, owing to the fact that the whole of the capital expenditure entailed has to be repaid in five years.

Jubilee of the First Atlantic Cable.—Mr. Charles Bright, F.R.S.E., who is the son of the late Sir Charles Tilston Bright, in reference to our editorial note on the jubilee of laying the first Atlantic cable, calls our attention to the fact that the first public news message was transmitted on August 17th, 1858—fifty years ago last Monday. Mr. Bright has also sent us a reprint of a lecture before the Royal United Service Institution last year, which contains a facsimile production of the Atlantic Telegraph Co.'s form with this message transcribed upon it. He also mentions that the first cable from Dover to Calais was an insulated core with leaden weights attached, and that Mr. C. J. Wollaston was the engineer who laid this for the Bretts. Sir Charles Bright was the first to lay a cable in deep water in 1852 from England to Ireland, and he was only twenty-one years of age at the time.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Aug. 13th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

1907 Patents

8,851. **Variable Speed Polyphase Induction Motor.** H. A. Mavor and Mavor & Coulson, Ltd. A polyphase induction motor, consisting essentially of two motor systems. The primary member of the main motor (usually stationary, and termed the "stator"), is capable of rotating in either direction, and is mechanically connected to the rotor or secondary member of the other or auxiliary motor. The relative speed of the primary and the secondary member of the main motor must always be the same, so that by rotating the primary member the rotor can be run above or below the synchronous speed. The speed of the rotor of the auxiliary motor may be varied by altering the number of its effective poles. The main motor may be constructed concentrically with or axially to the auxiliary motor, the primary member of which is stationary. Five claims, six figures.

16,485. **Limit Switch.** R. Lenner. This consists of an electro-magnet with a series winding, which lifts an armature when the current attains to a certain value. This inserts a resistance in the main circuit, so that the current is reduced to a very small amount. If the load resistance is increased, the resistance is short-circuited, and the load has the normal voltage. A winding on the electro-magnet, in series with the resistance, prevents the armature falling when the main circuit is broken. If the current coil of an ordinary wattmeter is substituted for the resistance, the current consumption is measured immediately it exceeds the contract value, but the voltage at the load is not affected. Six claims, four figures.

23,710. **Ventilation of Electrical Machinery.** H. G. Reist. A method of construction of the laminated cores of electrical machines, which consists in providing axial passages in the cores of both stator and rotor, parallel to the shaft, as well as the usual ducts at right angles to the shaft. One end of the machine is closed, and a fan attached to the rotor at the other end drives air through the axial passages in the rotor and back through the stator. Four claims, four figures.

26,134. **Field Systems for Turbo-alternators.** Siemens Brothers' Dynamo Works and J. Birrer. In alternators with rotating salient poles and running at high speeds, special means have to be provided to ensure both mechanical strength and good ventilation of the field winding. According to the present invention, the field winding is subdivided and supported against the action of centrifugal force by lateral projections of the poles, which form slots for the windings. The bunches of conductors are secured in the slots by dovetailed wedges of fibre. Three claims, two figures.

27,260. **Alternating Current Machine.** Dr. R. Goldschmidt. An alternating current generator, the operation of which is due to the peculiar reaction of a single-phase rotor winding, short-circuited on itself, and rotating in a stationary field. Continuous current is supplied to the stator field winding, which may be part of the generating winding. The rotor winding is short-circuited. An alternating current of double the frequency of the rotor current is generated in the stator winding. To prevent alternating currents from circulating in the exciting circuit, a choking coil is inserted in that circuit. If the exciting winding is supplied with alternating current, the machine acts as a frequency converter. Eight claims, one figure.

1908 Patents

3,583. **Wireless Telephony.** G. Siebt. In one method of effecting wireless telephony, the variations in intensity of the rapid frequency oscillations are caused by variations of the current that feeds the arc lamp, while these variations are produced by superimposing the microphone current upon the main current. The variations of the microphone current are, however, then only very weak, because this current must traverse the arc, the choking coils, and all the resistances in the circuit. An improvement is effected, according to this invention, by shunting the arc with a resistance or a capacity. This gives an easier path for the high-frequency microphone current. Six claims, two figures.

8,107. **Manufacture of an Insulating Material from Peat.** H. Branco and G. Gumpert. A process for producing an insulating material from peat without the addition of any binding media. The peat is treated in a moist condition, so that the fibres are entangled, and all foreign substances, such as sand or particles of wood, are removed. The product is then subjected to the action of dry superheated steam for two or three hours, after which it is moulded under high pressure. Chemical substances may be added to render the material fireproof. One claim.

9,497. **Elastic Supports for Metal Filaments.** W. Schäffer. On account of the contraction and expansion of metal filaments, it is necessary to make the supporting hooks elastic. The fine wires necessary for these were easily damaged when there were several to be inserted. According to this invention, comparatively stout wire (say 0·4 mm. diam.) is used, and is flattened out for part of its length to give the necessary flexibility. One claim, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

9,950, Mavor & Mavor & Coulson, Ltd. Control of alternating current generators and motors.
12,008, Saunders, Davis & Griffiths. Railway signalling apparatus.
15,016, Tracey. Apparatus for checking code telegraphy.
17,332, Mladek, Mladek & Samal. Electric power transmission.
17,463, Postans. Magneto-electrical ignition devices for internal combustion engines.
17,475, British Thomson-Houston Co., Wedmore & Hamlyn. Circuit-breakers.
17,490, Fennel & Perry. Thermo-electric generators.
18,444, Haigh. Marine electrically-controlled steering gear.
19,492, Siemens Bros. & Co. & Ferreira. Combined semaphores and indicators for railway signalling.
19,493, Siemens Bros. & Co. & Ferreira. Interlocking signal and points levers.
20,397, British Thomson-Houston Co. (*General Electric Co.*). Rheostatic controlling switches.
20,859, Beutel. Automatic signalling between trains.
22,572, Cummins. Sanding gear for tramway vehicles.
24,505, Scheffler & Schumacher. Screw clamp for connecting electric wires.
25,478, Electric & Ordnance Accessories Co. & Hall. Electric fuse holders.
25,605, Grosse. Insulating floor covering.
25,864, Feather. Device for supporting the trolley wires of electric tramways.
27,222, British Thomson-Houston Co. (*General Electric Co.*). Protective devices for electrical systems.
28,494, Boon & Mellaerts. System for preventing the falling of electric tramway wires.

1908 Patents

1,239, Hoffman. Suspending devices for electric conductors.
3,096, British Thomson-Houston Co. (*Allgemeine Elektricitäts-Ges.*). Control of alternating-current motors of the commutator type.
3,648, Böhmer. Method of automatically controlling the switches of hoists and elevators.
5,390, Struble. Lightning arresters.
5,489, Sykes, Sykes & Cooke. Electrical control of railway traffic.
6,162, Soc. d'Electricité Nilmelior. Contact-breaker mechanism for ignition apparatus of explosion motors.
8,874, Levy & Mehlhose. Electric ventilator.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

11,517, Siemens-Schuckert Werke Ges. Continuous-current machines.
15,664, Allegemeine Elektricitäts-Ges. Protective devices for electrical apparatus.
15,746, Lafitte. Long-distance lighting.
15,854, Compagnie Française de l'Ozone. Purification of water by ozone.
15,875, Moonen. Sparking-plugs for explosion motors.

Expiring Patents

No patents of electrical interest expire during the current week.

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THE WORKS AND WORK OF MESSRS. ERNEST SCOTT AND MOUNTAIN, LIMITED

IT would probably be impossible for such a firm as Messrs. Ernest Scott & Mountain to have had its origin and flourished in any other district than the Northumbrian and Durham coal area, unless, possibly, in South Wales. This is because this firm is an instance of specialisation upon a subject, and at a time which was bound to yield satisfactory results if the problems presented were dealt with in a sufficiently pioneering manner. As early as 1890 Mr. W. C. Mountain recognised that the application of electricity to collieries for the purpose of pumping, hauling, and coal-cutting had a considerable future, and in that year the firm secured its first mining contract, an electric pumping installation for the Cowpen Coal Co., at Blyth. At this time the firm was located at its old quarters, The Close, Newcastle, near to the new works of the Newcastle and District Lighting Co., Ltd., and when electrical work was first undertaken the firm employed only 50 to 60 men in the engineering department.

Orders for mining plant began to assume larger sizes. Underground haulage and coal-cutting were tackled in their earliest days by this enterprising firm. Their earliest coal-cutter, of the disc type, was supplied to Mr. G. A. Mitchell, of Glasgow, in 1893. They were also one of the first firms in this country to introduce three-phase colliery plant, the Tredegar Coal & Iron Co. being the earliest colliery fitted up in this way by the firm. Owing to this influx of work the firm had to migrate to larger works on the Gateshead site, and then purchased in 1904 the old works of Messrs. Black, Hawthorn & Co. Bearing in mind the special nature of Messrs. Scott & Mountain's business, it is interesting to note a few points concerning the arrangement and equipment of the works.

The plan of the works, which is shown in Fig. 1, indicates the general arrangement. Full-gauge rails run throughout the works as shown, connected with the North Eastern Railway siding. The disposition of the various shops is such that the work can be handled in a consecutive manner without undue carriage. Inspection of the arrangement of the various machines in the shop confirms this impression. For example, in the small machine shop the slotting and milling machines are all kept at one side of the bay. Down the centre, leaving an alley-way on each side, is a double row of high-speed light lathes for iron and steel works, while all brass turning, such as plungers for three-throw pumps, is kept to special lathes standing on the other side of the bay. Notice may also be taken of the fact that in the erecting shops the driving engines and the dynamos, pumps, or whatever else is to be driven, move forward in parallel lines to the test-bed, so that the complete job can be rendered and assembled in a natural manner. Views of several shops are given in the accompanying illustrations.

In going through the shops one notices several large tools which the engine-work of the firm necessitates. One of these is a forty-foot gap lathe suitable for either chuck or centre work, another being a planing machine to take work 20 ft. long by 6 ft. 6 in. high by 8 ft. wide, and a third a 20 ft. vertical lathe. A strong feature is made of vertical lathes and boring mills, enabling engine flywheels, end covers for centrifugal pumps, and similar work to be quickly negotiated. The factory is, however, well equipped with lighter tools for speeding up the rate of work in the shops. At the time of our visit we noticed a lathe attachment consisting of a motor-driven emery wheel engaged in truing up the core of a three-phase rotor; while special machines, both horizontal and vertical, are installed for slotting out shaft key-ways and making the necessary cut on commutator bars for the reception of connectors to the windings. In particular, a special machine by Dickinson & Keighley for milling key-ways should be mentioned for its quick and accurate action. In the erecting bay, besides the usual complement of wall drillers and a special face-plate built into the floor for building up large cores and commutators, very extensive use is made of compressed-air portable tools for chipping and drilling. In order to facilitate the moving of machine parts from one position to another, a crane of 5 tons' capacity serves the light machine shop, the erecting shop possessing three 15-ton overhead electric cranes; the electric and brass shop, in which the armatures, field magnets, small commutators, and other electrical details are made, has a 5-ton electric and a 2-ton hand crane; while the foundry has a 15-ton and a 5-ton electric crane in the main bay, together with an air-driven telfer in the brass foundry. A pressure of 100 volts direct current is maintained for the electric cranes, this being obtained by a belt-driven motor-generator operating from a 500-volt direct-current supply. In order to guard against the sudden fluctuations of load caused by the cranes, a compounding coil is placed on the dynamo field, while the motor is furnished with commutating poles. The air-compressor plant is driven electrically, about 40 h.p. being absorbed in supplying air at 80 lb. pressure for portable tools.

The testing department, which has already been mentioned, is very completely equipped for dealing with the large variety of mining machinery turned out by the firm. A speciality is, of course, the centrifugal pumps, with their attendant drive, either steam or electric. To

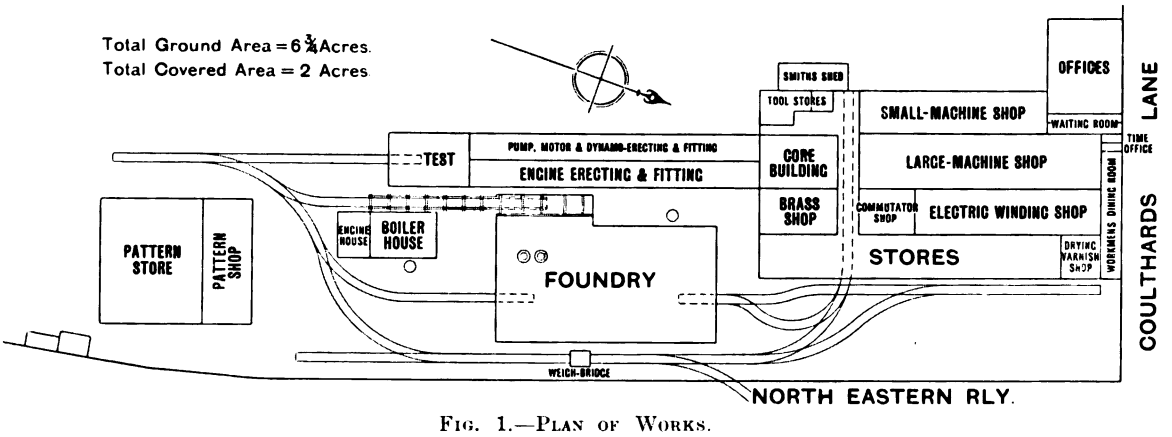

FIG. 1.—PLAN OF WORKS.

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test the output of these pumps a special tank is provided equipped with special calibrations and means for obtaining any virtual head of water on the pumps. Electric motors of the direct-current type are, if in duplicate, tested on the Hopkinson system, but otherwise they are connected to special dynamos, whose losses are known and whose output is absorbed in tanks. In addition to this, a motor of the three-bearing type giving an output of 250 effective h.p. is used for testing purposes, and for alternating colliery plant a motor is belt-geared to a special generator having a periodicity of fifty, this being the periodicity found by Messrs. Scott & Mountain to be usually adopted in colliery practice. This special set is necessary from the fact that the alternating current supply of the mains passing the works has 40 periods—a somewhat unusual frequency. Latterly a supply of three-phase current has been taken for testing purposes from the County of Durham Electrical Power Distribution Co., Ltd., who have built a static transformer sub-station on the premises equipped with two Westinghouse oil-cooled transformers of 500 kw. capacity operating at 6,000 volts, and having arrangements whereby pressures of 2,000, 3,000, 4,000, or 5,000 can be tapped off. The low-tension board carries one main panel equipped with ammeter and voltmeter, a Frahm frequency meter, relays for circuit-breaking on two out of three phases, and an oil-break main switch. From this four panels are arranged to feed as many different sections of the test-bed, although at present one section is found to be all that is necessary. Although the distribution side of the three-phase supply is under the control of the factory, the incoming side of the transformer house is kept strictly under lock and key, and is only accessible to officers of the Distribution Co. At the back of the board above described is a room set apart for the tanks or vats for load testing. These consist of the usual barrels with movable electrodes operated by ropes and counterweights, having a capacity of 200 amperes at 500 volts. A larger set of tanks is capable of taking loads up to 600 amperes.

The works were originally laid down before the three-phase supply was available; a large amount of direct-current power at 500 volts is therefore taken from the Gateshead station of the County of Durham Electrical Power Distribution Co., Ltd., for lighting and power. This is principally carried through the works in insulated cables mounted on porcelain insulators, and feeds motors of 10 to 50 h.p. through starting switches of either the metallic or liquid type. The latter variety is a speciality of the firm, being much used by them in colliery practice. Group-driving of the machines is resorted to in most instances, the third wire being very rarely used except for lighting purposes, so that there are no balancing difficulties. The number of motors installed for shop purposes totals 42, their aggregate horse-power being 400, including an air-blast motor for a Roots blower in the foundry. Besides 72 arc lamps, each of 1,000 nominal candle-power for general shop lighting, there is a large quantity of incandescent local lighting on special tools and in the offices. A small boiler plant is maintained for the purpose of steam testing, but the works, as a whole, present a fine example of electric drive.

Fig. 2.—Views of Various Shops in the Works of Messrs. Ernest Scott & Mountain.

Owing to the engineering strike, which was in progress during our visit, the full capacity of the works could not be gauged. We noticed, however, some very interesting examples which serve as an indication of the class of business which the firm is handling. In the electrical shop were the component parts of a complete line of interpole motors which Messrs. Scott & Mountain are now manufacturing. In the small turning shops pedestals for three-throw pumps were being machined for stock. Girder-type pumps of a particularly light and rigid character were being assembled for lifts up to 800 ft., variable demand; while vertical three-stage centrifugals for high lifts and constant demands were also being made. An interesting example was a vertical sinking pump equipped with a three-phase squirrel-cage motor, which was just being finished for the Hamsterley Coal Company. There were various haulage gears in the course of construction arranged for rope drive, as, for example, a large machine which had been recently supplied to the Birtley

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Iron Co. Engine work was also in progress, a speciality being made of central-valve compound engines, a small vertical high-speed engine for the Olympia Exhibition in London being on the test-bed at the time of our visit. On the electrical side, besides a certain amount of repair work, a 600-volt three-phase generator for Newbegin Colliery was nearing completion, while hand-winding was proceeding in a 2,500-volt 50-cycle three-phase generator for the Coltness Iron Co., measuring 160 in. by 12 in. over the core. An interesting piece of work was a special starting switch for operating a 350 h.p. 500-volt direct-current motor installed for haulage purposes at the Birtley Collieries at any required slow speed for any length of time. Some views of the works are shown in Fig. 2.

The present state of the works of Messrs. Ernest Scott & Mountain affords a valuable comment on the alleged desperation of manufacturers at the prolongation of the engineering strike. To judge from the healthy appearance of operations at this factory, disorganisation appears to be limited to the ranks of the man who will not work.

ELECTRICAL SCIENCE

British and American

Radium Emanation.—The amount of radium emanation which can be obtained from one gram of radium in equilibrium can be calculated when the rate of production of emanation per second and the radioactive constant of the emanation are known. The number of α particles expelled per second from a gram of radium has been accurately determined, and, assuming that the expulsion of a single α particle corresponds to the disintegration of a molecule of radium with the formation of a molecule of emanation, the rate at which the latter is produced is easily determined. The result is that a gram of radium in equilibrium contains 0·57 c.mm. of emanation. Ramsay and Soddy, and later Ramsay and Cameron, measured directly the volume of the emanation, and concluded that it was about 7·07 c.mm., which is of quite a different order from the calculated volume. If these experimental values are correct, they would indicate that much of the radioactive data and of the theory on which the calculations are based is seriously in error. E. Rutherford, using a preparation of radium containing about 250 milligrams of radium, has carried out an elaborate series of experiments in order to purify the emanation and to determine its volume. Some of these experiments are described in the *Phil. Mag.* for August. Two methods were used to obtain the emanation – one by heating the radium salt, the other by dissolving it in water and evaporating. The emanation was purified by condensing it with liquid air, when gases such as hydrogen, oxygen, and helium, which are not liquefied, could be removed. The greatest difficulty was experienced in getting rid of CO_2; it was found necessary to allow the emanation, after purification from other gases, to remain for many hours in contact with caustic potash. The purity was tested by the spectroscope, and the volume measured in a capillary tube 0·58 mm. diameter. When the emanation is first collected in the capillary tube its volume gradually diminishes; thus in one experiment it decreased from 1·05 c.mm. to 0·58 c.mm. The reason for this contraction is not known. Taking the contracted volumes in each case, the mean of three experiments gives 0·61 c.mm. per gram of radium, a number which is in reasonable agreement with the calculated volume. Rutherford concludes that the emanation used by Ramsay and Cameron could not have been pure.

Continental

Pure Iron.—H. Kreusler has gone to considerable trouble to obtain really pure iron, and he describes some interesting results in the *Verhandlungen*, No. 9, of the German Physical Society. He precipitated iron oxalate from iron-ammonium sulphate. The oxalate was ignited, and the resulting oxide reduced by pure hydrogen. The spongy iron was dissolved in hydrochloric acid, again precipitated with oxalic acid, and the process repeated. Great difficulty was experienced in getting rid of sulphur. He finally succeeded by forming an arc between electrodes of purified iron and letting drops of iron fall into mercury. The iron thus treated looks exactly like platinum. It is exceedingly ductile and malleable, is not attacked by hydrochloric acid, but rapidly dissolved in nitric acid. Compared with the best dynamo sheet iron, it shows a much greater hysteresis. This proves that hysteresis is not mainly due to impurities in the iron, as has been sometimes supposed. As regards conductivity, it is markedly superior to any yet found in iron. Lorenz's highest value is 9·685 at 0°. The author's is 10·61. The author enclosed wires of the pure iron in glow lamps and heated them to a yellow glow. They did not give off perceptible amounts of gas. Contrary to the behaviour of ordinary iron, the resistance was not affected by the treatment.

Electrocapillarity.—In the course of an elaborate research, described in an essay covering over a hundred pages of the *Annales de Chimie et de Physique* for August, G. Reboul deals with the electric phenomena at the surface of a metal immersed in a gas. There is, he says, an electrified double layer at the surface of a metal in a gas, just as in a liquid, and electrocapillary and thermoelectric phenomena exist equally in both cases. In Lippmann's capillary voltmeter, the liquid may be replaced by an ionised gas. Even the water-dropping electrometer may be replaced by an instrument in which an ionised gas escapes from a metallic orifice. The emission of ions by metals is, as already known, greatly influenced by the temperature. The author gives a fascinating theory of these actions. The double layer is the result of a dynamic equilibrium between positive ions, electrons, and neutral charges, which is governed by the law of Guldberg and Waage. Any modification of this equilibrium leads to the emission or absorption of ions of either sign. The author works out a formula for the emission of negative ions which is in accordance with Richardson's observations at low pressures.

Monotelephonic Circuits.—E. Mercadier, who proved some time ago that by means of electric tuning forks and suitably tuned telephones half a dozen simultaneous messages could be sent over the same wire, reports an extension of this system in the *Comptes Rendus* for August 10th. It is now possible to transmit messages from Paris to Marseilles from a dozen instruments over the same wire, and to record them at the other end by as many Morse or Hughes recorders. The system is particularly elegant. A small lever presses lightly against the tuned telephone disc. When the disc vibrates, the lever is repelled, and does not resume lasting contact until the vibration has ceased. If the lever works a direct-current relay, the alternate current transmitted is practically converted into a direct current suitable for a Morse recorder. The energy consumed is surprisingly small, and six accumulators suffice for working the whole apparatus, the line resistance being 1 ohm per kilometre.

Degradation of Copper.—Madame Curie and Miss Gleditsch, in the *Comptes Rendus* for August 10th, announced their having failed to confirm the conversion of copper into lithium under radium emanation, announced by Ramsay and Cameron.

The Journal.—The August issue of the Journal of the Institution of Electrical Engineers (No. 191, vol. 41) contains the following papers and discussions thereon:—"New Alternate-current Instruments," by Dr. W. E. Sumpner and J. W. Record; "High-speed Electrical Machinery," by G. Stoney and A. H. Law; "Electricity Supply Prospects as Affected by Metallic Filament Lamps and Electric Heating," by H. W. Handcock and A. H. Dykes; "Electrolytic Corrosion," by Prof. W. W. H. Gee; "Heating of Ventilated and Enclosed Motors," by W. Hartnell. Professor Silvanus P. Thompson's "Kelvin" lecture on the life and work of Lord Kelvin is included, and also a Paper by W. F. Long on electric street lighting, read before the Cape Town Local Section. The number concludes with the following original communications:—"On the Measurement of Large Inductances containing Iron," by Sir Oliver Lodge and Mr. B. Davies; "Magnetic Reluctance of Joints in Transformer Iron," by Dr. H. Bohle.

Electricity Supply in Naples.—An article in the *Atti della Assoc. Elettrot. Italiana* describes a scheme for supplying cheap electric power to Naples. There are at present three companies supplying power, with a total plant capacity of 20,000 h.p., and the price is about 1·0d. per h.p. hour. It is proposed to utilise the water-power of the Volturno at a point some 90 km. distant from Naples, where over 60,000 h.p. is available. The water will be carried along a canal 2,400 metres long, to a reservoir from which it will be delivered to the station through a pipe-line consisting of three steel pipes, each 1·3 m. in diameter and 1,200 m. long. In the station there will be seven turbine units of 2,000 kva. capacity each, running at 375 r.p.m., and generating 50-cycle three-phase current at 2,000 volts. The pressure will be transformed up to 45,000 volts for transmission. Steel poles will be used for the transmission line, which will be composed of six conductors of 55 sq. mm. section each. At the main sub-station in Naples the pressure will be transformed down to 6,000 volts. Two 1,600 kw. steam units will also be situated in this station as a reserve. The smaller sub-stations will transform down from 6,000 volts to the 260 volts distribution pressure. It is thought that the charge for power will be about 0·3d. per h.p. hour. The total cost of the whole installation, including the transmission line and the main sub-station, works out at about £28 per h.p.

The British Association.—The following Papers of electrical interest are now announced as down for reading before Section A of the forthcoming meeting of the British Association at Dublin:—"Secondary Radiation," by J. G. A. Hemsalach; "Do the Radioactive Gases (emanations) belong to the Argon Series," by Sir William Ramsay; "Discharge from the Wehnelt Cathode," by Dr. F. Horton.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5% *	10¼—10¾ xd	-¼
Do. 4½% Cum. Pref.	10	4½	4½%	9⅜—10 xd	-⅛
Do. 6% Cum. Second Pref.	10	6	6%	10⅛—10⅜ xd	-¼
Do. 4½% Debenture, Red.	Stock	4½	4½%	100—103	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	—	4⅛—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co., Ld.	5	10	5%*	6¾—7¼ xd	-¼
Do. 7% Cum. Pref.	5	7	7%	6¾—7½ xd	-¼
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	+1
Ch. Cross. W. E. & City E. S. Co.	5	5	2½%*	3⅛—4 xd	
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½ xd	
Do. 4% Deb. Red	Stock	4	4%	94½—97½	+½
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3—4	
Chelsea Electric Supply Co., Ltd.	5	4½	—	3—3½	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	5/-*	9¼—10½ xd	
Do. 6% Cum. Pref.	10	6	6%	11½—12½ xd	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ld.	10	5	—	7⅜—8½	+¼
Do. 6% Cum. Pref.	10	6	6%	10¼—10¾	
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	98—101	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	58—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	+1
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L. Co.	5	10	4%*	7⅞—8¾ xd	-¼
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	2½	2/6	⅜—1⅝	
Do. 6% Pref.	5		6	4½—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅜—5¼	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5	+⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	6	2/6*	5¼—5⅝	
Do. £2 Paid	5	8	4·85d. *	3¼—3⅜	+1
Do. 5% Pref. (fully paid)	5	5	2/6	5¼—5⅝	+⅛
Do. £2 Paid	5	5	4·85d.	3—3⅛	+1¼
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	12—13	
Oxford Electric Co., Ltd.	5	7	2/6	5⅝—6¼ xd	-⅛
Do. 4% Deb. Red.	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5/-	7—8 xd	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼ xd	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	—	1—1¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	—	¼—1½	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5/-	7⅛—8½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	91—93	
Central London	Stock	3	3½*	68—70 xd	-1
Do. 4% Preferred	Stock	4	4%	85—87 xd	-2
Do. Deferred	Stock	2	—	51—54 xd	-1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	82—84	
City and South London Cons.	Stock	4½	1½%	32—33	-½
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	7/6	7—7½	-¼
Do. 4% Perp. Deb.	Stock	4	4%	91—93	+1
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	¼	—	35½—36½	+½
Do. 3½% Preference	Stock	3½	3½%	84—87 xd	-2
Do. 3½% "A" Pref.	Stock	3½	3½%	74—77 xd	-2
Do. 3½% Convertible Pref.	Stock	3½	3½%	70—73	-3
Metropolitan District	Stock	—	—	11—12	-½
Do. 6% Perp. Deb.	Stock	6	6%	113—118	
Do. 4% Deb.	Stock	4	4%	71—76	
Do. Perp. Extension Pref. (5%)	Stock	—	—	21—26	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	46—50	+1
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	—	3—4	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅜—⅝	
Do. 4½% Deb. Red.	Stock	4½	—	86—91	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅜—1⅝ *	-⅛
Do. 6% Cum. Pref.	10	6	3/-	4—4½ xd	-½
Do. 5% Perp. Deb.	Stock	5	5%	95—98	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	6/-	12—13	
Do. 6% Pref.	10	6	6/-	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3¼—3⅝	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Street Tramways Co.	4	4/6	2/-	⅞—1⅛	
London United Trs., Ld., Cm. Pf.	10	5	—	6¼—7¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	79—84	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	¼—⅜ xd	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—½	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅜—½	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—½	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	6d.	⅜—½ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	93—96	
Provincial Tramways Co. Ltd.	10	4	3/-*	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	7½d	¾—1	
Do. 4% Deb. Red	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	76—81	+1
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	3⅛—3⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	15/-*	58—61	+1
Do. 6% Pref. Ord.	Stock	6	30/-	103½—104½	+1
Do. Def. Ord.	Stock	1	—	16¼—16¾	+⅜
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	84—87	+1
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3¼	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4¼	1/-*	13¼—13¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	99—101	+1
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99—102	
Do. do. (Mauritius Sub.)	25	4	—	100—102	
Eastern Ext. Australasia & China	10	7	2/6*	12⅜—13½	+¼
Do. 4% Mort. Deb. Perp.	Stock	4	4%	99½—101¼	
Eastern Telegraph Co.	Stock	7	1½%*	134—137	
Do. 3½% Pref.	Stock	3½	3½%	84—86	+½
Do. 4% Mort. Deb.	Stock	4	4%	101½—103½	+½
G. N. Tel. Co. (Copenhagen)	10	20	5/-	27—29	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	106½—108½	+½
Do. Deferred	Stock	6	6%*	118—120	+2½
Do. 6% Cum. 1st Pref.	10	6	6%	10—12	
Do. 6% Cum. 2nd Pref.	10	6	6%	10—12	
Do. 5% 3rd Pref.	5	5	2/6	5⅛—5¾	
Do. 3½% Deb. Red	Stock	3½	3½%	98½—100½	+½
Do. 4% Deb. Red.	Stock	4	4%	102½—104½	
Western Telegraph Co., Ltd.	10	7	3/-*	13⅜—14¼	
Do. 4% Deb.	Stock	4	4%	100—102	+½
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	1 2½d.	1/4½d.	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	—	3½—3⅝	
Do. 6% Pref.	1	6	—	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	3/-	6¼—6¾	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	102—105	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—⅞	-⅛
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	-⅛
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	-3
Callender's Cable and Const. Co., Ld.	5	15	—	9¼—10⅜	+¼
Do. 5% Cum. Pref.	5	5	5%	5½—5⅞	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—108	+1
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	3/-	1½—1¾	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	90—93	
Dick, Kerr & Co., Ltd.	1	10	—	1½—1⅝	
Do. 6% Cum. Pref.	1	6	6%	1—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A," £3 paid	5	2/6	—	⅜—⅝	
Do. do. (fully paid)	5	4/2	—	1½—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	⅝—⅞	+⅛
Do. 7% Cum. Pref.	2	—	2/9⅞	1⅜—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	66—71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	84—87	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	—	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	5/-*	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98½—100½	
Tel. Const. & Maintenance Co.	12	17½	12/-*	31½—33½	+½
Do. 4% Deb. Bds. Red	100	4	4%	100—102	
Willans & Robinson, Ord. Shres	1	5	—	¾—1¼	
Do. 6% Cum. Pref.	5	6	6%	2½—3	-½
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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LOCAL NOTES

ABERDEEN: *System of Charging.*—A sub-committee has been appointed by the Electricity Committee to consider and report as to whether a system of charging other than the present should be adopted.

AMBLE: *Electric Lighting Scheme.*—A scheme has been proposed for the construction of a suction-gas-driven generating station, and it has been agreed that the council form themselves into a committee to go into the subject fully.

BARNES: *Electricity Supply.*—The District Council is to extend distributing cables at a cost estimated at £90, and G. Smith & Sons are to wire fifty houses. Another extension of mains is to be made at a cost estimated at £55 in order to enable 20 houses to be wired, the application having been made in this case by Hunt & Son. To more effectively check coal consumption, the Electrical Engineer is to instal a Lea recorder for accurately measuring the whole of the water evaporated. The estimated cost of the apparatus is 60 guineas. The Law and Parliamentary Committee of the Council has postponed the question of proceeding further with opposition to the Electric Supply Bills (against which petitions were presented).

BATLEY: *Electricity Accounts.*—The net profit for the year ended March 31st on the Corporation Electricity Department has been £121.

BELFAST: *New Tramway Extension.*—Lieut. Col. Druitt held a Board of Trade inspection of the new Queen's Road tramway extension, which has been built to facilitate access to the shipbuilding yards, by the Harbour Commissioners, at a cost of £17,233. The Corporation has agreed to work the lines for a term of 21 years at a rental of 3¾ per cent. of the cost of construction, and will also maintain the lines. The contractors for the lines were Messrs. Dick, Kerr & Co., and operations were commenced on March 31st last, and completed on July 22nd, notwithstanding the large number of crossings necessitated by the frequent intersection of the route with the railway lines, and six swing bridges required to permit the passage of boilers and other heavy machinery. The line has been opened for traffic.

Tramway Accounts.—The total revenue for the year ended March 31st, 1908, amounted to £193,813, and the total number of passengers carried during the year was 45,233,122, which is 130 times the population of Belfast. The total car miles run during the year amounted to 5,808,901. The total working expenses were £119,823, or 62 per cent. of the gross revenue. The traffic expenses worked out to 2·46d. per car mile, this, with the addition of 1·05d. for general repairs and maintenance, 0·37d. for power, and 0·56d. for management and other expenses, gives a total of 4·94d. for working expenses, which compares very favourably with any Corporation tramway system. The gross trading profit thus amounted to £73,990, which, after the payment of interest, sinking fund, income tax, and an annual contribution of £8,962 to the general purposes fund of the Corporation, left a final surplus of £4,306, which will go towards wiping off the balance of the debit of the net revenue account. Two fatal accidents are reported during the year, but in neither case could the driver avoid anything which had occurred. The average number of units used per car mile was 1·25. The average traffic revenue per care mile was 7·84d. and the average fare paid per passenger was 0·99d.

BENWELL (NEWCASTLE): *Electricity Supply Schemes.*—A public meeting was held last Thursday at Newcastle to consider the desirability of a supply of electricity being provided for the districts of Benwell and Fenham. It appears that a provisional order was obtained by the Benwell and Fenham District Council in 1901, and in 1904 an arrangement was made with the Newcastle District Electric Lighting Co., but this was not carried out owing to the incorporation of the district into the city. An agreement was then made with the Corporation, who applied for a loan to cover the cost of mains, &c., but this was not granted. The following resolution was carried :—"That this meeting of residents of Benwell and Fenham calls upon the Corporation to assure the district that an efficient electric light service will be provided without further delay, and that a deputation be appointed to urge the Corporation to allow the electric lighting company to do so until a satisfactory solution of the matter can be arrived at.

BLACKBURN: *Electricity Accounts.*—Blackburn's Borough Treasurer issued his annual report on Friday last. The electricity account revealed an expenditure of £17,743. Generation absorbed £9,274; repairs and maintenance, £2,922; lamps, carbons, and fittings, £1,497; rates and taxes, £2,611; and management expenses, £1,438. The income was £34,761, giving a gross balance of £17,018, of which interest and sinking fund absorbed £15,574, leaving a net profit of £1,444 for reserve fund account. Sale of current produced £32,012, rentals of motors and lamps £1,204, and sales of lamps and fittings £1,544. The total expenditure on the electricity works up to date was £261,780, and the debt £200,540. The electric tramways involved an outlay of £38,197, of which traffic expenses were £14,106, general expenses £3,200, repairs and maintenance £9,087, and power expenses £11,804. The income reached £59,822, or a gross balance of £21,625, of which interest and sinking fund accounted for £20,820, leaving a profit on the year's working of £804, carried to the reserve account. The capital expenditure on tramways was £325,527, and the debt stood at £226,405. Passengers' fares were £57,566, and receipts from parcels, advertising, and rents amounted to £2,256.

BLAIR-ATHOLL: *Electricity Lighting.*—The village is now electrically lighted from a water-power station which the Duke of Atholl has established for the lighting of Blair Castle.

BO'NESS: *Extensions.*—A reply has been received from the Secretary for Scotland to the application for a loan of £7,000 to defray the cost of new machinery and plant, but disapproval is expressed with regard to the proposal to avoid the formation of a reserve fund.

BRIERFIELD: *Supply to New School.*—The Council decided on August 13th that the application of the Education Committee for a supply of electricity to the new school be granted, subject to an agreement being entered into regarding a minimum supply covering a period of five years.

BRIGHTON: *Charges for Electricity for Districts Outside the Borough.*—Some readjustment has been decided upon of the charges for electricity within the parishes of Preston Rural and Patcham. A flat rate of 4½d. per unit will be charged for the lighting, and 2d. for power, with 2s. 6d. per quarter rental for meters. It will be remembered that the price in Brighton is now 4d., as the maximum demand system of 7d. and 1d. has been discontinued for some time.

BURTON-ON-TRENT: *Reduction of Tariff.*—The Gas and Electricity Committee have just decided to reduce the charge for current for outside arc lighting from 5d. to 4d. per unit. This reduction applies only to arc lamps which overhang the public footway, and are on the exterior of the building when closed, and the only stipulation is that the wiring which supplies the arc lamps shall be continued to the Corporation's cut-out, so that a meter may be fixed there, which will be done free of charge and meter rent. This reduction has been conceded because the use of arc lamps, particularly flame arc lamps, assists in the illumination of the streets, and generally benefits the town. These lamps also prove a very good advertisement for the Electricity Department.

CHALFONT ST. PETER: *Public Lighting.*—The Parish Council, which is considering the best method of lighting for the village, has asked the Uxbridge Gas Co. and the Uxbridge Electrical Co., and the Gerrards Cross & District Electrical Co., to give estimates of the cost of fixing lamps (the number of which is to be decided by a Council sub-committee), and all necessary fittings. At a meeting of the Parish Council, Mr. Price, of the Uxbridge Gas Co., advised brackets fixed on walls for the lights, rather than standards. It would be possible to turn the lamps on or off without employing a lamplighter, but at the present stage the cost would be £1 10s. extra per lamp.

CRAYFORD: *Proposed Supply Scheme.*—A Committee of the Parish Council is to consider the question of lighting the parish by electricity. At the last meeting of the local authority Councillor Hopper said that after study of figures, he felt confident that the district could be lighted much better by electricity than by gas.

DEWSBURY: *Supply of Electricity to the Tramways.*—The National Electric Construction Co. has agreed to the price of 1¾d. per unit as the price to be paid to the Corporation for electricity to be used on the portion of the Dewsbury to Ossett tramways within the borough, and the Electrical Engineer has been instructed to make preparations for giving the supply.

DUBLIN: *Proposed Adoption of the Trackless Trolley System.*—A movement is on for the introduction of the new system of trackless electric tramways in Ireland, the first contemplated route being between Donnybrook, in the suburbs of Dublin, and the pretty seaside resort of Bray. The new system, it is said, can be worked inexpensively on the existing roads from power derived from the usual overhead wires. The project has been submitted to the manager of the Dublin United Tramways Co., and to the County Council.

DUNDEE: *Electrical Laboratories.*—The erection of the new Peters' Electrical Laboratory at University College, Dundee, is to be proceeded with at once. The building, which is to cost £2,792, will consist of a lower floor containing battery room, high-tension instruments room, and dynamo rooms, and an upper floor devoted to lecture rooms and photometric and other test rooms. The remainder of the £4,000, forming the bequest of the founders, will be expended upon equipment.

Theatre Lighting.—During the interval in which Her Majesty's Theatre has been closed, a complete electrical equipment has been installed. Not a single gas jet is now to be found behind the scenes. The work has been carried out by Her Majesty's Theatre's chief electrician, while Mr. Richardson, the Corporation Electrical Engineer, has also given his advice and assistance in the carrying out of the work.

EALING: *Dispute as to Supply.*—In reference to the case by the Corporation against the Empire Palace (Ealing) Ltd., and the London Theatres of Varieties, Ltd., for supplying current in bulk to a restaurant on the theatre premises occupied by Lipton's, Ltd., the defendants have entered an appeal against

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the decision of the justices, in view of the fact that they ordered payment of costs against the company, although they dismissed the information.

FARNHAM: *Electric Lighting Scheme.*—At a recent meeting of the Urban District Council a letter was read from Mr. Roumieu, of the Farnham Electric Lighting Co., containing plans and particulars of the company's scheme for the whole district, showing the positions of the poles and overhead wires proposed. After some discussion as to the possibility of placing the poles behind houses, the matter was referred to the Public Works Committee.

HAMPTON: *Tramways and Telephones.*—The following councils have been invited to attend a conference to take into consideration the present condition of the permanent way of the London United Tramways, and its method of construction, with the view to some united course of action being taken in order to obtain improvement :—The town councils of Ealing and Hammersmith, and the urban district councils of Twickenham, Chiswick, Acton, Brentford, Southall-Norwood, Teddington, Hampton Wick and Hounslow. A letter was received recently from the London United Tramways, Ltd., stating that they propose to continue the work of repairing the permanent way within the Hampton district upon which their workmen were engaged until everything needing attention should have been completed. The company also intimated an intention to apply a new type of silencer to certain spring points. The District Council has resolved that the attention of the Metropolitan Police Commissioner be again called to what they contend to be the unsatisfactory condition of a number of the cars of the London United Tramways, Ltd., whereby considerable noise and annoyance to residents along the route is caused. At the last meeting of the District Council the Clerk reported that he had also invited the urban district councils of Hampton Wick, Twickenham, Teddington, East Molesey, and Sunbury to attend a conference on the proposal of the Postmaster-General to extend the telephone system in the district, and for that purpose to construct overhead wires, with a view to uniformity of action on the part of the councils interested in the case of the present, and of any subsequent similar applications. Replies having been received from Twickenham, Teddington, and Sunbury, it was decided that the Postmaster-General be informed, in reply to his application for a general consent, that each case will be treated on its merits.

HASLINGDEN: *Electricity Supply.*—At a meeting of the Building Committee of the Haslingden Board of Guardians on August 13th, a communication was read from the Rawtenstall Corporation declining to supply electricity at the rate of 3d per unit as the Board had agreed. A letter had been received from the electric advisers of the Board, and it was decided to ask them to meet the committee in a fortnight.

Tramways.—The Haslingden tramway tangle now bears a different complexion. A close scrutiny of the clause causing the difficulty shows that it explicitly permits the provision of mechanical power, including electric and other plant, for the working of the tramways, but states that nothing in it shall empower the construction of a generating station. The two things are contradictory. The Corporation, it is stated, are appealing to the Board of Trade, and if this authority will rule that the Corporation may take the complexion that it is only a generating station as a building that the Act does not sanction, the difficulty will be simplified, for the cost of the building will be small compared with that of the plant.

HYDE (CHESHIRE): *Electricity in Textile Mills.*—Messrs. Ashton Bros., Ltd., of the Carrfield Mills, Hyde, Cheshire, have just had coupled up several large electric motors for driving machinery in the weaving, winding, warping, and slashing departments. Not a single hour was lost by the operatives during the change over from steam driving.

HYTHE: *Proposed Tramways.*—At a recent meeting of the Town Council it was reported that the General Purposes Committee had interviewed Mr. Cownie, of the National Electric Construction Co., who had informed them that his company had decided not to adopt the Dolter surface-contact system for the tramways when laid. He proposed, therefore, the substitution of the overhead system, and also some modifications of the route, in order to save expense, as the company were not prepared to find the capital required for the original scheme. They recommended the acceptance of these recommendations, but after considerable discussion it was decided to defer the matter until a poll of the ratepayers had been taken.

LLANDILO: *Light Railway.*—The Board of Trade have confirmed the Llandilo and Lampeter Light Railway Order, 1908, authorising the construction of a light railway in the counties of Carmarthen and of Cardigan, from Llandilo to Lampeter.

LONDON: *St. Pancras.*—In connection with the proposed construction by the London County Council of a tramway on the conduit system through Crowndale Road, from High Street, Camden Town, to Pancras Road, the suggestion is made that a bridge should be constructed over the Metropolitan Railway Station at King's Cross, but the Islington and St. Pancras Borough Councils decline to make any contribution towards this project, contending that the entire cost should be borne by the general tramway account.

LOWESTOFT: *Free Wiring.*—The Electric Lighting Committee have resolved that a clause shall be inserted in all free wiring agreements providing for a minimum payment.

The Borough Electrical Engineer has been directed to submit a plan showing the suggested lighting by electricity of 14 streets, with the price per lamp, and the cost of lighting each street. At the last meeting of the Town Council it was reported that the cost per lamp would not exceed the present cost per lamp for incandescent gas.

MIDDLESEX: *Tramways.*—Progress is being made with the track construction of the Friern Barnet Road and Woodhouse Road section of the Middlesex County Council's tramways, which will link up Southgate and Barnet, and contracts, amounting to £157,198, have been entered into for lines through Hendon and Finchley, linking up the Edgware and Barnet systems and from Southgate to Enfield.

NELSON: *Electricity Accounts.*—In his annual abstract of accounts this week, the Borough Treasurer of Nelson stated that the electricity department made a profit of £3,023, equal to 4·10 per cent.; the electric tramways £788 (7·08 per cent.), and the light railways £843 (2·36 per cent.).

OLDHAM: *Interruption of Supply.* At a meeting last week of the Electricity Committee, it was reported that the recent interruption of supply to the tramways was due to steam having got low, owing to the carelessness of two stokers, who had let their fires get dirty.

PORTSMOUTH: *Electricity Accounts.*—The accounts for the year ended March 31st last show a total expenditure of £26,639, made up as follows :—Generation, £17,574; distribution, £2,054; public lamps, £1,931; rents, rates, taxes, management, special charges, &c., £5,080. The total receipts were £48,312. Of the balance of £21,733, interest, sinking fund, &c., absorbed £18,248, £1,000 was transferred to insurance fund, and £150 was contributed towards capital outlay; £2,000 was voted in aid of rates, and £335 was carried to reserve. The amount contributed to the rates last year was £3,500, with £5,991 carried to reserve. The total units sold amounted to 3,294,040, including 648,791 for public lamps, so that the total cost per unit sold, not including capital charges, works out at 1·895d., or, with the inclusion of capital charges and contributions to reserve, at 2·64d. The maximum supply demanded was 2,680 kw., which gives an average load factor of 12·8 per cent.

RHONDDA VALLEY: *Proposed Lease of Tramways.*—It is announced in the *London Gazette* that it is proposed to lease the tramway undertaking of the Rhondda Urban District Council to the Rhondda Tramways Co., Ltd., with the consent of the Board of Trade, for a period of 42 years, at a yearly rental of £2,250.

ROSARIO (Argentine): *Tramways.*—According to a consular report, the electric tramway service, which is in the hands of a Belgian company, is nearing completion, and several sections have been inaugurated during the year. Suburban property has consequently risen in value. The extent of track when completed will be 75 miles, and the total cost over £750,000.

TAUNTON: *Tramways.*—The agreements between the Taunton Traction Co., the British Electric Traction Co., and the Corporation, which are due to expire very shortly, are to be renewed with modified conditions, including the construction of the Rowbarton extension, and the opening of the same for public traffic as early as might conveniently be done, and not later than six months from the present date.

TORQUAY: *Charges for Power.*—The Electrical Engineer has recommended that the following charges be made to consumers whose demand is continuous for at least eight hours per day on an average; for the first 200 units per annum 2d. per unit, and the next 100 units 1½d. per unit, and for all consumed above this amount 1½d. per unit.

Tramways.—A visit has been paid to Torquay by a deputation of engineers from Paris, who are studying various tramway systems with a view to arriving at greater uniformity in the Paris tramways. A full inspection was made of the Dolter surface-contact system, which is in use at Torquay.

TOULON (FRANCE): *Cessation of Supply.*—In consequence of the lighting company having been unable to obtain payment of an account from the municipal authorities, the supply was entirely cut off on Friday. As a means of putting an end to this state of affairs, the municipal authorities are considering the question of floating a loan to enable them to pay the company.

WAKEFIELD: *Reduction of Tariff.*—The charge for electricity used for domestic purposes other than lighting is to be reduced to 1d. per unit.

Telegraph Traffic.—The past week has again been a very quiet one, for not only have there been no interruptions of telegraphic communication to report, but also no repairs, with the exception of the lines of the Indo-European Telegraph Co., which were again restored to working order on the 13th inst. The cable between Cadiz and Teneriffe, which is rather unfortunate in its experiences, is in part being diverted from its present bed, and in consequence is not in a good working condition. The Tarifa-Tangier, Assab-Massouah; Kwandang-Menado, Djedda-Souakim, Sierra Leone-Accra, Las Palmas-Arecife, and Pera-Dardanelles cables are still interrupted. One hundred and seventy-five knots of new cables have recently been landed in the island of Hayti, West Indies.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRIA-HUNGARY.—According to the *Hungarian Official Gazette* of July 30th, tenders are invited up to 10 a.m. on September 3rd by the Municipality of Nagy-Kanizsa for the installation of electric plant for the lighting of that town. The contract is to be: (1) For the erection of the necessary buildings; (2) for the mechanical fitting up of the electric plant; (3) for the necessary supply of water-power; (4) for the electrical installation; (5) for the necessary materials for secondary installation (*secundärinstallaczión*). Plans, conditions of tender, &c., may be obtained on application at the office of the Town Engineer (Varosi Hernoki Livatal, Nagy-Kanizsa), at a cost of 150 crowns (£6 5s.). A copy of the notice inviting tenders (in Magyar) may be seen by British contractors on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

BRIDGEND.—The Council has decided to apply a loan of £3,250 to the purchase of the South Wales Electrical Power Co.'s station at Bridgend, and works connected therewith. The cost of the station as it stands is £5,000, and the remaining £3,250 will be devoted to mains extensions, pumping plant, refuse destructors, and an hydraulic coal tip.

ITALY.—A report has been issued by the Italian Ministry of Agriculture, Industry, and Commerce on electrical installations authorised in Italy during 1907. The report may be seen by British firms interested on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

KINGSTON-ON-THAMES.—A Local Government Board inquiry was held on Tuesday into an application for a loan of £12,600 for the purposes of the Electricity Department.

SALFORD.—A Local Government Board inquiry was held last week into an application for a loan of £15,281 for the purposes of the electricity undertaking by Mr. F. H. Tulloch. The sum is made up as follows: £11,707 for water-cooling plant, £578 for expenditure on the turbo-generators at the works, and £3,000 for extensions to the Prestwich electric lighting system.

TONBRIDGE.—A Local Government Board inquiry was held last week into the Council's application for a loan amounting to £4,200 for extensions to the generating station. In the course of the inquiry the inspector suggested that the Board should not be pressed to sanction the cost of certain portions of the work, including boilers and accessories, which would not be required until next year, when the cost might be sanctioned without further inquiry.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Premises in Seven Sisters Road, for London and South-Western Bank. Muskett & Co., surveyors, 491 High Road, Tottenham.

S.E.—Police station, &c., at Greenwich (£23,220). J. Dixon Butler, surveyor, New Scotland Yard, S.W.; Patman & Fotheringham, builders, 100 Theobalds Road, W.C.

Thirteen houses, Lewisham. H. & G. Taylor, builders, Boyne Road, Lewisham.

Ten houses, Lewisham. W. J. Scudamore & Sons, builders, 13 Manor Lane, S.E.

Four houses, Lewisham. Jas. Watt, builder, Bromley Road, Catford, S.E.

Business premises, Perry Hill. J. W. Falkner & Sons, builders, 24 Ossory Road, Deptford, S.E.

Benedictine monastery and church at Dulwich. J. N. Cowper, architect, 35 Old Queen Street, S.W.

W.—Shops and flats, Henrietta Street and Wimpole Street. W. King & Son, builders, 3 Vauxhall Bridge Road, S.W.

Extension to 39 Duke Street, by W. Smith, shirt-maker, &c., 396 Oxford-street.

Re-erection, Nos. 13 and 14 Great Castle Street. H. Kingerlee & Sons, builders, Shepherd's Bush.

W.C.—Addition to Whitfield's Tabernacle, Tottenham Court Road. W. Downs, builder, Hampton Street, Walworth.

PROVINCES.

ABERDARE.—Baptist Sunday school (200 places). Architect, J. Llewellyn Smith, Central Chambers, High Street, Merthyr Tydfil.

ASHTON-UNDER-LYNE.—School (1,200 places). D. H. Wade, Secretary Education Committee.

BARNES.—Twenty-one villas, Fitzgerald Estate, and four villas, Mortlake. Architect, R. B. Rowell, Triangle Corner, East Sheen, S.W.

Alterations, Working Men's Institute. Architects, Bartlett & Ross, 8 Bream's Buildings, W.C.

Three houses, Mortlake. Builders, C. Ellis & Co., East Sheen.

BARNSLEY.—Alterations and additions to Liberal and Radical Club, Market Street.

BECKENHAM.—Iron art school (£2,000), and alterations (£1,100) to Technical Institute, for District Council. Surveyor, J. A. Angell.

BLACKPOOL.—Methodist Free Church, in Shaw Road.

BOLTON.—New premises in Bradshawgate, for National Provincial Bank of England.

BRISTOL.—Mission Church, Bedminster (£2,750). Builder, T. Weeks, 6 Beauley Road, Bedminster, Bristol.

BURY.—Extensions to offices, Town Council. Surveyor and Engineer, A. W. Bradley, Town Hall.

Alterations and additions to mill. Architect, A. J. Howcroft, 2 Waterloo Street, Oldham.

Alterations and additions to Grammar School. Architect, H. Nuttall, Bury.

Fourteen houses. Architect, Wm. E. Gill, 6 Fleet Street, Bury.

CARDIFF.—School (£12,000). Architects, Teather & Wilson, Andrew's Buildings, 67 Queen Street, Cardiff.

Additions to Secondary School (£3,500). Architects, James & Morgan, Charles Street Chambers, Cardiff. Builder, F. Bond, 49 Beda Road, Cardiff.

DARLINGTON.—Science class rooms. Architects, Clark & Moscrop, Feethams, Darlington.

United Methodist Chapel, Blackwell.

DUDLEY.—Training college (£10,800); also secondary school. J. M. Wynne, Secretary Education Committee.

FRIERN BARNET.—Development, Bethuen Estate. Architects, Bennett & Strutton, Broadway, Finchley.

FRIZINGHALL.—Wool warehouse. Architect, Abraham Sharp, Market Street, Bradford.

GRANTHAM.—Additions to Co-operative premises, St. Catherine's Road, for Grantham Co-operative Society.

HAVERFORDWEST.—Additions to workhouse. Architect, E. Thomas & Son, 17 Victoria Place, Haverfordwest.

KENDAL.—Business premises, motor garage, and workshops. Architect, John Hutton, Kendal.

LEEDS.—Corporation stores. Architects, Connen & Chorley, 16 Park Place, Leeds.

LEYTON.—Proposed increased installation of electric light by Frank Bearman, house furnisher, draper, &c., 859 High Road.

Shops, stores, and house for Stratford Co-operative Society, 54 Maryland Street, E.

Increased office accommodation (£8,500) for District Council. W. Dawson, surveyor, Town Hall.

Additions to factory. A. W. Hudson, architect, 87 Finsbury Pavement, E.C.

Additions to offices. W. Manders, builder, Leyton Green.

Alterations to beerhouse. W. G. Ingram, architect, 4 Verulam Buildings, Gray's Inn Road, W.C.

MERTHYR TYDFIL.—Twenty-two houses for Gellifaelog Building Club.

NETHERTON.—Additions to training school. Armstrong & Wright, architects, 38 Grainger Street West, Newcastle-on-Tyne.

NORTHAM APPLEDORE (DEVON).—School (£3,000). Percy Morris, architect, 1 Richmond Road, Exeter; A. W. Coles, builder, Plymouth.

PERTH.—Infirmary (£50,000). John Jas. Burnett, architect, 239 St. Vincent Street, Glasgow.

SHEFFIELD.—The sanction of the Local Government Board has been obtained for a loan of £1,500 for fitting electric light at the Lodgemoor Hospital.

SOUTH SHIELDS.—Fourteen houses. Architect, H. Grieves, 63 King Street, South Shields.

Two villas. Architect, J. H. Morton, 50 King Street, South Shields.

Additions (cellarage) to business premises. Architect, G. R. Smith, 67 King Street, South Shields.

SWINDON.—Additions to Borough Press Works, Eastcott Hill.

TOTTENHAM.—Dancing hall for Union Club, Ltd., 14 Bruce Grove.

Additions to workshop, Derby Road, for Atlas Metal and Alloys Co., Ltd., 52 Queen Victoria Street, E.C.

Nineteen houses. Builder, G. W. Rowley, 278 Philip Lane, N.

Forty-nine houses. Architects, Hodson & Whitehead, 7 Finsbury Square, E.C.

Factory in Fountayne Road, for Clark & Co., piano frame makers, Broad Lane Ironworks, Tottenham.

TWYNYRODYN.—Additions (£8,700) to school. Architect, J. Llewellyn Smith, Central Chambers, High Street, Merthyr Tydfil. Builder, A. J. Colbourne, Swindon.

WEMBLEY.—Four houses. Builder, W. Poulter, 59 St John's Road, Wembley.

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WEST BROMWICH.—Extensions of Wellington Tube Works, Blades Street.

YORK.—Eight semi-detached villas. Architect, J. C. Proctor, Cabinet Chambers, Basinghall Street, Leeds.

Miscellaneous

ANTWERP.—Tenders are invited by the municipal authorities of Antwerp for the supply and erection of four electric bollards on the quays of the Royers Lock at Antwerp. A deposit of 5,000 francs (about £200) will be required to qualify any tender. Tenders, enclosed in sealed, registered envelopes, should be addressed to Monsieur le Bourgmestre de la Ville d'Anvers, Hôtel de Ville, Antwerp, by whom they will be received not later than August 31st. The specification (*cahier des charges*) may be obtained from the Hôtel de Ville, at a cost of 0·50 franc. A copy may be consulted by British contractors on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

LONDON.—The Postmaster-General is inviting tenders for creosoting telegraph poles. Specifications from Mr. G. Morgan, controller of stores, Stores Department, General Post Office, 17-19 Bedford Street, and tenders by September 7th.

PERU.—The *Board of Trade Journal* reports that considerable extensions are in progress of telegraphs and telephones. In 1906 1,297 kiloms. were constructed, and 533 kiloms. in the first half of 1907. The lines to be constructed are from Locumba to Candarave and Ticaco.

TENDERS RECEIVED AND ACCEPTED

BLACKBURN.—The electrical fittings, &c., for the new Council school being erected in Accrington Road, Blackburn, by the local Education Committee, are being supplied and fixed by Mr. Thomas Barton, of the Electric Works, Blackburn.

GLASGOW.—Messrs. Mavor & Coulson have just completed the installation of a 100-h.p. motor at the saw-mills of Messrs. Anderson & Henderson. The motor was put in to replace steam plant which has broken down in order to save time, and there was only an interruption of two working days.

GRAVESEND.—The following tenders for arc lamps have been received :—The Brockie Pell Arc Lamp Co., £438 12s. 2d. and £554 2s. 2d.; Johnson & Phillips, Ltd., £534; Thomas L. Scott & Co., Ltd., £542 1s.; Oliver Arc Lamp Co., £551 17s.; the Gilbert Arc Lamp Co., £580 and £514; Warner Engineering Co., £600 15s.; Mackensie & Moncur, Ltd., £619; Crompton & Co., Ltd., £686. Owing, however, to all these tenders exceeding the engineer's estimate of £420, of which £100 was to be paid out of capital and the remainder, £320, out of revenue, it was decided to defer the matter for twelve months.

LOWESTOFT.—The following tenders have been received by the Electric Lighting Committee: Messrs. Parish & Durrant, street wiring work at a price of 7s. 6d. per point; Messrs. J. W. Brook & Co. for the supply of 50 new street lamp-posts at 33s. 6d. per post; Messrs. Melloine & Goulder (Ipswich) for the Bestwood nutty slack at 10s. 9d. per ton up to 1,500 tons; Messrs. E. Foster & Co. (London), 1,000 tons of Ibstock large steam coal at 14s. 5d. per ton; Messrs. Bradbury, 500 tons of cobbles at 14s. 11d. per ton. Consideration of further coal contracts will be made at a later date.

MIDDLESEX.—The tender of Messrs. Wimpey & Co., of Hammersmith, of £40,220, for the construction of 1½ miles of double track overhead tramways at Southgate, including some road widening.

ONTARIO.—The Government have awarded a contract to Mr. F. H. McGuigan for the construction of 293 miles of transmission lines from Niagara to St. Thomas and Toronto at a total price of £254,000. The contract includes the furnishing and erection of 3,176 steel towers and cables of aluminium wire, weighing 1,014,209 lb.

WAKEFIELD.—The tender of Messrs. Flower Bros. for boiler seatings at the electricity works at £110 has been accepted.

COMPANIES' MEETINGS AND REPORTS

A.-G. BROWN, BOVERI & CIE. (BADEN, SWITZERLAND).—The report for the year 1907-8 states that the works have been fully engaged during the year, and that the gross profits were considerably larger than in the previous year. The expenses, however, were also increased, and the net profit is not appreciably larger than that of last year. In September last year the capital of the company was increased from 16,000,000 to 20,000,000 francs by the issue of 3,200 new shares. The employees at Baden now number 3,090. The German firm at Mannheim has also been very busy during the year, and a dividend of 6 per cent. on the share capital of 6,000,000 marks has been declared. About 1,780 men are employed at these works. The capital of the Italian company, *Tecnomasio Italiano Brown, Boveri*, of Milan, which took over recently the business of Messrs. Gadda & Co., of Milan, has been increased to 6,000,000 lire. A dividend of 6 per cent. was declared for last year. The employees there number 1,020. The *Compagnie Electro-Mécanique, Paris-le-Bourget*, have also done well, a dividend of 8 per cent. having been declared. The London firm, *Brown, Boveri & Co., Ltd.*, shows increasing business, and the firm at Christiania has declared a dividend of 6 per cent., 1 per cent. higher than that of last year. The *Elektricitätsgesellschaft Baden* have reduced their dividend 5 per cent. on account of the heavy expenditure demanded by the new works on the Limmat. The accounts of the Baden company show a net profit of 2,351,445 francs, which enabled a dividend of 11 per cent. to be paid, as in the previous two years.

CHILIAN ELECTRIC TRAMWAY AND LIGHT CO.—The report for the year ended December 31st, 1907, states that the result of the company's operations for the past year, after deducting interest and redemption of debentures, London office and other charges, shows a balance of £14,160, from which must be deducted the balance to the debit of profit and loss account brought forward from the previous year, viz., £2,447, which leaves a balance available for distribution of £11,712. The sum of £10,000 has been transferred to renewals reserve account, leaving £1,712 to be carried forward The company has not so far been able to pay a dividend on the ordinary capital, and the preference dividends are still in arrear. All the preference shares, which amount to £650,000, are held by the Deutsche Uberseeische Elektricitäts-Gesellschaft of Berlin. The year under review has not been characterised by the untoward circumstances which so seriously affected the company's traffic in 1906, and consequently the tramway returns show a total of 61,451,234 pasengers carried, as against 50,998,903 carried for the previous year. The business of the electric lighting department shows a gratifying development on the figures of the previous year; the public continue to avail themselves both of the light and power in increasing ratio, and the profit for 1907 amounts to $470,928.81, against $510,448.89 for 1906. Unfortunately the continued depreciation of the Chilian currency has adversely affected the net profit resulting from the good receipts obtained in the tramway and electric lighting departments. At the meeting on Monday the report and accounts were adopted.

LOCH LEVEN WATER & ELECTRIC POWER CO.—At the half-yearly meeting last week Mr. J. D. Bonner, who presided, stated that the whole of the issued capital was held by the British Aluminium Co., who had agreed to subscribe for the balance authorised. They were thus in command of the funds necessary for the carrying out of the scheme. The progress at the works was so advanced that there was every indication that the production of aluminium at Loch Leven would commence some months earlier than had been anticipated. The report was adopted.

METROPOLITAN DISTRICT RAILWAY CO.—The half-yearly general meeting was held last week. In moving the adoption of the report and accounts, Sir George Gibb, who presided, said that the company was now in a much sounder financial position than it had been formerly. In referring to the projected issue of prior lien debenture stock, which had been approved and sanctioned, he said that it was not proposed to issue this until the holiday season was over. £550,000 would probably be issued in the autumn, but, from the point of view of liability for interest, this would practically replace the present temporary loans, which amounted to £478,195. The capital expenditure during the last half-year had been £59,499, and the estimated amount for the current six months was £75,000. This would be partly devoted to the development of surplus land, and to a number of improvements on the railway and the rolling stock, including the substitution of hand-worked doors for the pneumatic doors originally used, which were not popular with the public. During the period under review they had carried 29,500,000 passengers, an increase of 16½ per cent., and the receipts had advanced by £27,433, or 13½ per cent. over the corresponding half of 1907. The average receipts per passenger worked out at 1·86d. With regard to the extra traffic attributable to the Franco-British Exhibition, he did not think that the railway had benefited to any great extent directly—in fact, to some extent it had suffered from the diversion of traffic from the Hungarian Exhibition at Earl's Court. In his own opinion these special circumstances had not added more to the traffic than they were likely to get in future ordinary seasons. The net result of the half-year's working, after payment of debenture interest, was a deficiency of £8,951. When this was compared with the figure of £18,035 for the corresponding half of 1907, it would be seen that the position had increased by roughly £9,000. The deficiencies were getting every year smaller, and he hoped that before long they would disappear altogether. After some remarks from a shareholder, who complained of the inconvenience suffered by passengers residing on the Inner Circle caused by the excessive delays at Gloucester Road and South Kensington, with regard to which

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the chairman was unable, however, to promise any definite improvements, the report and accounts were adopted.

NORTH METROPOLITAN TRAMWAYS.—At the half-yearly meeting last week Mr. George Richardson referred to the sale of the Romford Road tramways to the East Ham Corporation, with the proceeds of which a return of 2s. per share was proposed. At a subsequent extraordinary meeting this reduction of capital was agreed to. It had been proposed at one time to put the company into liquidation in order to save an application to the Courts for this disboursement, but it was decided to wait until the outstanding debenture bonds fell due for repayment on January 1st next. These amount to £51,700, and the necessary funds are now at the bank.

WILLANS & ROBINSON.—At a meeting of debenture holders, held on Friday, Mr. Mark Robinson presiding, a resolution was passed authorising the directors to sell the company's leasehold interest in the Queensferry works, and to invest the sum realised in securities or in the purchase of plant, provided that not more than one-third of such proceeds of sale be applied in the purchase of plant.

COMPANY MORTGAGES

BOURNE END ELECTRIC INSTALLATION CO.—Particulars of £2,000 debentures, created by resolution of July 17th, 1908, have been filed. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees. All above debentures have been issued.

BRISBANE ELECTRIC TRAMWAYS INVESTMENT CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Section 14 of the Companies Act, 1900, has been filed pursuant to Section 12 of the Companies Act, 1907. Particulars—Trust deed, dated November 21st, 1900, securing £400,000 first debenture stock.

BUENOS AYRES GRAND NATIONAL TRAMWAYS CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—Trust deed dated May 11th, 1894, and sundry supplemental deeds, under which £148.300 is outstanding, and income debenture bonds dated March 30th, 1894, securing £74,523.

BUENOS AYRES NEW TRAMWAYS CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—Prior lien debentures dated July 28th, 1893, securing £50,000 and debentures dated October 24th, 1888, securing £250,000.

ELECTRICITY SUPPLY COMPANY FOR SPAIN.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Section 14 of the Companies Act, 1900, has been filed. Particulars—Two charges on realty in Spain and the company's other assets, dated 1892 and 1893, securing £75,000 First and £42,500 "B" debentures, of which £32,800 and £18,200 respectively are outstanding, and trust deed dated November 30th, 1898, securing £250,000 Consolidated Debentures, of which £121,200 are outstanding.

THE ELECTROMOBILE CO.—A memorandum of satisfaction in full of a mortgage dated July 19th, 1906, securing an indefinite amount, but stamped to cover £20,000, has been filed. A mortgage dated March 25th, 1908, to secure £12,000, has also been registered. Property charged: Interest under an agreement for lease of certain freehold hereditaments, and assignment of certain leasehold hereditaments in St. George's, Hanover Square, W., and the company's undertaking and property, present and future, including uncalled capital. Holders: North of England Trustee, Debenture and Assets Corporation, Ltd., 104 King Street, Manchester.

GLOUCESTER RAILWAY CARRIAGE AND WAGON CO.—Issue on July 22nd, 1908, of £2,800 debentures, part of a series of which particulars have already been filed.

W. T. GLOVER & CO.—Deed of exchange, dated July 23rd, 1908 (supplemental to indenture, dated October 14th, 1901, and to trust deeds, dated July 26th, 1899, securing £100,000 first mortgage debenture stock, and September 29th, 1906, securing £100,000 second debenture stock, of which only £80,000 has been issued), has been registered.

LA CAPITAL TRAMWAYS COMPANY.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Section 14 of the Companies' Act, 1900, has been filed. Particulars—First and Second Mortgage Debentures, dated November 23rd, 1896, and November 25th, 1896, securing £110,600, and £142,100 respectively.

LA CAPITAL (EXTENSIONS) TRAMWAYS CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—Mortgages or charges dated February 10th, 1898, and October 1st, 1899; mortgage debentures securing £108,700 and £1,000 car trust debentures respectively.

MOUNTAIN & GIBSON.—Particulars of £30,000 debentures created by resolution of July 17th, 1908, have been filed pursuant to section 10 (3) of the Companies Act, 1907. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees. Amount of present issue, £20,000.

NORFOLK ELECTRICAL CO. (BIRMINGHAM).—Particulars of £1,000 debentures created by resolution of June 13th, 1908, have been filed pursuant to Section 10 (3) of the Companies' Act, 1907, the whole amount being now issued. Property charged—the company's undertaking and property, present and future, including uncalled capital. No trustees.

NORTHAMPTON ELECTRIC LIGHT & POWER COMPANY.—Particulars of debentures to secure not more than two-thirds of the subscribed and paid-up capital for the time being, created by resolution of June 3rd, 1896, have been filed. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees. Amount of present issue, £450.

A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—First mortgage debentures dated 1896 to 1900, securing £19,800, and second debentures dated November 15th, 1899, securing £3,600.

F. REDDAWAY & CO.—Particulars of £150,000 debentures, created by resolution of March 30th and April 15th, 1903, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £20,000. Property charged—The company's undertaking and property, present and future, including uncalled capital (subject to prior debentures). No trustees.

TRAFFORD POWER & LIGHT SUPPLY CO. (1902).—Deed of exchange, dated July 23rd, 1908 (supplemental to indenture, dated October 14th, 1901, and to a trust deed, dated February 14th, 1902, securing £75,000 first mortgage debenture stock), has been registered.—Trustees—North of England Trustee Debenture and Assets Corporation, Ltd.

CATALOGUES AND PAMPHLETS RECEIVED

ASPHALT TROUGHING.—The Howard Asphalt Troughing Co. have issued a catalogue describing their system of laying mains "solid" in asphalt troughing. The troughs are made in lengths of about 4 ft., and manufactured from natural rock asphalt, made continuous by welded joints. The cables are laid on the bottom of the trough. Asphalt separators are inserted between the cables. Hot bitumen is poured over the cables. Then hot asphaltic concrete is poured over the bitumen, welding the whole into a solid mass. The welding of one length of troughing to another is effected with a hot iron. The catalogue describes in some detail the method of laying by the aid of very clear illustrations of the actual processes being carried out, and includes also full instructions for sealing rubber tails to cables laid in Howard troughing.

COUNTRY HOUSE LIGHTING.—Messrs. Mavor & Coulson, of Glasgow, are sending out a calendar card for August, with a description of the lighting installation which they have carried out at Tandergree Castle in Ireland. The generating plant consists of a 25-B.H.P. steam engine direct-coupled to a shunt-wound dynamo, which is used in connection with a 54-cell accumulator battery. The wiring is on Messrs. Mavor & Coulson's "C.C." concentric system.

ELECTRIC COOKING OUTFIT.—A leaflet from the General Electric Co. contains particulars of a self-contained electric cooking outfit, consisting of an oven for roasting, baking, or stewing, with a hot chamber on top for heating plates, or keeping food warm; a large vegetable pan with steamer; a small pan for sauce, milk, or small vegetables, &c.; a hot-plate for boiling flat-bottomed utensils on, or keeping large pans gently simmering, &c.; and a frypan for chops, steaks, fish, &c. It is stated that this equipment can cook a dinner for eight persons for 4¾d.

ELECTRICITY SUPPLY.—The Hackney Borough Council are issuing a pamphlet entitled "A Logical Development," calling attention to the facilities for arrangements for electricity supply in the district, and pointing out the economies available with metal filament lamps.

HOUSE FUSE-BOXES.—A new catalogue from British Insulated & Helsby Cables Ltd. describes a great variety of patterns of house fuse-boxes. Some of these are combined with a special type of switch, the body of which consists of a porcelain drum, through which the switch blades pass, and all parts of the switch being balanced, thejarring effect produced by the operation

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of the switch is reduced to a minimum. The spindle upon which the switch rotates is extended at each side of the cast-iron box, so that the handle may be fixed at either side, and all parts of the fitting can be readily removed and replaced. Except in the case of single-cable boxes, the sealing chamber is arranged so that cables may enter at either side or at the bottom, and fittings suitable for single, twin, concentric, triple concentric, or three-core cables are provided as required.

IRONCLAD SWITCHGEAR.—Messrs. Berry, Skinner & Co. are issuing a new list of their well-known "foul-proof" iron-clad switch and fuse gear. The main features of this gear were described in Electrical Engineering, July 2nd, page 26, in connection with the Franco-British Exhibition, where large numbers of these switches are in use. The switches are of the pull-off and push-on type. The moving part of the switch is actually a fuse-carrier, which is inserted into and with-drawn from its clips by the action of the switch. An in-genious arrangements of springs gives a quick make and break effect. The standard switches are listed up to 400 amperes at 500 volts. In sizes up to 100 amperes they can be combined with interlocked plugs for mining work.

METAL FILAMENT LAMPS.—The Electrical Co. have issued an attractive black and white show-card for the use of agents marketing their "Aegma" metal filament lamps. Other new publications relating to these lamps include an ingeniously arranged card calculator, and the shape of a lamp showing the saving obtained by, as against carbon lamps, for various prices of current. A circular also calls attention to the advantages of the "Aegma" lamp for shop lighting.

OSRAM LAMPS.—The General Electric Co. have sent us samples of their latest Osram show-card, which is a convenient size for shop windows and show-rooms, and has a gauze backing, rendering it equally suitable for a dark background or a window pane, the letters "Osram Lamps" standing out boldly in either case. A new circular containing testimonials relating to these lamps is also being issued, on the front page of which is a view of the auditorium of the Empire Theatre, showing lighting by Osram lamps.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire-bars, net c.i.f. port of arrival, quoted on Tuesday night, was £62 to £63 per ton (last week £64 to £64 10s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The adjourned public examination of Albert William Bennett (lately trading as Bennett & Co.), electrical engineer, of 43 Elford Grove, late 32 Park Cross Street, Leeds, was held on Tuesday last at the County Court House, Albion Place, Leeds, before the Deputy Registrar, Mr. Haigh. The liabilities were stated at £1,124, and there were said to be no assets, the debtor ascribing his failure to competition and bad trade. Debtor was further questioned, and the case was ultimately concluded.

A committee of inspection consisting of Mr. F. Taussig and Mr. F. J. Tiffin has been appointed to act with the official receiver as liquidators of the Kevan Electrical Co.

W. T. Garnett, trading as W. T. Garnett's Cable Co., of Barkerend Mills, Bradford, electric cable and wire manufacturer, has been adjudicated bankrupt. The first meeting will take place on August 26th, at 11 a.m., at the Official Receiver's Chambers, 12 Duke Street, Bradford. The public examination will be held on October 7th, at the County Court, Manor Row, Bradford, at 10 a.m.

WARNER ENGINEERING CO.—The manufacture of the Warner non-parallel axle truck under patent No. 15,059, 1905, has now been taken over by Messrs. Mountain & Gibson, Ltd., of Elton Fold Works, Bury, Lancs. A description of this truck was given in "Electrical Engineering," Vol. III., page 88. The conversion of existing trucks will be undertaken either by the Warner Engineering Co., or by Messrs. Mountain & Gibson, Ltd.

NEW PUBLICATIONS

"Electric Lighting and Power Distribution." By W. Perren Maycock. Seventh edition. (London: Whittaker & Co.). 6s.

"Journal of the Institution of Electrical Engineers," August. Vol xli. No. 191. (London: E. & F. N. Spon.) 5s.

APPOINTMENTS AND PERSONAL NOTES

On Friday last Mr. A. R. Howden was, on the occasion of his leaving to take up the position of Station Superintendent at Dumbarton, met by the members of the staff of the Dundee Electricity Department, and made the recipient of a handsome case of compasses. Mr. C. Lamb made the presentation, and in the course of a few remarks said they all regretted that Mr. Howden was leaving, and at the same time wished him every success in his new appointment. Mr. Howden suitably replied.

MISCELLANEOUS CITY NOTES

CHLORIDE ELECTRICAL STORAGE CO.—The year ended June 30th shows a profit of £24,945. A dividend of 10 per cent. is recommended, with £2,000 transferred to reserve, and £10,612 carried forward.

ELECTRIC TAXICAB CO.—The response to invitations for subscriptions for ordinary shares amounting to £300,000, has been so small that the promotors have not proceeded to allotment, and the application money has been returned.

NORTHAMPTON ELECTRIC LIGHT & POWER CO.—An interim dividend of 4½ per cent. has been recommended on the "B" ordinary shares for the past half-year.

RANGOON ELECTRIC TRAMWAY AND SUPPLY CO.—A prospectus has been issued inviting subscriptions at a premium of 2s. 6d. per share, for 10,000 six per cent. £5 Cumulative preference shares (being the balance of the 50,000 preference shares authorised), for the purpose of providing for extensions of the company's undertaking.

SOUTH AMERICAN LIGHT & POWER CO.—A dividend of 2 per cent. has been recommended on the ordinary shares, with £167 carried forward.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—The scheme of readjustment having become binding, the company is now prepared to pay to note holders the amount of the coupon due July 1st, 1908 (representing seven months' interest from December 1, 1907), on the new 4½ per cent. bonds of 1933, to be given in part exchange for the notes.

NEW COMPANIES

BENJAMIN ELECTRIC CO.—This company was registered on August 8th, with a capital of £1,000 in £1 shares, to acquire from the Benjamin Electric Manufacturing Co., of Chicago, Illinois, U.S.A., the benefit of certain existing inventions, relating to electrical clusters and lighting specialities, and to carry on the business of electricians, producers, and workers of and dealers in electricity for power and lighting purposes, &c. The subscribers are R. B. Benjamin, B. J. Grigsby, A. Bathurst, and J. Lord. Private company. The number of directors is not to be less than two, nor more than six; the first are R B. Benjamin, W. D. Steele, W. C. Jones, K. H. Addington, and B. J. Grigsby No qualification necessary. No remuneration. Registered by Freshfields, 31 Old Jewry, E.C.

GENERAL RAILWAY SIGNAL CO.—This company was registered on August 10th, with a capital of £100 in £1 shares, to carry on the business of railway signalling engineers, manufacturers, and installers of, and dealers in, signal appliances, railway engineers, and contractors, electricians, electric, and pneumatic engineers, &c. The subscribers are:—J. Mortimer, G. Macleod, F. Doyle, P. Chadwick, W. H. Revz, S. Wall, W. Rushforth. Private company. Table "A" mainly applies.

PATENTS FOR SALE.

THE PROPRIETOR OF PATENTS Nos.
11933/00, "Improvements relating to the Regulation of Electric Motors."
19899/05, "Improvements relating to Alternating current Electric Motors."
26808/05, "Improvements relating to Alternating current Electric Motors."
is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring their full development and practical working in this country. All communications should be addressed in the first instance to—

HASELTINE, LAKE & CO.,
Chartered Patent Agents & Consulting Engineers,
7 & 8, Southampton Buildings, Chancery Lane, London, W.C.

THE PROPRIETORS OF PATENTS Nos.
13287/02, "Improvements relating to Apparatus for the Transmission of Sound for Submarine Purposes."
13288/02, "Improvements relating to the Transmission of Sound for Submarine Purposes and to Apparatus therefor."
3266/03, "Improvements in Apparatus for producing Sound Vibrations in Water."
10463/04, "Improved means for producing Sound Vibrations in Water applicable to Marine Signalling."
10477/04, "Improvements in Apparatus for Receiving Submarine Signals."
14230/04, "Improvements relating to Submarine Signalling and to Apparatus therefor."
are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring their full development and practical working in this country. All communications should be addressed in the first instance to—

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ELECTRICAL ENGINEERING

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Corrections in Standing Advertisements, *Monday first post.*

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Binding Cases for Vol. III. may now be ordered, price 2s. each, post free 2s. 4d. Readers can have their volumes bound by their own bookseller; or they may send their numbers to us, carriage paid (with the reader's name and address), and a remittance of 4s 6d. under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad.

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SUMMARY

The death is announced, from Paris, of Henri Becquerel, at the age of 56. (Page 308.)

A letter from "One of the Minority" objects to the wording of the official report of the special meeting of the Institution of Electrical Engineers, with regard to the acquisition of new premises on the Victoria Embankment. (Page 308.)

The following books are reviewed in this issue:—"Principles of Direct Current Engineering," by J. R. Barr; "Electrical Engineering," by W. Slingo and A. Brooker; "Some Quick and Easy Method of Calculating: A Simple Explanation of the Theory and Use of the Slide Rule, &c.," by R. G. Blaine; "Handbook of Farm Buildings, Ponds, &c., and their Appurtenances," by T. Winder, with a chapter on "The Application of Electricity to Farming and Agriculture," by J. W. Beauchamp; "Elektrotechnische Messkunde zugleich Leitfaden für das Elektrotechnische Praktikum," by A. Königswerther. (Page 309.)

The accounts of the Sheffield Corporation Tramways Department for the year ended March 25th, 1908, show that the undertaking is financially in a very good condition. The working expenses, excluding capital charges, amounted to 6·045d. per car mile; including capital charges, to 9·184d. per car mile. The total receipts amounted to 10·049d. per car mile. A sum of £22,532 was transferred to the General District Rate. (Page 310.)

An analysis of the accounts of the Acton Electricity Undertaking shows that the capital expenditure has been about £200 per kw. of maximum demand, although energy is bought in bulk, and therefore only converting plant, distributing network, &c., had to be provided. The loss, taking account of capital charges, has been 1¼d. per unit sold. (Page 311.)

In connection with the results of tests on the 5,000-6,000-kw. Willans-Siemens' turbo-alternator at Manchester, which we published in last week's issue, we reproduce this week the actual curve of steam consumption for the range of loads from 2,500 to 6,000 kw. The lowest consumption was 15·84 lb. of steam per unit at an output of 5,650 kw. (Page 311.)

In a Paper read before the Erfurt Congress of the Verband Deutscher Elektrotechniker, the question of the possible harmful influence on the eyes of the modern sources of artificial light was raised. The authors of the Paper remark that owing to the high temperatures of the latest types of electric illuminants, the proportion of ultra-violet rays in the emitted light has considerably increased. These rays, they point out, are injurious to the eyes, but can be entirely cut off by surrounding the light-source with a globe of special glass which absorbs all ultra-violet rays. In an article in a German contemporary, some experiments are described which show that these fears of injury to the eyes from ultra-violet rays in artificial light are

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unfounded, as for a given degree of illumination, the proportion of ultra-violet rays in the light emitted from most electric lamps is less than that from sunlight. The danger of injury to the eyes through the influence of unequal illumination is emphasised in the latter Paper, and the importance of shading the new metal-filament lamps with frosted globes is insisted on. (Page 312.)

A large power station has been established by the Société de l'Energie Electrique du Nord de la France for the supply of electric power in the district of Lille Roubaix and Tourcoing. The station, which adjoins a canal at Wasquehal, is designed to contain turbo-generator sets aggregating 25,000 kw., of which plant representing 10,000 kw. is already complete or under erection. Current is generated at 10,000 volts 3-phase, at which pressure it is transmitted to substations, partly by cables and partly by overhead lines. (Page 313.)

A Paper read by Mr. S. B. Fortenbaugh at the Summer Convention of the American Institute of Electrical Engineers described the results of some tests on the leakage from the conductor rails of the London Underground Electric Railways, which show that the difference of potential between the positive conductor and earth is always normally considerably greater than the potential between the negative conductor and earth, and that a reversal of the polarity is always instantly accompanied by a considerable increase in the normal leakage current between the positive and the negative conductors. (Page 315.)

A railway contemporary publishes an interview with Mr. J. A. Boyd, a member of the Victorian Government, in the course of which some interesting information with respect to the electrification of the suburban railways of Melbourne was divulged. It appears that the report, which will shortly be presented by Mr. C. H. Merz to the Victorian Railway Commissioners, will recommend the electrification of some 40 miles of track, as a first instalment. The electrification will, it is expected, be carried out on the third-rail continuous-current system. (Page 318.)

A tramway accident resulting in injury to ten persons occurred in Liverpool on Friday last. A car with thirty passengers failed to stop at the usual stopping place at the bottom of a hill, and collided with a heavy lorry, falling over on to the same. The driver states that when he put on the hand-brake to stop the car, he failed to put the clutch in the proper position to engage in the teeth of the ratchet wheel at the base of the brake staff, with the result that the handle flew round and struck his elbow, temporarily disabling him. (Page 318.)

An interesting example of the application of electricity for lighting and power purposes is the installation in the West End premises of Messrs. Debenham & Freebody. The interior lighting is carried out chiefly with inverted arcs, but a large number of metal filament lamps are employed as well. All the arc lamp circuits, each of which consists of five lamps in series, are brought down to a central distributing board. An ingenious arrangement for indicating when the lamps require trimming is provided, and the method, by which the insulation of the system is kept continuously under test, is also very interesting. The cost of lighting each department is charged up separately to that department, and so special arrangements for metering the departments separately is provided. In the work-rooms are to be found electrically-driven sewing machines and electric irons, and there are many electric fans. Four of these fans are used in connection with a carefully designed ventilating system. This latter includes a complete installation of Ozonair apparatus for purifying the air. Electric lifts, electric clocks, and a very complete telephone system are also included in the installation. (Page 319.)

An article by Mr. H. R. Speyer describes the electrical equipment of a group of salt miles in Germany. Power is generated at a steam-driven power station, owned jointly by the several mining companies, electric driving is used for main winding engines on the Ilgner system, and for auxiliary 3-phase winders, and 3-phase motors are employed for underground haulage, aërial ropeways, tippers, elevators, cranes, pumps, crushing mills, and various other purposes. (Page 322.)

A short description is given of a form of oil circuit-breaker for a voltage of 75,000 volts, in use on one of the large transmission systems in the west of the United States. (Page 329.)

The exhibits relating to the heavier branches of electrical engineering at the Marseilles Electrical Exhibition cover a considerable range. Amongst them may be noticed examples of aluminium wires and cables, vehicles propelled by Edison accumulators, and examples of new designs of electrical machinery of interest embracing single-phase motors, rectifiers, double-current generators, as well as more usual patterns of machines. Examples of new forms of quartz mercury vapour lamps are exhibited, and a great number of applications of electrical power are exemplified. Another feature of the Exhibition is a large collection of maps, plans, &c., of transmission systems in France. (Page 330.)

Under Electrometallurgy and Electrochemistry notes are given on certain improvements in the electrothermic methods for oxidising atmospheric nitrogen and fixing it in the form of nitric acid, with a view to getting over the difficulties in producing highly concentrated nitric acid. At one time the mines of Coniston were famous for their copper ore, and large quantities were mined; at present they are not worked, the best part of the ore having been removed. There are, however, large clumps of tailings containing from 1·5 to 2·0 per cent. of copper. It is proposed to work this by an electrochemical process devised by Mr. T. Scott Anderson. Satisfactory trials of the process extending over two years are said to have taken place. (Page 331.)

Under "Electrical Science" in the British and American section, are notes on a method of calculating the resistances of spark gaps, and some experiments on Heusler's magnetic alloys. In a Paper abstracted in the Continental section, Athanasiadis describes a singing arc and rectifier obtained with a liquid anode. (Page 332.)

The water power station of the Great Northern Power Co., on the St. Louis River, contains four 7,500 kw. alternators, driven by vertical shaft turbines, working with a head of water of 378 ft., and running at 375 r.p.m. (Page 333.)

An article in an Australian contemporary describes the systems of electrical signalling in use in some of the large mines in the Kalgoorlie district. A 110-volt continuous-current system with motor-generator and stand-by battery is described. A 15-volt alternating-current system is in use in one mine, but it is stated that more trouble is experienced through electrolysis on alternating than on continuous-current systems. Telephones are not often employed. (Page 334.)

Among the Patent Specifications published by the Patent Office on Thursday last, is one by H. A. Mavor relating to a method of generating alternating current of variable frequency, particularly suitable for use in conjunction with electrical systems of marine propulsion with turbo-alternators running at a constant speed. The British Thomson-Houston Co. have a protective device, in which an insulating fluid is kept constantly flowing across the spark-gaps, to prevent the formation of arcs. A method of preventing the fall of tramway trolley wires when broken is the subject of a specification by A. G. Bonn and F. Mellaerts, and another taken out by the British Thomson-Houston Co. relates to the driving of machine tools with a reciprocating

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motion by single-phase commutator motors. (Page 335.)

The running of electric accumulator omnibuses is proposed in Aberdeen.—A report of the Dublin Electric Lighting Committee recommending extensions, &c., costing about £70,000, has been considered by the Corporation, who have asked for a joint report by the Lighting and Finance Committees.—The Dunfermline Corporation have finally decided to hand over their Provisional Order to the Fife Electric Power Co.—The Board of Trade has promised to give the circumstances of Col. Yorke's inspection of the Ealing tramways full consideration.—A scheme has been proposed for the construction of a steep grade electric railway, partly in tunnel, in the City of Lincoln.—It is expected that the work on the electrification of the remaining horse trams in Battersea and Wandsworth will be taken in hand very shortly.—An automatic telephone exchange is to be established in Lyons.—The use of automatic tramway point controllers in Sheffield is being extended.—The prohibition of the importation into Turkey of electrical instruments has been withdrawn. (Pages 337 and 338.)

Applications for loans for electrical purposes are being made by the following local authorities:—Frome (£11,000); Kingston (£12,600); Stirling (£3,000); Whitehaven (£2,000).—Tenders are invited for feeder pillars, &c., by the Salford Corporation.—Further tenders for telephone material are required for Australia.—For the information of wiring contractors we give particulars of a large number of buildings about to be erected in London and the provinces.—The tender of the Western Electric Company has been accepted for a telephone exchange switchboard at Melbourne.—The Dublin Corporation have resolved to ask for new tenders for certain plant on account of a complaint that all the firms tendering had not been given equal opportunities for revising their tenders. (Page 338.)

Meetings have been held during the past week of the Dublin and Lucan Electric Railway Co., the Lanarkshire Tramways Co., and the South American Light & Power Co. (Page 340.)

Sir Francis Oppenheimer's Consular Report for the district of Frankfort deals with the proposed German Government monopoly for electric power, and announces an attempt that is to be made to utilise the motion of the tides for the production of electricity. (Page 341.)

Our correspondent at Colombo states that some extensions and improvements in the telephone system may be expected in Ceylon. Electric lighting in the capital is making only slow progress; overhead distribution has not been allowed in the suburbs, and 8d. per unit is charged for private lighting; there would seem to be a good field for metal filament lamps. (Page 341.)

It may be admitted that flame arc lamps have an unpleasant effect on the colour of ladies' complexions, but no one would aver that there is any prejudicial action upon the face that is permanent. In this respect, metal filament lamps are less fortunate, for it has been suggested, wrongly we contend, that their light contains an undue proportion of ultra-violet rays, which are said to have a deleterious action upon the eyesight. We give in this issue abstracts of two Papers, dealing with this subject, which have been published recently in a German contemporary. The experiments described in the first of these Papers merely confirm the fact that the proportion of ultra violet rays in the light from modern electric lamps has increased owing to the higher temperatures employed; but the authors of the Paper state that these rays are very dangerous to the eyesight, and they recommend the use of globes of a special glass to absorb all the ultra-violet rays. We cannot but think that these fears are very much exaggerated. It is by no means certain that the various diseases of the eyes traceable to the effect of artificial light, are mainly due to the ultra-violet rays contained in the light; indeed, there is every reason to believe that the chief cause is the frequent employment of intensely bright concentrated sources of light without any diffusing globe. It is often mentioned in support of the former hypothesis, that erythropsia, or "red sight," is very frequently developed on exposure to a bright light after the removal of the lens in cataract cases. The lens is said to absorb the ultra-violet rays, and in the absence of the lens, the rays reach the retina and cause erythropsia. Again, a case has come under our notice, in which X-rays, which may be regarded in this connection as ultra-violet rays of exceedingly short wave-length, produced cataract. The rays were being used for the treatment of lupus on the face, and as it was before the days of lead-glass screens, the eyes also were exposed to the action of the rays. There is thus every reason to be always on the look-out for the slow, but dreadful, effects of ultra-violet and other invisible rays. However, it has yet to be demonstrated that we have anything to fear, in this direction, from the influence of our commercial illuminants; indeed, in the second Paper which we abstract, some experiments are described by which it is conclusively proved that, on the whole, the proportion of ultra-violet rays in the light from artificial sources is less than that in daylight. As the same author mentions, there is much more chance of harmful effects from the use of concentrated light sources, such as the naked arc or metal filament, with their high intrinsic brilliancy. The pupil of the eye automatically adjusts itself by a reflex action to the average illumination of the field of view, and when one or more concentrated, and intensely brilliant, points of light are viewed on a more or less dark background, fatigue of the eyes is soon produced. If the light is well diffused, and no rays of a brilliancy much over the average are allowed to impinge on the retina, artificial light will cause fatigue of the eyes no sooner than daylight. Arc lamps should never be used for interior illumination without diffusing globes, and now that the increased efficiency of the metal filament lamp has enabled us to obtain our light at a cheaper rate, it will certainly be of advantage to employ frosted bulbs, adequate shades, or holophane globes, sacrificing a small amount of light in order to prevent the access of the direct rays of high intensity into the eye. Indirect illumination by reflected light is, of course, the ideal, but with the present prices of electrical energy this may be considered to be too extravagant, although it will possibly be the accepted method of illuminating interiors a few decades hence.

In conclusion, we may mention two examples of the harmful influence of strong light. The sudden and intense glare produced by a heavy short-circuit produces that painful affection of the eyes known as retinal asthenopia, accompanied by conjunctivitis or inflammation of the eyes, which may last for a month or more. It is practically certain, however, that these affections are due, not to the ultra-violet rays in the light, but to the inability of the pupil to contract sufficiently quickly, and thus reduce the intensity of the light rays impinging on the sensitive retina. The duration of such a short-circuit is often only a fraction of a second, and it is inconceivable that the ultra-violet

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rays can have any influence, as the effect of such rays is a function of the time of exposure. The other example is that of "glass-blowers' cataract," which is generally attributed to the great heat. It is probable, however, that this is also due to the frequent sudden exposures of the eye to the brilliant light of the furnace.

The Liverpool runaway car accident, which occurred last Friday, has certain unusual features about it, as will be seen from the explanation which we publish from an official source. The account given by the driver is a credible explanation of the occurrence, and includes the admission that the brakes were in good order. The Liverpool practice is to fit cars with the rheostatic-electric and hand-wheel brakes, and much attention has been paid there to the correct handling of this combination, one which has certain potentialities of danger if used unintelligently. According to the driver, the car descended the slope approaching the scene of the mishap on the electric brake, at a safe speed, and should have been stopped at a Board of Trade stop just before reaching it. This necessitated the application of the hand brake, as an electric brake will not hold a car stationary on a descent. The driver putting on the brake failed to put the pawl into the ratchet wheel at the bottom of the brake spindle, and the handle flew back, striking him a severe blow on the arm, disabling it for a moment. Unfortunately, a van was on the track, or drew on to the track, a few yards ahead, and, before the motor man recovered, the car struck the van, and, being on a curve, overturned. The driver is said to be an experienced man of excellent character, and as his story will be minutely investigated at the Board of Trade inquiry, we need not inquire into some minor points, but can accept it as substantially correct. It serves as a pointed reminder of the importance of the continuous physical and mental fitness of the men conducting tramway and similar services to the security of traffic. The very temporary disablement of a man in this case brought about an accident, which under unfavourable conditions might have been a disaster. What a knock on the elbow did, a passing dizziness or faintness may do just as completely. The importance of frequent medical examination of the men is thus, curiously enough, enforced by an occurrence in which physical disability was produced by a purely external cause. Temporary absence of mind would be an equally serious danger with physical disablement, but it is fortunately of rare occurrence among tramway drivers and men in similar occupations. It probably gets detected, when it is habitual, before the men are put into responsible positions.

The engineer knows how dangerous it is to generalise from particular cases, and we need hardly warn him therefore that, although the Acton electricity undertaking, in which power is bought in bulk from a company, and distributed by the Local Authority, has proved itself a financial failure, it would be far from correct to assume that this method of operation is inefficient, and that it is not suitable in the case of small supply districts similarly situated. From a short analysis of the accounts, which we publish on another page, it will be seen that the chief cause of the large deficits that have been recorded since the commencement of supply, about three years ago, has been the enormous capital expenditure, and the consequent large sums that have had to be paid yearly as interest and sinking fund. The total capital expenditure up to date has been equivalent to just over £200 per kilowatt of maximum demand, which would be a very large figure for a station with its own generating plant, and is, of course, enormous for a sub-station and distributing network. It may be contended that this embraces certain sums expended on consumers' installations and on public lamps, but, even deducting these items, the residue still amounts to £191 per kw. of maximum demand. It is thus seen that the circumstances at Acton have been peculiar, and can hardly be used as an argument against the generation of electricity at large power houses and its distribution from sub-stations in smaller areas, instead of the erection of small independent generating stations. It is more reasonable to argue that had Acton built its own generating station on the same lavish scale of expenditure as it has bestowed on its sub-station and distributing network, the results there would have been even more disastrous.

OBITUARY

Henri Becquerel.

In the death of Henri Becquerel, at the age of 56, just reported from Paris, we have lost one of our greatest physicists. Although it is to his pupils, the Curies, that the discovery of radium is due, this discovery was only made in carrying out a systematic research to investigate further the cause of the invisible rays which Becquerel had found to be emitted by certain compounds of uranium. His announcement that photographic plates enclosed in a light-tight box with uranium salts were acted upon actinically was at first received with a considerable amount of scepticism, but it was this that formed the basis of the whole enormous field of research that has been opened up by the realisation of the existence of radio-active bodies. Up to the present no practical application has yet been made from these researches, but if the direct production of artificial light on a commercial scale ever becomes possible, it may be expected to be an outcome of Becquerel's work.

CORRESPONDENCE

THE NEW BUILDING FOR THE INSTITUTION OF ELECTRICAL ENGINEERS.

To the Editor of Electrical Engineering.

Sir,—In the report of the special general meeting which has just been circulated, it is stated that "the resolution (to confirm the action of the Council) was put and carried unanimously." This is incorrect.

No word in favour of the scheme came from anyone but the Council and those associated with them. All the other members who spoke, strongly opposed it. An amendment was finally put, which was stated by the Council to be a direct negative. As such, it was voted on. What the result would have been without the votes of the members and ex-members of Council it is hard to say, but, as it was, it was lost by a considerable number. The substantive motion was then immediately put; and the minority, seeing themselves outvoted, let it go *nem. con.* as being a mere matter of form.

The purchase looks a fairly good speculation, and we all hope it will be; but good or bad, the Council must take the whole responsibility on their own shoulders, and not try to relieve themselves of it by "unanimous" confirmation from the body of members, or even of the tiny proportion present at the meeting.

One of the Minority.

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REVIEWS OF BOOKS

Principles of Direct Current Electrical Engineering. By James R. Barr. 543 pp. 8¼ ins. by 5½ ins. 294 illustrations. (London: Whittaker & Co.) 10s.

A NUMBER of lecturers in electrical engineering have endeavoured, with more or less success, to supply the want of a really suitable text-book to be used by the students attending their lectures. The tendency has, however, been in many cases for such manuals to be practically nothing else than the lectures themselves written out, with the result that, although possibly welcomed by students irregular in their attendances or too lazy to take notes, they fail in their proper object of being supplementary to the lectures themselves. A work of this nature should not attempt to be a self-contained treatise which will do away with all class-room and laboratory teaching, but to provide the student with reminders and explanations of what he hears and sees, and to contain supplementary information which he will require for reference embodied in tables, diagrams, and letterpress. Mr. J. R. Barr, of the Heriot-Watt College, Edinburgh, has, we think, kept these objects well in view in the work before us, which is admittedly based on his lectures to second-year students, and is intended, quoting the preface, to bridge the gap between the several elementary manuals and many excellent works on specialised branches of the subject.

The author assumes a certain preliminary knowledge and intelligence in his readers, and it is a relief to find that he plunges at once into electromagnetic units without troubling us first with the vagaries of pith balls and gold-leaf electroscopes. After the ideas of current and magnetisation of iron are dealt with, there is a long section on measuring instruments, and actual modern forms of apparatus are dealt with; the space is not wasted on historical reminiscences of the tangent galvanometer, and other such old friends of our youth. The illustrations are for the most part diagrammatic, although actual apparatus is usually represented, and anything of the nature of the instrument-makers' catalogue is rigidly excluded. The succeeding chapters on storage batteries and electric lighting are equally practical. Metal filament lamps are dealt with, but apparently this part of the book went to press before the now familiar tungsten lamp was brought out, as only the tantalum, and the practically obsolete osmium lamps are mentioned. The arc lamp section is fairly up to date, and photometry is treated in a much more practical manner than is usual in educational works. There is also a great deal of a thoroughly practical nature in the section of underground and aërial conductors, both as regards the insulation and laying of cables and the construction of pole lines. The chapters on the dynamo, which commence about half-way through the book, bear the same character in their treatment, and more attention is given than usual to the mechanical construction of machines. The complicated subject of commutation is clearly handled, and the effects of commutating poles and compensating windings are fully dealt with. The latter part of the book includes portions treating of motors, boosters, motor-starters, and switchgear for continuous current stations. It may be suggested that the arrangement would have been improved by incorporating earlier in the scheme part of a chapter on losses, efficiency, and testing, which is given near the end, in order that the reader should be familiar with the thermal limitations to the output of machines before considering the limits imposed by commutation and flashing over—but on the whole the arrangement, as well as the proportions in which the theoretical and the practical are blended, are excellent.

Electrical Engineering. By W. Slingo and A. Brooker. 832 pp. 389 illustrations. 5 ins. by 7½ ins. (Longmans, Green & Co.) 12s. 6d.

IN this well-known text-book, which has passed through many editions since its first appearance in 1890, the authors originally set themselves the ambitious task of covering the whole field of electrical engineering in a manner at the same time suitable to the technical college pupil and (to quote the preface to the first edition), "also to those who, having little or no electrical knowledge, have under their supervision various kinds of electrical machinery." This was no doubt easier in 1890 than now, but in succeeding editions the revisers (Mr. Slingo and Mr. T. F. Wall) have made brave, if only partially successful, attempts to pursue this ideal, and to keep pace with the strides that electrical engineering has made since then in all its branches.

A good deal relating to thoroughly modern practice has been put in, but we are sorry to have to say that the result is somewhat of a patchwork, as, naturally enough perhaps, the authors have been loath to expunge the earlier work even where it relates to matters obviously of historical rather than present day interest. We do not object to obsolete machines being referred to briefly when they have a direct bearing upon the line of development which has led to present design, but to denote almost equal space to an ancient de Meritens magneto alternator, and to a modern 3,000 kw. Dick, Kerr turbo-alternator, shows a great lack of sense of proportion. There is also, from the same cause, an incongruous mixture of the elementary and the advanced; for example, after the refinements of hystersis cycles have been gone into, it is suddenly remembered that the reader is supposed not to have been to school, and about two pages are taken up explaining what the sine of an angle is. Nor are the recent additions to the book always quite accurate. It is incorrect, for example, to say, in speaking of turbo-generators, that "the temperature at which high-speed machines are worked is higher than in the case of slow-speed machines." What is meant is that more complete methods of ventilation are required in order to keep within the same limits of temperature.

There is, however, a great deal that is excellent in the more recent additions. The lamp section has been brought up to date by the inclusion of recent work that has been done in the standardisation of carbon filament lamps, although it is not too much to say that in a few years these too will be almost as obsolete as the de Meritens are lighter. Numerous results of tests of the tantalum lamp are given, but we have searched the index in vain for a reference to the Osram or other form of tungsten lamp.

Some Quick and Easy Methods of Calculating: A Simple Explanation of the Theory and Use of the Slide Rule, &c. By R. G. Blaine. Third edition. (London: E. and F. N. Spon.) 2s. 6d

SINCE *Punch's* famous joke of the curate's egg, many reviewers have applied the useful quotation, "Parts of it are excellent," to many books, but whether the readers for whom this book is intended may be trusted to have the curate's power of discriminating between the good and the bad is doubtful. In fact, the author is at great pains to make his book suitable for users whose knowledge of arithmetical computation is very elementary. In some of his simple examples he would almost appear to suggest the slide rule as a substitute for the multiplication table. The tendency of the book is, we fear, to produce "slaves of the slide rule"; what is wanted is a clearer knowledge and mastery of it as a brain-saving tool. The position of the decimal point, in the final figures of a slide-rule operation, is the subject of many involved and, let us confess, tedious passages, requiring, besides, jottings on paper. The fate of most of these rules is

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that they are forgotten, and that the engineer applies the plain law of common-sense as a substitute. On the other hand, there is hardly an owner of a slide rule who would fail to benefit by a perusal of Mr. Blaine's book. Incidentally we may deplore a surprising dearth of the definite article, and why, oh why, the terrible word "delogarize"!

Elektrotechnische Messkunde zugleich Leitfaden für das Elektrotechnische Praktikum. By A. Königswerther. 5¾ in. by 8¾ in. 172 illustrations. (Hanover: Dr. Max Jänecke.) M. 4.80.

This book is the second volume of a series entitled "Grundriss der Elektrotechnik." The first volume was by the same author, and was entitled "Physikalische Grundlagen der Gleich- und Wechselstromtechnik." The present volume is intended as a text-book for the use of students, and treats with the various measuring instruments, both for laboratory and general use, and with the different methods of carrying out electrical measurements. Apparatus used in testing, such as standard resistances and condensers, is also included. The descriptions are very concise, and no unnecessary details or modifications are dealt with. The sketches are well chosen, so as to show only the principle of the instrument in question, and only a very few outside views are given. The subject of photometry, which will be dealt with in a future volume of the series, is not included in this one. The last chapter includes methods of measuring phase differences and short descriptions of three modern phase-meters. The numerous references to works dealing more fully with the various subjects should be of great use to the reader who has a technical library within reach.

Hand-Book of Farm Buildings, Ponds, &c., and their Appurtenances. By Thomas Winder. With a chapter on "The Application of Electricity to Farming and Agriculture. By J. W. Beauchamp. 171 pp. 5¼ in. by 8½ in. 106 illustrations. (Sheffield: Pawson & Brailsford.)

The main portion of this book deals with the design and construction of farm buildings, and contains, besides a good collection of scale drawings and photographs of modern farm buildings, several interesting photographs of old types. That portion of the book which concerns us, however, consists of seven pages of printed matter, together with nine half-tone illustrations relating to the application of electricity to farming and agriculture. The author summarises what has been done in this country in this direction, and mentions a few of the advantages which are to be obtained by electrically driving cream separators, churners, chaff-cutters, and other farm apparatus. This will serve to whet the appetite of the farmer for electric power. It is to be regretted, however, that such details as the necessary horse-power required to drive individual machines, and the probable total horse-power required by a large modern farm, are missing. The application of electricity for the purpose of hastening the germination and growth of crops is only mentioned briefly, without reference to the recent developments in this direction.

Electrical Engineering in Bahia.—A British Consular report states that the tramway system of the lower city has been acquired by the Bahia Tramway, Light and Power Company. This company has been incorporated under the laws of the State of Maine, United States. It is stated that the company has been organised with the objects of acquiring, constructing, and developing tramways, and of supplying electrical power, electric light and gas in the city of Bahia and in the surrounding districts. It has purchased, as already mentioned, the tramway system which serves the lower city. This tramway system, known as Carris Electricos, consists of over 15 miles of track, worked by electrical traction; it is licensed to carry freight as well as passengers. It formerly belonged to a German company, by whom the line had been built and equipped. All rights pertaining to the tramway system were sold by the German owners to the Bahia Tramway, Light and Power Company during the year 1906. The company has also acquired, by purchase, the interests of La Compagnie d'Eclairage de Bahia, a Belgian corporation, which had acquired the exclusive right to manufacture and to sell gas and to distribute electric light and electric power in the city and suburbs of Bahia until the end of 1950. The new company hopes to be instrumental in greatly extending here the use of electric power, of electric light, and of gas—the last mentioned for cooking purposes as well as for illumination. In order to provide for the anticipated demand the company has entered into a contract with the British firm of Dick, Kerr & Co., Ltd., for increasing the existing gas plant and for installing a first-class light and power plant, to be worked by powerful gas engines. The same company has acquired valuable water-power rights in connection with the falls of the River Jequiriça, some 45 miles south of the city. The falls in question are 175 ft. in height, and it is calculated that there can be transmitted therefrom over 10,000 commercial horse-power to the city of Bahia. The company has furthermore acquired the water-power rights in connection with the falls of the River Santarem, which are situated some 60 miles to the south of the city, close to the sea coast.

SHEFFIELD CORPORATION TRAMWAYS ACCOUNTS

THE report and statement of accounts for the year ended March 25th, 1908, issued by the Tramways Committee of the Sheffield Corporation, contain information of a financial character only, with the exception of the following statistical returns. The car miles run during the year amounted to 7,065,380, as against 6,804,656 for the previous year. Over 77,500,000 passengers were carried during the year, an increase of over 3,500,000 on the corresponding figure for the previous year. The traffic receipts have increased from £276,907 to £289,744. The number of permanent employées in the Tramways Department is now 1,527. The rolling stock consists of 268 service cars and 11 water, stores, or sand cars. The total working expenses of the system amounted to 6·045d. per car mile, as compared with 5·940d. for the previous year. The increase is accounted for by increased wages paid to employées in the department.

Analysis of Expenses per Car Mile.

	Year ended Mar. 25, 1907.	Year ended Mar. 25, 1908.
Traffic expenses—	d.	d.
Salaries and wages	2·729	2·775
Cleaning cars and depot expenses	0·342	0·388
Cleaning, salting, and sanding track	0·113	0·103
Ticket check, including wages of inspectors	0·084	0·079
Uniforms	0·145	0·121
Miscellaneous	0·029	0·037
	3·442	3·503
General expenses—		
Salaries and wages	0·133	0·138
Rent, rates, and taxes	0·424	0·413
Insurance, and law expenses	0·067	0·064
Miscellaneous	0·090	0·083
	0·714	0·708
Repairs and maintenance—		
Permanent way	0·250	0·239
Electrical equipment of line	0·130	0·147
Cars	0·602	0·654
Buildings and miscellaneous	0·064	0·057
	1·046	1·097
Power expenses—		
Fuel	0·372	0·418
Salaries and wages	0·152	0·155
Oil, waste, water and stores	0·064	0·037
Repairs and maintenance	0·150	0·127
	0·738	0·737
Total costs, excluding capital charges	**5·940**	**6·045**
Capital charges—		
Interest	1·460	1·265
Income tax	0·078	0·082
Sinking fund	0·907	1·045
Renewals and special purposes funds	0·776	0·747
Total costs, including capital charges	**9·161**	**9·184**

The total working expenses amounted to £177,950, and the total receipts to £292,393, of which £289,744 was traffic receipts, and the remainder, £2,649, was the income from advertising on cars, rents, &c. Of the balance of £114,443, interest, sinking fund, and income tax absorbed £37,242, £30,753, and £2,427 respectively. The remainder of the balance, together with the interest on investments and bank interest, amounted to £47,472. This was appropriated as follows: £22,066 was transferred to the Renewals Fund; £2,000 to the Special Purposes Fund; and £873 to the Surplus Fund. The remaining £22,533 was handed over to the General District Rate. The total number of units generated amounted to 13,192,575, and the total cost of generation, 0·668d. per unit, of which 0·394d. was accounted

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for by fuel, stores, wages, &c., and the remainder by a proportion of the capital charges. The percentage of the working expenses to the total receipts was 60·86 per cent. The following figures are also of interest: Total number of units used for cars, 12,188,861; number of units used per car mile, 1·725; average traffic revenue per car mile, 9·842d.; and the average total revenue per car mile, 10·049d.

THE ACTON ELECTRICITY UNDERTAKING

WE referred briefly in our last issue to the comparatively heavy deficit shown in the electricity supply accounts of the Acton Urban District Council, in spite of the fact that this undertaking has merely the simple task to perform of buying its electricity in bulk, converting it to low pressure, and retailing it to the consumer.

Electrical energy is bought from the Metropolitan Electric Supply Co., Ltd., at an average price of 1·14d. per unit (847,916 units for £4,021). The number of units sold during the year 1907-8 amounted to 511,212. As the number of units generated at the low tension terminals was 645,335, the all-year-round efficiency of the converting plant was 76·1 per cent. Of the balance, 85,720 units were used in the sub-station, and 48,403 represent the distribution losses, and it is seen that the overall efficiency between high tension 'bus-bars and consumers' terminals is 60·3 per cent. Although this may not seem a very low efficiency, it must be noted that it means that about 66 per cent. more energy has had to be paid for than is actually sold. Still, even when this percentage is added, the cost would be still under 2d. per unit, and the average selling price was 3·88d. per unit (511,212 units for £8,260).

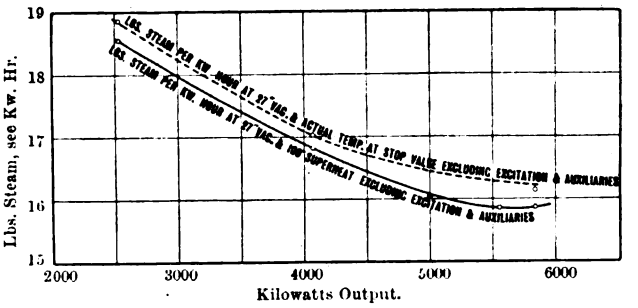
This margin, however, has not been nearly sufficient to meet the sub-station, distribution, and management costs, and the capital charges. The last-mentioned have been particularly large. The total capital expenditure has been £66,647, representing £201 per kw. of maximum demand (332 kw.). Part of this sum, it is true, has been spent on consumers' installations and public lamps, but if allowance is made for this, the balance is still £63,501, or £191 per kw., which is enormously high when it is remembered that it has only been for the converting plant and distributing network. The interest and sinking fund charges have amounted to £3,993, or 1·87d. per unit sold. Adding wages, repairs, and renewals, rents, rates, and taxes, management expenses, and other miscellaneous expenditure, the total expenditure for the year, exclusive of the cost of the energy bought "in bulk," comes out to £8,007. This includes a sum of £538 for installations on consumers' premises and meters, against which is an item of £607 on the revenue side, representing "amounts recoverable for sale of lamps and apparatus and work executed." It also includes a sum of £367 for maintenance and repairs of arc lamps, for which the Council is well paid, as 4d. per unit is charged for public lighting. If we deduct the two items of £538 and £367 from the total of £8,007, we get £7,102 as the cost of converting and distributing the 511,212 units sold, including capital charges, and this works out to 3·34d. per unit sold.

The total costs per unit sold, including the cost of the bought units, as well as the capital charges, is therefore 5·23d.

The average selling price, as we have said, was 3·88d. per unit, but to compare it with the total costs as given above, we must deduct from the revenue the cost of arc lamp maintenance, as this has already been deducted from the expenditure side, and is paid for out of the 4d. per unit paid for arc lighting. The average price obtained per unit thus works out to £7,893 divided by 511,212, *i.e.*, 3·70d., and there is thus a loss of over 1½d. per unit sold.

TESTS ON A 6,000 KW. TURBO-ALTERNATOR

WE published last week the results of some tests of a 5,000-6,000 kw. Willans-Siemens turbo-alternator which has been running since last May at the Manchester Corporation electricity works in Stuart Street. This week we are able to give the actual curve of steam consumption for the range of loads per



2,000 to 6,000 kw. It will be seen that the actual readings have been corrected to apply to a superheat of 100° F., and a vacuum of 27 in. The consumptions do not include the energy used for driving the air-pump and circulating pump of the condensing plant, nor the excitation losses. The lowest consumption was 15·84 lb. of steam per unit when the machine was developing 5,650 kw.

Wireless Telephony and Telegraphy.—The American wireless telegraphy expert, Dr. Lee de Forrest, has very hopeful views as to the future of wireless telephony. He announces that the French Government has consented to allow him to use the Eiffel Tower for the purpose of establishing wireless telephonic communication between Paris and New York. For the same purpose, a contract was signed last week between the American De Forrest Co. and the Metropolitan Life Insurance Co., providing for the use of the 700-ft. high tower of the latter company's new building in Madison Square. Dr. De Forrest estimates that the range of his telephonic apparatus in its present state is only 1,000 miles; but he fully expects that certain improvements, which he is now working at, will render wireless telephonic communication between Paris and New York possible within two years. The installation on the Metropolitan tower will, it is expected, be ready for operation at the end of this year. By the use of unusually long wave-lengths, Dr. De Forrest hopes to prevent interference of the service by other wireless messages.

Some further particulars with regard to the experiments which are being carried on in France by some naval engineers have been published in the *Matin*. The Poulsen transmitter, with one carbon and one water-cooled copper electrode, is used at the Eiffel Tower station, and the electrolytic detector of Captain Ferrié is employed for receiving. It is stated that the power necessary to keep up wireless telephonic communication between Paris and Dieppe does not exceed four kilowatts. We understand from the Amalgamated Radio-Telegraph Co., Ltd., who are the owners of the British & Continental rights of the Poulsen wireless telephone patents, that they have not granted any licences to any other firms, either in this country or on the Continent. They also inform us that the Danish group, who still retain the American rights of the Poulsen patent, have not granted any licences to Dr. De Forrest or any other company.

As a result of the successful experiments in wireless telephony conducted by Prof. Majorana, head of the technical department of the Italian Ministry of Posts and Telegraphs, at Monte-Mario, the professor is installing apparatus to enable communication to be effected between Rome and Sardinia. The success of the experiments is attributed partly to the use of a special form of microphone invented by Prof. Majorana, in which running water is said to occupy a prominent part.

According to the *Electrical World*, communication has been established between Iquitos, on the river Amazon, and Lima, partly by wireless telegraphy. The means of connection from Lima to Puerto Bermudez is an ordinary wire telegraph line, but from Puerto Bermudez to Iquitos, the distance of about 1,000 km., including long stretches of primeval forest, is bridged by wireless. The original intention of the Peruvian Government to connect Iquitos with the outside world by wire was given up on account of the immense difficulty and cost. The Telefunken Co., putting in the system, succeeded in establishing the service within two years. The expense of installation, which was about £40,000, was defrayed by the Peruvian Government.

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THE EFFECT OF METAL FILAMENT AND ARC LAMPS ON THE EYES

IT has long been suspected that "snow-blindness," or that affection of the eyes produced by long exposure to a strong light, such as exists in snow-clad regions, is partly due to the action of ultra-violet light reflected from the surface of the snow; and an affection known as *Ophthalmia electrica*, caused by direct exposure of the eyes to the rays of the electric arc, is sometimes considered to be identical with "snow-blindness." The proportion of ultra-violet rays in the light emitted by our artificial illuminants has necessarily increased with the increase in the temperature of the illuminating gas or body, and it has been suggested that the light emitted by the new metal filament lamps, and also that given out by those arc lamps which work at a high temperature, may have a very harmful influence on the human eye.

A recent issue of the *Elektrotechnische Zeitschrift* contains a Paper on the subject, which was read by Drs. F. Schanz and C. Stockhausen, before the Erfurt Congress of the Verband Deutscher Elektrotechniker in June last. Some experiments, carried out at the Technical University in Dresden, showed that, of the various types of electrical illuminants, the mercury-vapour lamp with quartz globe emitted the largest proportion of ultra-violet rays. The naked arc lamp came second, and the naked Nernst lamp third. The glass globe essential to all filament lamps and enclosed arc lamps, was found to absorb all ultra-violet rays of wave-lengths shorter than about 300 $\mu\mu$, but rays of wave-lengths longer than this have a distinctly harmful influence on the eyes. The authors describe the various affections of the eyes which are the results of exposure to ultra-violet light, and state that, in their opinion, the question of the protection of the eyes from the harmful influence exerted by artificial light sources should be seriously considered. Ordinary coloured glass globes, unless of such density as to reduce seriously the intensity of the light, are useless for this purpose, but after careful experiments, the authors have produced a glass (which they term "Euphos" glass) which, though only faintly yellow-green in colour, effectively cuts off, or rather absorbs, all the ultra-violet rays, without absorbing more than from 3 to 5 per cent. of the light emitted. They have produced glasses of slightly different compositions for different light sources; and the composition is such, that in each case the ultra-violet rays are totally absorbed with the least possible absorption of light rays in the visible spectrum. Photographs of the spectrum emitted by an arc lamp showed that an ordinary 1 mm. globe absorbed all rays shorter than 300 $\mu\mu$; but that an 0·8 mm. "Euphos" globe absorbed all the ultra-violet rays, leaving only the visible spectrum. Photographs of the spectrum of metal-filament and Nernst lamps showed the same effects.

An article by Dr. Voege, of the State Physical Laboratory at Hamburg, in the same issue of the *Elektrotechnische Zeitschrift*, describes the results of some experiments made to determine the relative proportion of ultra-violet rays in daylight and artificial light respectively. The author states that, although the experiments of Drs. Schanz and Stockhausen showed that modern electric lamps emit a larger proportion of ultra-violet rays for a given amount of light than do the older forms of illuminants, owing to the higher working temperature, there was no evidence to show that the proportion is higher than that for daylight, or direct sunlight.

The experiments conducted by Dr. Voege were divided into two series. The first series were made to determine the proportion of ultra-violet rays reflected from a white matt reflecting surface illuminated by sun or daylight and artificial light respectively. Two halves of a photographic plate were exposed respectively to the light reflected from two such surfaces illuminated from the two lights to be compared, after the distance of the artificial light source had been so adjusted that the two surfaces were *equally illuminated* as judged by the eye. All lenses were of quartz, so that no ultra-violet rays should be absorbed, and a screen or filter, consisting of a quartz vessel containing a solution of nitroso-dimethylanilin, was interposed between the illuminated surfaces and the plate. This filter absorbs all the light rays of the visible spectrum, but is transparent to the ultra-violet rays. The actinic rays of the visible spectrum are also absorbed by this filter, so that any chemical change on the surface of the plate would be due to ultra-violet rays only.

Experiments made with this apparatus proved that *for a given illumination* of the white surfaces, the proportion of ultra-violet rays in the reflected light was nearly always greater in the case of daylight. Even in the case of the mercury-vapour lamp with quartz globe, the difference, though pronounced when the comparison was made with light from a white clouded sky, was hardly distinguishable when the light from a clear blue sky was used. From these experiments the author concludes that for equal illumination, the light from artificial sources contains generally a smaller proportion of ultra-violet rays than does ordinary daylight, and consequently cannot be harmful to the eyes on this account. Certain arc lamps without globes and the quartz-globe mercury-vapour lamps do certainly provide a light richer in ultra-violet rays than sunlight, but the difference is only slight, and the ordinary glass outer globes used in conjunction with these lamps would certainly absorb the excess.

The second series of experiments were made with the object of comparing the proportion of ultra-violet rays in light received direct from an artificial source of light, and in that reflected from the sun by a polished metal mirror. Photographic plates were exposed for a given time through a spectrometer to lights from various sources in this way, and the results proved conclusively that the spectrum from sunlight extended much further into the ultra-violet region than any other. The lamps were placed at distances from the spectrometer, which were assumed to be the distances usual between the eyes and the respective light sources, for example, one metre for the arc lamp and 40 to 60 cm. for a filament lamp. The intensity of the ultra-violet rays was also found to be greatest in the case of sunlight. Other experiments showed that the reflected sunlight from a plaster or white-washed wall is stronger than the direct rays from the translucent globe of a 2,000 candle-power flame arc lamp at a distance of two metres, both as regards the extension of the spectrum into the ultra-violet region, and the intensity of the rays, both visible and invisible.

The fact that an arc lamp is apparently so much more brilliant than a sunlit surface, and is even unpleasant to look at directly, is explained by the author as being due to the unequal intensity of the light in the field of view in the former case. We have, in the author's opinion, much more to fear from the influence of unequal illumination than from ultra-violet rays in the light itself. The fear of harmful injury to the eyes from the influence of ultra-violet rays is consequently shown to be unfounded by the results of the above experiments, as if the proportions which obtain for daylight are not departed from to any considerable extent, no prejudicial action on the eyes need be expected.

The unequal illumination generally produced by artificial lighting is, however, a serious matter, and worthy of consideration. The new metal-filament lamps should really never be directly visible to the eye on account of the high intrinsic brilliancy of the filaments. Frosted globes surrounding a group of lamps and producing a uniform diffused illumination are to be recommended, and, of course, where possible, an indirect system of illumination is to be preferred, although this is uneconomical, owing to the amount of light lost by the absorption of the reflecting surfaces.

Electric Traction in the Simplon Tunnel.—The period of two years, after which the electrical equipment of the Simplon Tunnel was to be either removed by Brown Boveri & Co., or purchased by the Administration of the Swiss Railways, elapsed on June 1st last. The electrical equipment has proved so satisfactory that it has been purchased. It will be remembered that the firm of Brown Boveri & Co. undertook to provide the electrical plant at its own risks, and to restore the tunnel for steam traction if, after a period of two years, it was found that steam traction would be preferable. It is stated that the experiment, in spite of the sale of the equipment, has been a source of considerable loss to the company.

Telegraph Traffic.—Persian telegraphic communication has suffered temporary interruption, the line to Tauris and the province of Azerbaidjan having failed; but messages for these places are being sent *via* Indo.—The submarine cable between Cadiz and Teneriffe, which was previously reported as working badly, ceased working on 20th inst.—Telegrams to and from Brazil, Argentine Republic, Paraguay, and Uruguay, which under normal conditions went *via* Talisman, are now being forwarded by the Brest-Dakar cable without change of rates, and are sent "*via* Talisman" beyond. This route indication must appear in the preamble of the message.—We are also in a position to state that the line between Rome and Pera was restored on 21st inst. The delay in the repair of the Kwandang-Menado cable is due to the repairing steamer *Patrol* having run aground. The c.s. *Recorder* has gone to her assistance.—Communication with Nantucket has been restored, and messages by wireless can now again be sent by this route to Atlantic Liners.—The cable-repairing steamers *Relay* and *Mexican*, owned by the Mexican Telegraph Company, are both at present at New York. The latter is up for sale.

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POWER SUPPLY IN THE NORTH OF FRANCE

A DESCRIPTION has been given recently in *Le Génie Civil* of the power supply undertaking of the Société de l'Energie Electrique du Nord de la France which commenced operations last year in the important industrial district of Lille, Roubaix, and Tourcoing. This company was formed for the supply of electricity for lighting and power in the towns already mentioned and a group of surrounding places of smaller size as far as the Belgian frontier, and also to supply current to Compagnie de Tramways de Roubaix-Tourcoing and the Société l'Electrique Lille-Roubaix-Tourcoing.

The power station is in a very central position in the district served, at Wasquehal between Lille and Roubaix adjoining a branch of the Roubaix Canal. Its construction was commenced in September, 1906, and the supply was started in October, 1907, since which time the load has increased to such an extent as to necessitate extensions. A sketch plan of the site is given in Fig. 1. Communication with the railway is obtained by a special branch line crossing the canal by a bridge, and coal can be obtained either by train or from the neighbouring mines by canal. The building consists of parallel boiler and engine-rooms, constructed principally of reinforced concrete and, as is often the case, one end is permanent and the other temporary with a view to extensions. The equipment when complete will provide for an output of 25,000 kw. and will contain 40 boilers, of which 16 are now installed, and 7 turbo-generators varying in size from 1,500 kw. to 5,000 kw., of which four are already complete or in course of erection.

As already mentioned, coal can be obtained either by railway or by canal. In the former case the waggons are brought from the railway depôt over the company's own line to the works by an electric locomotive. This locomotive runs on a continuous current, 440-volt circuit, and was constructed by the firm of Hillairet Huguet. It has a weight of 5½ tons and can carry 1½ tons of ballast. A load of 30 tons can be drawn up a 1·7 per cent. gradient with a curve of about 400 ft. radius at a speed of about 1·7 mile per hour. The draw bar pull is 1 ton.

The coal arriving by water is taken from the barges moored to a special quay by a travelling jib crane provided with a grab, and deposited on the storage ground. This crane is constructed for a load of 2½ tons and has a radius of about 30 ft. with the pulley about 28 ft. from the ground. The lifting motor is rated at 28 h.p., and the slewing and travelling motors are 5 h.p. and 9 h.p. respectively. As a general rule, however, no great amount of coal is stored. The coal is taken from the storage ground to the boiler house in small trucks made in two halves, after the manner of a grab, so that the coal can be discharged below. These are filled from a hopper and are taken in trains of six to the entrance of the boiler house, where they pass over an Avery automatic integrating weigher. The top parts of the truck are then lifted bodily off by a special electrically-driven transporter, which takes them to the required point over the overhead coal bunkers and causes them to open and discharge the coal. In the event of breakdown of the transporter or repairs being required to the overhead bunker, arrangements are made so that the trucks can be taken direct to the firing floor. A further service of trucks from the basement of the boiler house returns the ashes and clinker. A section of the station is given in Fig. 2. The boiler house equipment will consist of 40 Niclausse water tube boilers, of which sixteen are already installed. These boilers are grouped in batteries of two and arranged in two rows on either side of the boiler house. Each is capable of evaporating about 110,000 lb. of water per hour and has its own 96-tube Green economiser and Niclausse superheater intercalated among the tubes. A superheat of 325°C. is available. Each boiler has about 2,000 square feet of main heating surface, 460 square feet of superheater surface and a grate area of about 62 square feet. The economisers are arranged with bypass flues, so that they can be put out of action for cleaning or inspection when required. Several systems of mechanical stoking are in experimental use, including a Bennis stoker and one of the underfeed type. Another boiler is being fitted experimentally with a Marconnet

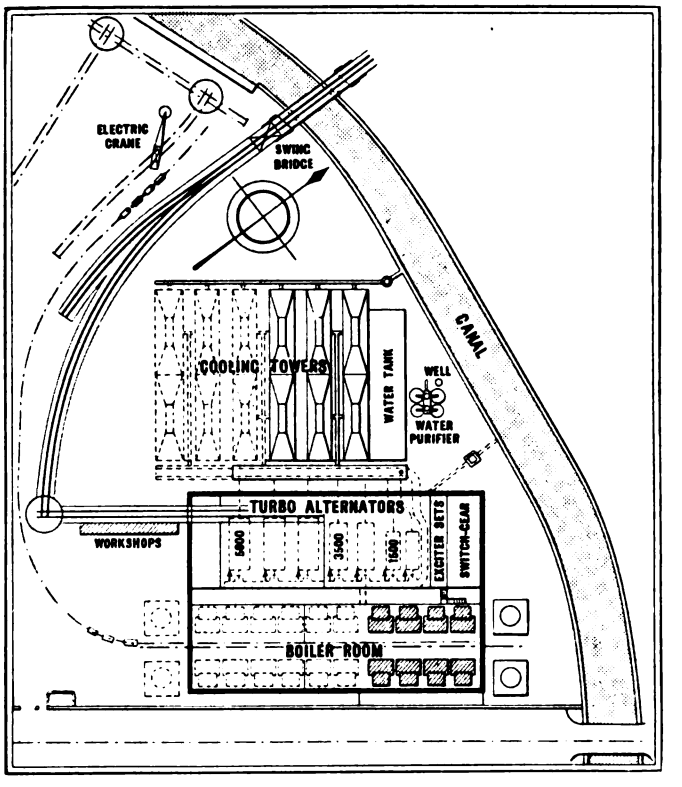

FIG. 1.—GENERAL PLAN OF SITE.

apparatus for burning low grade fuel in dust or powdered form.

The boilers can be fed either direct or through the economisers and the bad quality of the water obtainable which contains salts, such as sulphate and carbonate of soda, difficult to remove by the ordinary processes of purification, necessitates very special arrangements being provided. The boilers are divided for feeding purposes into two groups, one containing four boilers and the other the remaining 36. The small group are fed entirely from the make-up feed water which has passed through the purifier, and therefore all the soluble salts remaining in the water are concentrated in the four boilers which are very frequently cleaned. The other boilers are fed exclusively with the condensed water from the surface condensers and the steam traps. The boilers are fed by five-stage centrifugal Sülzer pumps driven at 2,800 r.p.m. by induction motors. Duplex steam-driven "Monitor" pumps are used as a stand-by.

The cooling water from the condensers passes through a group of Balke wooden cooling towers. The total amount of water evaporated when an output of 20,000 kw. is being given will amount to about 350,000 lb. per hour, and to condense this quantity of steam about 175,000 gallons of water per hour are required. For

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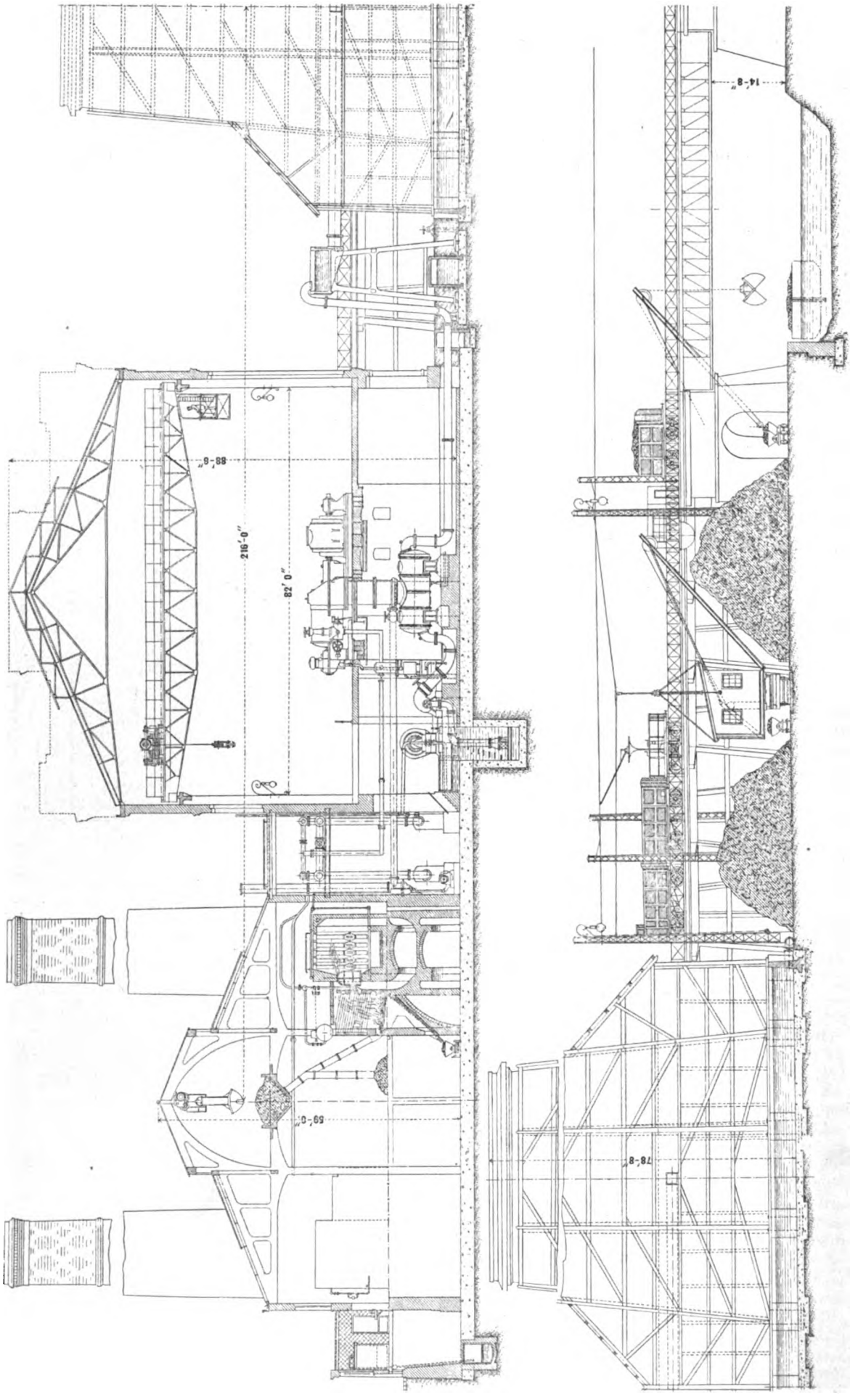

Fig. 2.—Section of Power Station and Elevation, showing Coal Handling Arrangements.

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cooling this water six towers, each capable of dealing with 32,000 gallons per hour, will be provided, of which three have already been erected. The make-up water for this purpose can be taken either from a well nearly 500 ft. deep or from the canal. In order to avoid corrosion of the condenser tubes this water is passed through a purifier on the Declercq and Verbiège system, capable of dealing with some 2,450 gallons per hour, in which the calcium carbonate is precipitated in the presence of the deposit accumulated from the water that has previously passed through, which renders the reaction more rapid. The water is carried to the top of the cooling towers by centrifugal pumps driven directly by three-phase induction motors.

The engine room is of ample proportions, and is served by a 30-ton electric travelling crane of 32 ft. span. The arrangement of the various generating sets which will compose the equipment is shown in Fig 2. The turbines at present installed are of the Brown-Boveri-Parsons type, running at 1,500 r.p.m and designed to work at a steam pressure of 200 lb. per. square inch and superheated up to 300°C. The two first sets have an output of 2,250 k.v.a. at a power factor of 0·8 (1,800 kw.), and two further sets for 4,350 k.v.a. 3,500 kw.) are in course of erection. As will be seen from Fig. 3, which gives a section of the engine room, each set has its condensing plant directly beneath it. Automatic valves permitting of an atmospheric exhaust when the vacuum is impaired are provided. The following are the guarantees for coal consumption:—Maximum load, 15·3 lb. per kw.-hour; normal load, 15·7 lb., and half-load, 18·5 lb. The generators are guaranteed to give their maximum output per 24 hours without the temperature rise exceeding 55°C., or their normal output without exceeding 45°C. The next instalment of plant to be erected will be two 5,000 kw. sets.

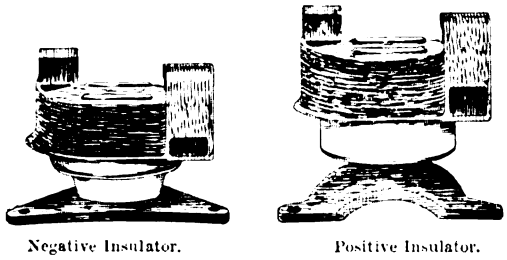
The alternators are wound for 10,000 units 50 cycles and are excited by a 210-volt exciter driven by a 300-volt alternating motor. Current is taken from the alternators to two sets of ring bus-bars, either of which can be completely isolated if necessary. These bars are of sufficient section to carry the whole ultimate output of the station (25,000 kw.), and are protected by water jet surge preventors. Current for service purposes about the station is obtained from a set of step-down transformers fed from the main bus-bars, and supplying a 300-volt circuit from which current is taken by the excitation motor generators and auxiliary motors already mentioned. Another supply of continuous current, from which the excitation can be taken if necessary, is provided by a battery which can be charged by a separate steam-driven high-speed continuous-current dynamo. This battery has a capacity of 120 ampere-hours, and can be used for station lighting in cases of emergency. The station lighting is, however, usually supplied from a 100 k.v.a. Westinghouse rotary converter, which also supplies at 440 units the crane, locomotive and transporter, which have already been spoken of in connection with the coal-conveying plant.

The switchgear is arranged at one end of the engine-room on galleries of reinforced concrete forming fine floors. In the basement is placed the battery and the transformers, and on the next floor are the 10,000-volt bus-bars and high-tension switches, surge preventers, &c. Above this is the operating gallery, whereon are placed the desk-type control panels for the generators and the boards for the auxiliary station service, exciting circuits, &c. The feeder switches, &c., for the underground feeders are situated on the next floor above, and the apparatus connected with the overload feeders occupies the top floor. A panel is provided on the operating gallery with measuring instruments for observing and recording the whole output of the station.

The outgoing feeders are composed partly of cables and partly of overhead lines leading to various transformer sub-stations. The four main sub-stations for the supply of tramways are at Roubaix, Tourcoing, La Madeleine, and Leers; each of these contains five 240 kw. Westinghouse rotary converters, and the necessary transformers and switchgear.

CONDUCTOR RAIL LEAKAGE ON THE LONDON UNDERGROUND RAILWAYS

A PAPER, entitled "Conductor Rail Measurements," was read by Mr. S. B. Fortenbaugh at the Summer Convention of the American Institute of Electrical Engineers, in which are included some results of tests of leakage, &c., on the conductor rails of some of the underground electric railways of London. The Paper commenced with a few notes on the differences between the equipment of the District Railway and the new Tube lines. As is well known, "third" and "fourth" rails are employed on all the railways of this group. Both the conductor rails are of low carbon steel, and are supported on stoneware



Negative Insulator. Positive Insulator.

FIG. 1.—INSULATORS USED ON DISTRICT RAILWAY.

insulators. The insulators used in supporting the positive (outside) and negative (centre) conductor rails are essentially of the same design on the individual roads, the top of the positive insulator being 1·5 in. higher than the negative. A malleable-iron cap and base is used on the District Railway insulators, the difference in height of the positive and negative insulator being partly in the depth of the insulation and partly in the design of the base. The form of the insulators on the District Railway is shown in Fig. 1.

No base or cap is used with any of the insulators on the Tube railways. The top of the positive conductor rail is 10 in. and 10·5 in. above the top of the sleepers on the District and Tube railways respectively.

Fig. 2 gives full details of the arrangement of the track and conductor rails, including some additional sections to those given in Mr. Fortenbaugh's Paper.

An extended series of preliminary measurements and tests were made on the Hounslow and Putney section of the District Railway early in 1905, with a view of trying to account for the comparatively low insulation resistance of the negative conductor rail. These tests were made during the constructional period; with the regular steam trains in daily commercial service, and the insulation of the conductor rails was therefore more or less of a variable quantity and subject to the temporary changes and conditions incidental to such work. The positive (outside) conductor rail, particularly at the stations, was heavily coated with grease from the steam trains, and this, together with loose ballast dirt, &c., made it practically impossible to maintain good insulation during these tests. The results were therefore somewhat erratic, but plainly indicated the existence of the peculiar phenomena afterwards observed under more favourable conditions on the Tube railways. Subsequent tests of the voltage between the earth and the positive and negative rails respectively were made after the trains had been running about six months, and with a line voltage of 580 this was found to vary between the limits of 540 volts for the positive rail, and 40 volts for the negative rail in "very fine" weather, to 478 and 102 volts respectively in "very wet" weather.

The tests on the Baker Street and Waterloo Railway, like

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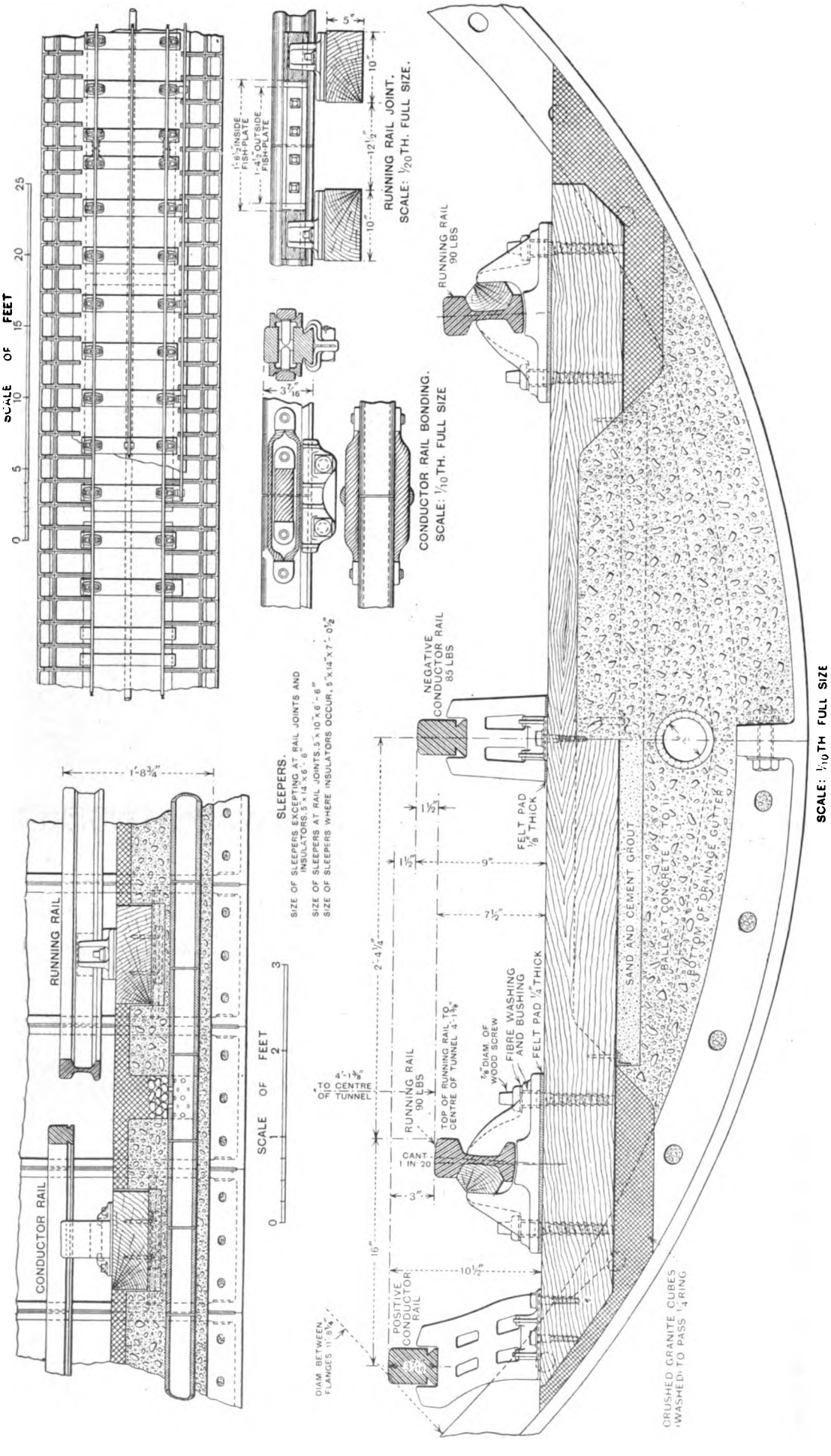

FIG. 2.—SECTIONS AND DETAILS OF ARRANGEMENT OF TRACK AND CONDUCTOR RAILS, BAKER STREET AND WATERLOO RAILWAY.

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those on the District Railway, were made about the end of the constructional period, and were therefore subject, but in a much lesser degree, to the possibility of the same general disturbances. The conditions of weather and temperature were, however, practically eliminated in these deep level tunnels. The following measurements were made on the "up-road," between the cable passageway beneath the London Road sub-station and the far end of Baker Street Station platform, a distance of 3·47 miles :—

Between positive (outer) and negative ...	570 volts.
,, ,, and earth	510 ,,
,, negative and earth...	60 ,,
Leakage, positive to negative	0·5 amperes.
,, current per mile of single track ..	0·144 ,,
,, positive earthed	5·0 ,,
,, negative earthed	0·57 ,,

Current was on for 2·5 hours on the preceding afternoon, and for 3 hours continuously and immediately preceding the above measurements, and the insulators were supposed to have been cleaned before the observations.

The polarity of the conductor rails was reversed immediately after the preceding readings and the pressure applied continuously for 48 hours, all other conditions remaining the same. Readings were taken regularly between the outer rail (now negative polarity) and earth, the results being shown on Fig. 3.

At the end of the 48 hours the following readings were taken :

Between positive (centre) and negative ...	570 volts.
,, ,, and earth	455 ,,
,, negative and earth...	115 ,,
Leakage, positive to negative	0·5 amperes.
,, current per mile of single track .	0·144 ,,
,, positive earthed	2·8 ,,
,, negative earthed	0·7 ,,

These results show that the potential between the outer rail and earth was reduced from 510 (positive to earth) to 104 volts (negative to earth) in 24 hours. Some local disturbance then caused a sudden rise to about 118 volts, after which it again slowly but steadily fell to 115 volts at the end of 48 hours. During the first half-hour immediately following the reversal, the leakage current increased steadily from 0·5 to 1·27 amperes, and then gradually became less. It reached the normal value of 0·5 of an ampere on or before the end of the 48 hours.

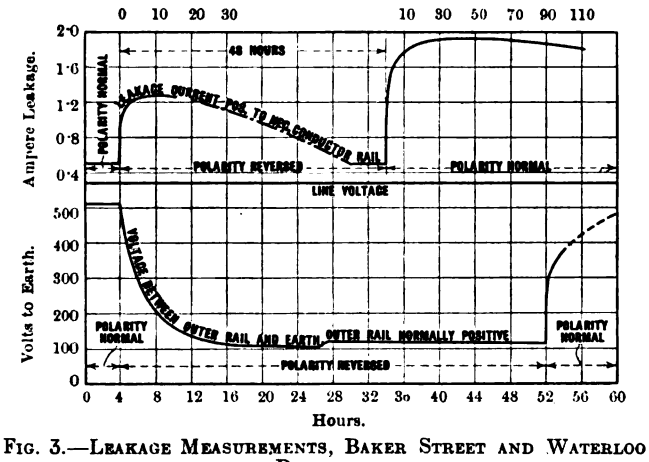

Fig. 3.—Leakage Measurements, Baker Street and Waterloo Railway.

The polarity of the conductor rails was again made normal—immediately after the 48-hour run with polarity reversed—the increase in leakage current and the variation in potential between the outer rail and earth for the first two hours being also shown in Fig. 3. The leakage current rose rapidly immediately following the change from reversed to normal polarity, the maximum value of 1·92 amperes being reached in about 35 minutes.

The conductor rails were alive, normal polarity for running trains a total of 117 hours between the readings on January 4th and the following readings on January 16th, 1906 :—

Between positive (outer) and negative ...	565 volts.
,, ,, and earth...	530 ,,
,, negative and earth	35 ,,
Leakage, positive and negative	0·32 amperes.
,, current per mile single track ...	0·092 ,,
,, positive earthed	5·70 ,,
,, negative earthed	0·35 ,,

The following measurements show the effects of reversing the polarity of the conductor rails, the rails having been alive about 24 hours, normal polarity, for running trains between the tests of January 16th and 19th. The rails were alive continuously for 43·5 hours between the readings of January 19th and 21st with the polarity reversed; that is, outer rail negative—and for 21 hours, normal polarity, between the readings of January 21st and 22nd. Fig. 4 gives full details of these tests, and Fig. 3 the details of similar tests on the same road and under practically the same conditions.

		Jan. 19.	Jan. 21.	Jan. 22.
Between positive and negative...	volts	575	575	575
,, outer rail and earth ...	,,	531	112	530
,, centre rail and earth ...	,,	44	463	45
Leakage, positive to negative ...	amperes	0·29	0·35	0·3
Amperes leakage per mile single track ...		0·084	0·101	0·087
Leakage, outer rail earthed ...	amperes	4·3	—	—
,, centre rail earthed ...	,,	0·3	—	—
Approximate distance	miles	3·47	3·47	3·47

Some tests with similar results made on the "down" road are also recorded in the Paper.

The results are corroborated by many other measurements made during the years of 1903–1907, all of which plainly and unmistakably show the existence of the phenomena substantially as illustrated in Figs. 3 and 4. There has been considerable study and investigation as to what actually takes place at the time of reversal, the general consensus of opinion being that it is an ordinary case of electrolytic action combined with ordinary insulation resistance conductivity. These results seem to depend upon one form of phenomenon which has long been known in connection with static charges, namely, that a negatively charged conductor leaks away its charge with much greater facility than does a positive; or virtually that under the same conditions a positively electrified conductor is better insulated. A negatively electrified conductor appears to be continuously discharging negative ions, which have the effect of conferring conductivity on the surrounding gas and of causing deposition of moisture from air more or less saturated. It is perfectly conceivable, therefore, that this negative discharge should favour the depositing of moisture between the surfaces of insulators progressively in such a manner that a slight conductivity might be conferred upon the insulator surfaces, and that this effect might be expected to be absent with the positive side of the system. The film of liquid existing between the electrodes on a glass surface will gradually move from the positive to the negative electrode, and the negative insulators may therefore lose their insulating properties by having moisture drawn upon

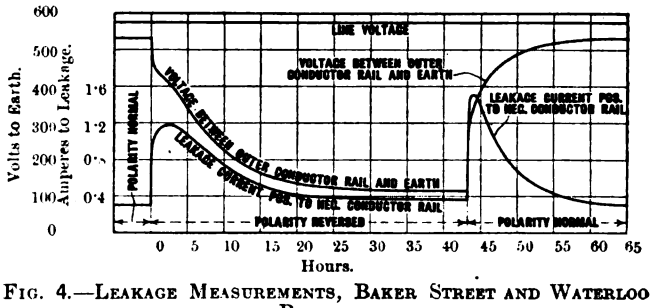

Fig. 4.—Leakage Measurements, Baker Street and Waterloo Railway.

them, an action which does not take place on the positive side. The reducing or chemical action of the ions liberated at the positive rail insulator may result in the formation of compounds which lower the resistance of the negative insulator, while the oxidation which takes place at the positive insulator may improve the insulation.

Conclusions.—These results, whatever the immediate cause or the reason, have clearly demonstrated certain facts which are probably applicable to all similar installations, and may be briefly summarised as follows :—(1) That the difference of potential between the positive conductor and earth is always normally considerably greater than the potential existing between the negative conductor and earth. (2) That this difference between the positive and negative insulation becomes more marked the longer the conductors are subjected continuously to a difference of potential in the same direction. (3) That a reversal of the polarity is always instantly accompanied by a considerable increase in the normal leakage current between the positive and negative conductor. (4) The above phenomena can be repeated indefinitely and are independent of the length of time that the pressure has been previously applied to the conductors in either direction. (5) That the insulation of the negative conductor to earth cannot be proportionately maintained.

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THE ELECTRIFICATION OF THE VICTORIAN RAILWAYS.

THE question of the electrification of the suburban railways of Melbourne has been under consideration for over a year, and there now seems to be every probability of the commencement of the work in the near future. It will be remembered that Mr. Charles H. Merz was appointed consulting engineer to the undertaking about a year ago, and was ordered to prepare a full report for the guidance of the Victorian Government, together with recommendations as to the most serviceable system, and the probable financial results. As mentioned in a previous note on the subject on page 759 of ELECTRICAL ENGINEERING, Vol. III., the original proposal was to convert at first only the St. Kilda and Port Melbourne lines, 3½ and 2¼ miles of double track respectively, but according to the latest information, the first instalment will include a much greater length of track.

In a published interview with Mr. J. A. Boyd, a member of the Victorian Government, who has just completed a tour of inspection of the British electric railways, the *Railway Times* states that Mr. Merz's report is now complete and will shortly be presented to the Victorian Railway Commissioners, who will in turn lay the matter before the Government of that Colony. It is believed that Mr. Merz will include in his report, besides the St. Kilda and Port Melbourne lines, the lines of Essendon and Brighton as the first instalment. The length of the Essendon line is 5 miles, while the Brighton line is 9 miles long, so that, including the St. Kilda and Port Melbourne lines, the total route length to be electrified would be 19¾ miles, or about 40 miles of track. It is expected that the adoption of the third-rail continuous-current system will be recommended in the report, similar to that of the Tyneside lines of the North-Eastern Railway and the Liverpool-Southport line of the Lancashire and Yorkshire Railway. The report contains full specifications to enable the Commissioners to call for tenders immediately the Government's sanction has been obtained.

The Melbourne suburban railways comprise altogether 149 miles, practically the whole of which is double track. Most of the lines run eastward of the city, which is the principal residential area, and it is here that the congestion of traffic, which has compelled the authorities to consider electrification or duplication of the track, has been most felt. The power station will probably be located at Laverton, a point considerably to the west of the city, where some large coal-beds lie undeveloped.

Should the present scheme be accepted by the Government, the results should provide useful data for further extensions. The mileage of the suburban railways, as we have already seen, is 149, the track mileage amounting to 263 miles, while there are 148 suburban stations. The total population served is 531,000. The latest available figures relating to the Melbourne suburban railways are those for the year ended June 30th, 1907. These show that 2,992,283 train miles and 24,455.631 car miles were run during the year. There were 64,162,344 passenger journeys, the passenger mileage being 305,071,565, and the average distance travelled by each passenger (single trip) 4·76 miles. The average seating capacity per car was 52, the average seating capacity per train mile 420, and the average number of passengers per car mile, 12·47. The surburban revenue (exclusive of parcels, mails, &c.) was £645,448, the revenue per train mile being 51·77d., per car mile, 6·33d., per passenger mile, 0·50d., per passenger journey, 2·41d., per mile of railway, £4,332, and per mile of track, £2,454.

The Korn System of Telephotography in Denmark.—Our Danish contemporary, *Ingeniören*, contains a report of a lecture by Prof. Korn, of Munich, in connection with the first apparatus being installed in Denmark for the daily paper, *Politiken*. The apparatus described was similar to the installation recently experimented with at the offices of the *Daily Mirror* in London (see ELECTRICAL ENGINEERING, Vol. II., page 766), and it is unnecessary to repeat the details of the arrangement for employing the variations in the resistance of selenium under the influence of light to attain the desired result. After the lecture Prof. Korn showed the apparatus that is to be used by the daily paper, *Politiken*, in Copenhagen, and *Dagens Nyheter*, in Stockholm. A photo was telegraphed from the one apparatus to the other, and after that an attempt was made to receive a photo sent from Berlin. This was, however, not successful, because of some fault on the circuit by means of which the current from Berlin was considerably weakened. Prof. Korn, however, claims to have sent photos successfully over much greater distances, but it appears that mishaps like this will always be liable to take place as long as the circuits used are not especially arranged for telephotography.

TRAMWAY ACCIDENT AT LIVERPOOL.

AN unfortunate tramway accident, resulting in slight injury to some of the passengers, occurred in Liverpool on Friday last. The scene of the accident was the junction of Lambeth Road and Commercial Road in the Sandhills district, at the north end of the city near the docks. Shortly before nine in the morning, a workmen's car with thirty passengers, which was descending the steep gradient of about one in fourteen of Lambeth Road, suddenly left the rails, according to the local papers, and collided with a lorry heavily laden with paper. According to the official account of the accident, however, the car did not leave the rails before colliding with the lorry.

The official report states:—"Car 443 Breckfield Road and North Docks, in charge of Driver Richard Walsh and Conductor John Doyle, was proceeding down Lambeth Road at about five minutes to nine. Everything went well until it reached the bottom of Lambeth Road, when for some unexplained cause the driver failed to stop the car at the junction of Lambeth Road and Commercial Road, and allowed it to travel across the road, when it collided with a wagon loaded with paper materials. The car at this point tilted over from the force of the collision on to the wagon. As a result of this some of the passengers were thrown from their seats, and some of them were injured by the falling of broken glass. Six passengers who were suffering from what turned out to be comparatively slight injuries were taken to the Stanley and Northern Hospitals, where they received prompt attention, and were then able to proceed to their homes. The only person whose injuries were of a serious character was the driver, who still remains an inmate of the Stanley Hospital. It may be mentioned that the brakes, both electric and hand, were tested immediately after the accident, and were found to be in perfect order, together with the whole of the car equipment."

Prior to the commencement of the business of the meeting of the Tramways Committee on Friday, Sir Charles Petrie, who presided, referred to the accident, and said that the driver was a man who had been in the tramways' employ for a considerable number of years, and bore an excellent character. So far they did not know the cause of the mishap, but an inquiry would be held.

Mr. C. W. Mallins, the General Manager of the tramways, informs us that the first accounts of the accident were grossly exaggerated, and has sent us a statement, made by the driver, as to how the accident occurred. He commenced to descend Lambeth Road at a low rate of speed on the electric brake, and brought the car to the bottom of the hill in perfect safety, where it was necessary to put on the hand-brake to hold the car stationary at the compulsory stopping station. In doing so he inadvertently failed to put the clutch into the proper position to engage in the teeth of the ratchet wheel at the base of the brake staff, with the result that the hand-brake flew off and the staff struck him a heavy blow on the elbow, disabling his arm for the moment, and thus allowing the car to go without the brake for a distance of 18 to 20 yards, where it collided with a wagon, thereby causing the accident. In addition, he says the brakes and other equipment were in perfect condition, and the car did not leave the metals. Had the waggon not come in the road he would have been able to put the brake on immediately afterwards, and have brought the car to rest, thus avoiding the accident. The force of the collision with the waggon disturbed the equilibrium of the car, as it was on the curve at the time, causing it to cant on to the waggon. This statement is corroborated to a great extent by passengers who were travelling in the car at the time.

German Regulations for Accumulator Factories.—According to *Engineering*, some new regulations concerning the hygienic arrangements in lead accumulator works came into force in Germany on July 1st replacing the regulations of 1898. Floors of wood, asphalte, or linoleum are forbidden in rooms in which lead-dust or vapours may form; the walls and ceilings should be painted in oil, or be whitewashed at least once a year. All dust and vapour must be sucked up at the point of origin; this refers to lead-fusing, sawing and cutting, to the preparation of lead-dust, and to sifting and mixing the compounds. All soldering has also to be performed under suitable ventilation-hoods. The zinc and sulphuric acid for generating the hydrogen, used for soldering, must be technically pure. The employer must provide his men with suitable clothes for carrying on the dangerous work; there must be tooth and nail-brushes in the lavatories, and the men must take a warm bath once every week. Female labourers and boys must not be employed at all in the lead department. The rooms for meals must be kept entirely apart from the others, and the men are not permitted to enter those rooms before changing their garments. The use of alcohol and tobacco is forbidden. Nobody may be employed in the lead department who is not certified as fit by the physician, who has to examine all the employees at least once every month. The employer and the physician have to keep records of the men's work and state of health. Dangerous work may be performed either on a shift of eight hours, with a break of at least one hour and a half, or in a shift of six hours.

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ELECTRIC LIGHT AND POWER IN THE WEST-END PREMISES OF MESSRS. DEBENHAM AND FREEBODY

THE electric lighting and power arrangements in the fine new premises of this well-known drapery establishment in Wigmore Street afford an excellent example of the perfect control which may be obtained over the lighting and power supply of a large business concern, both as regards efficiency and economy, by the application of electricity for these purposes. The fine block of buildings, most of which is comparatively new, occupies a ground area of some 32,000 sq. ft., and is divided into two halves: the retail and the wholesale departments respectively. This block stands entirely by itself, but is connected by an underground passage to a small block of buildings used as cloakrooms and stables, on the opposite side of a narrow road at the back of the main building. The incoming service cables, of which there are two, are both brought in to the main switchboard room situated in the basement under the stables. Supply is taken from the mains of the Marylebone Borough Council, and is continuous-current three-wire, with 480 volts across the outers. The charges, both for lighting and power are on the maximum demand system; and in order to take advantage of the fact that the maximum demand of the building as a whole is less than the sum of the maximum demands of the various portions, it was decided to take in the service cable at one point only, whereas from other points of view it would have been more satisfactory to have supplied the building from several different services led in at convenient points. There are two service cables, however. These are concentric, each consisting of two outers and a neutral. They are taken from different sections of the distributing network, and are connected respectively to the two sides of a two-way change-over switch, after first passing through the Marylebone Council's fuses, maximum demand meters, and energy meters. There are three energy meters on either side of the three-wire system, these being for the basement lighting, upper-floor lighting, and power respectively. The basement lighting supply is on a flat rate, but the other two supplies are on the maximum demand system. The three-wire system is divided at the intake into positive and negative halves, so that all the above meters, including the power meters, are connected between one outer and a neutral. The two halves of the system are kept entirely separate, the lighting and power being divided between them, with the exception of a few 480-volt motors, which are connected across the outers of the power cables. There are in this switch room six energy meters and four maximum demand meters belonging to the Marylebone Council; another set of sixteen maximum demand indicators, eight on each side of the system, register the maximum demands of the different departments. These latter meters are read every night and re-set every month, as the lighting and power costs are charged up separately to each department, the manager of each department keeping careful accounts of all expenses in his department. The necessity for thus metering the consumption of each department separately rendered the wiring of the building particularly difficult, and as will be explained later, nearly every circuit is provided with a meter.

The rates charged by the Marylebone Borough Council are those in force all over Marylebone, namely, a flat rate of 2d. per unit for the basement; an upper-floor lighting rate of 8d. and 1d.; and a power rate of 2d. and 1d. For the winter months, an amount equivalent to 200 hours per quarter at the maximum demand is charged at the high rate, and in the summer an amount equivalent to 50 hours at the maximum demand. From the main switch room the cables run to a large distributing board in an adjacent room, which consists of a positive and a negative half. There are sixteen panels in this board, one of which is diagramatically illustrated in Fig. 1. Each panel contains the apparatus needed for six circuits. Each circuit is provided with a double-pole switch, fuse, electrolytic meter, ammeter, and in the case of the arc-lamp circuits, of which there are sixty, a clock. Although there is provision on the

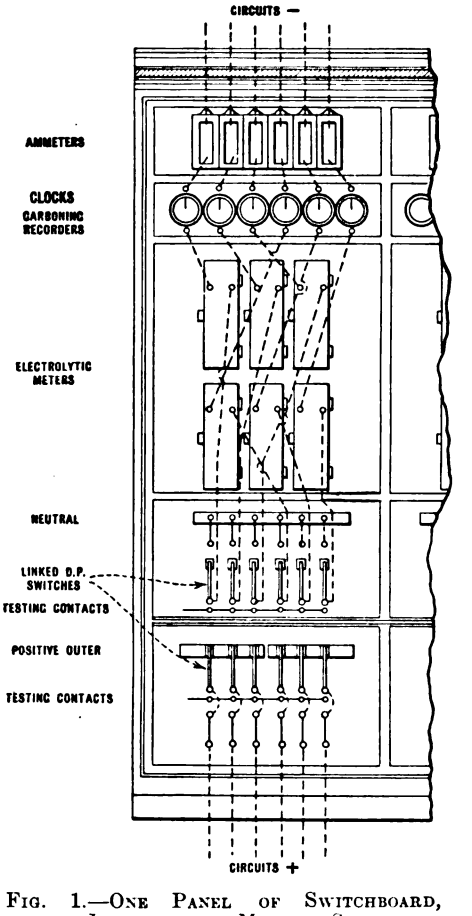

FIG. 1.—ONE PANEL OF SWITCHBOARD, SHOWING INSTRUMENTS, METERS, SWITCHES, AND CLOCKS FOR SIX ARC LAMP CIRCUITS.

board for sixty arc lamp circuits, or 300 lamps, only 44 of these circuits have been installed at present.

The use of the clocks or "carboning recorders," in the arc-lamp circuits is as follows:—The arcs are of the open inverted pattern, and are connected five in series, each group of five constituting a circuit, and having a switch, fuse, meter, ammeter, and clock on the distributing board, as described above. There are in all 220 lamps, of which 200 are 8-ampere, and 20 are 5-ampere arcs. The former burn about nine hours and the latter seven hours before needing fresh carbons. After any particular group of lamps has been trimmed, the clock corresponding to the group is set to twelve o'clock; when the lamps are switched on, a sole-

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noid and detent device releases the clock mechanism, and the clock thus registers the number of hours the group of lamps has been burning. The switchboard attendant can thus, by glancing at the clocks, see at once when any group of lamps requires trimming, and can also make certain that all lamps have sufficient carbon to last through the day, before switching them on, except on foggy days, when they may be alight all day.

The other pieces of apparatus in the room include four large ammeters on the two lighting and power circuits, and two recording voltmeters, one on the positive and one on the negative side of the system.

There is also an insulation resistance recording instrument in connection with the insulation-testing system which is worthy of a full explanation. This system is patented by Mr. A. D. Stevenson, the consulting engineer to Messrs. Debenham & Freebody. It consists of the recording instrument mentioned above, which is practically a recording voltmeter, the resistance of which is about 14,000 ohms, a three ampere-hour, 200-volt E.P.S. battery with charging board, and a number of contacts which put all the lighting and power circuits in parallel on to the testing set. These contacts, which are indicated in Fig. 1 (p. 319), are so arranged under the double-pole circuit switches, that when the switches are opened the circuits are totally isolated from the supply mains, but are put on to the testing set. A continuous test is thus being made of all of the circuits which are not at the time connected to the mains. A fault in a basement circuit will thus be indicated at night when that circuit is switched off, and in the case of the lighter rooms, the record of a fault would, of course, continue in the daytime. If a fault is indicated, the switches are one by one lifted off the testing contacts until the voltmeter indicates that the fault has disappeared. That particular circuit is then inspected, and the fault localised and repaired. The battery and the charging board are situated in the main switch room. The battery is charged for one hour every week, but it would keep the system working continuously for three weeks on one charge.

A novelty in the main switch room is a lamp-pairing board for pairing the 120-volt Osram and Tantalum lamps which are used in series; as there are 370 Osram and 170 Tantalum lamps in use in the building, all connected two in series, this little board is found very useful. It carries two lamp-holders connected in series, a voltmeter, and a two-way switch for putting the voltmeter across either of the two lamps under test.

As previously mentioned, the main switch room is situated in the basement of the separate building used as stables, &c. By putting the main two-way switch in the neutral position, the main building is entirely cut off from the supply. This is done every evening by the switch-board attendant. The lighting of the other building, in which live certain members of the staff, and in which are also situated the rooms of the fire brigade, is supplied quite separately from another service point with the ordinary complement of meters, fuses, &c.

We now come to the lighting arrangements proper. Wherever practicable, the system of indirect illumination by inverted arcs has been followed. The open spaces and the unusual freedom from obstruction due to partitions and columns, gave opportunity for the use of large units of light, thereby conducing to a considerable economy in current consumption; while at the same time the requirements of even diffusion of light and intrinsic brilliancy at every point are met by the adoption of the indirect as opposed to the direct method of illumination. The type of lamp adopted is that of the Union Electric Co.'s open inverted arc, and these are fitted with inverted reflectors for the purpose of throwing the light up to the ceiling, where this is sufficiently near the correct hanging level of the lamp to afford a good even illumination. The reflector used is a 19½ in. diameter enamelled cone.

In cases where the ceiling is not sufficiently near the crater of the arc to give a sufficiently strong illumination, over-reflectors, constructed with a surface of vitrified white enamel, and measuring 35½ in. in diameter, are fitted. These are placed approximately 12 in above the arc, and a small under-reflector measuring 12 ins. diameter, is placed immediately below the arc, so as to catch any rays which may fall at an angle greater than about five degrees to the horizontal.

As the under reflectors are not large enough to comply with the insurance companies' specified minimum diameter of 3 ft. 6 ins. for open unprotected arcs, it was necessary to fit all the lamps with glass cylinders. These cylinders do not improve the distribution of the light, and moreover, they absorb a certain amount of the light, which is sometimes said to be as much as 15 to 20 per cent.

The light from these arcs is said to be excellent for matching colours. In the days of the carbon glow lamp, material was taken to a special room for matching in the evening, which was lit by a "Jandus" enclosed arc lamp, with a special coloured glass globe. The light from the inverted arc lamps is found, however, to be quite suitable for this purpose.

There is no special lighting for the windows, which are deep and glazed in (as is seen on the left hand side of Fig. 2). The inverted arcs near the windows are moveable to the extent of one or two feet away from, or towards, the window front, as they are hung from rails. The whole of the illumination of the windows is thus derived from the general illumination of the showrooms. The windows are only very lightly draped above, and this arrangement is found to answer very well. There are a few arcs on the exterior of the building, but these are too high to help much in the illumination of the windows.

One great advantage of the uniform diffused illumination is that the arrangement of the showrooms can be altered, and show cases and counters placed in different positions, without the necessity of altering the lighting arrangements, as would most certainly be necessary if a large number of small units were employed. Besides the inverted arcs, a few pairs of 50-c.p. Osram lamps are hung in each room, but these are only used when the rooms are closed to customers, and a small amount of light is required for cleaning or other purposes.

There are no switches in the rooms for the arc-lamps; if they are needed, the switchboard attendant is telephoned to. The switchboard attendant has all the arc circuits under his control, and he is thus enabled, by switching off wherever possible, to keep down the maximum demand. This is especially important at the end of September, when the lamps are just beginning to be used.

As the lamps are arranged five in series, and as there was often need for a fewer number of lamps in one showroom, much difficulty was experienced in grouping the lamps so that the departments were all kept separate. Lamps which might be required for late working, had also to be kept on separate circuits, to avoid burning lamps unnecessarily. The restaurant and the reception rooms are lit with groups of Osram lamps in fours, shaded with frosted glass diffusing globes. The metal fittings for these lamps, and also the copper covers and reflectors for the arcs, were supplied by the Birmingham Guild of Handicrafts. In the offices and smaller rooms, tantalum lamps, arranged two in series, are used.

The dressing and fitting-on rooms, of which there are several, are each fitted with a group of four 50-c.p. Osram lamps, without frosted globes. The mirrors

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are fitted with "Linolite" lamps at top and bottom. There is also a wall plug for a portable lamp, and another pattern of plug on the heating circuit for a radiator. Flush-type switches are used. In a few cases there was occasion to have two arc lamps only, and so two 120-volt enclosed arc lamps were connected to the 240-volt circuit in series. In the basement and particularly in the old portion of the building, there is a large number of carbon filament lamps. In all there are 230 arc lamps, 700 carbon filament lamps, 370 Osram lamps, and 170 tantalum lamps.

In an establishment such as that under consideration, there are not many opportunities for the application of electric power. In the present case the total horse-power installed aggregates only 110 h.p., and is divided up among 50 motors. Of these, two are 5-h.p. motors driving blowers for supplying air to the basement rooms. The air is taken in at two points at about the level of the first floor, and blown through dust filters and moistening screens. It is then supplied with a quantity of ozone from "Ozonair" generators, and passed through brick ducts under the floor. It was necessary to pass the ducts under the floor, as otherwise the isolation provided by the fireproof partitions and sliding doors would have been rendered useless. There are also two extracting shafts, measuring 3 ft. by 5 ft. internally, and extending from the basement to the roof. At the top of each there is a 3-h.p. motor driving a 48-inch extractor fan. All the rooms are connected with the shafts, the gratings being provided with adjustable louvres. The two 10-plate ozone generators which supply ozone to the incoming air have their own transformers. There are 15 other generators distributed amongst the various workrooms; a transformer in each workroom operating a group of generators. The current for the transformers is obtained from a special circuit supplied by a 1-h.p. converter running off the 240-volt power circuit, and generating at 160 volts 50 cycle alternating current. The transformers transform up to from 3,500 to 5,000 volts, and the current is conveyed to the various ozone generators hung from the ceilings of the workrooms, by rubber-covered wires drawn through tubes made of a rubber-fibre compound. The generators in these rooms have no fan attached, the ventilation of the room being considered sufficient to cause the necessary circulation of air. The operating pressure of the generators can be varied between 3,500 and 5,000 volts by switches on the primary sides of the transformers. This ozone generating installation was not in the original scheme designed by Mr. Stevenson.

Another application of electric power is the parcels conveyor. The parcels come down from the various departments in spiral chutes, and alight on travelling belts, which in turn convey them to a rotating table which passes them before men who pick out the particular parcels they have to deal with as they pass them on the table. A number of small motors are employed to run this conveying plant.

Several sewing machines in the workrooms are electrically driven. The operation of switching on is performed by pressing the treadle, which starts the motor and then puts on the clutch. There are 16 electrically-heated Prometheus flat-irons in the workrooms. To prevent these being left on after working hours, each is provided with a lamp which is alight when the iron is switched on. It was found, however, that these lamps were used for illuminating purposes by cleaners, &c., and high voltage lamps were therefore substituted for the normal voltage lamps. These only give a slight glow. Screw holders are used in order that the normal lamps cannot be put in these indicating lampholders. Electrically-heated glue-pots, with a similar arrangement of indicating lamp, are to be found in the packing room. The heating of the building is done by steam, but there are a few electric radiators in use.

The wiring is entirely in screwed steel conduit. In the showrooms and other retail departments it is hidden, but in the basement and in the wholesale departments it is on the surface. The contractors for the whole of the electrical work, with the exception of the Ozonair installations and the electric lifts, were Messrs. Thompson, Ritchie & Co., Ltd., who supplied the switchboards and fittings. The switchboards were constructed to the design of Mr. A. D. Stevenson, the consulting engineer, who also superintended the carrying out of the whole of the work, including the heating arrangements and the ventilating arrangements, and who courteously showed our representative over the establishment.

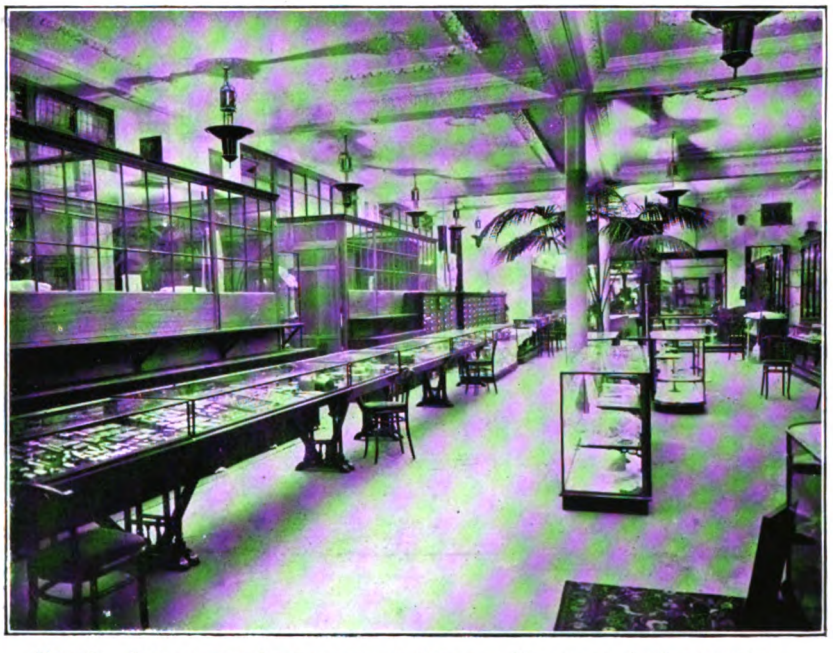

Fig. 2.—One of the Showrooms at Messrs. Debenham & Freebody's. The Photograph was taken by the Light of the Inverted Arcs.

The premises are equipped throughout with a service of uniform and accurate timepieces by means of the well-known "Synchronome" system. The electrically operated pendulum clock is of the latest type with the detached gravity escapement, the joint invention of Sir H. H. S. Cunynghame, and Mr. F. Hope-Jones. This master-clock operates 66 dials, arranged in the various rooms all over the building. These dials are all connected in series. The master-clock sends a current impulse every half-minute. The operating current is very small, and is derived from a primary battery.

The main building is provided with a service of electric lifts, comprising four passenger lifts of the "Otis" standard drum type, three of which have a lifting capacity of 1,600 lbs. at a rate of 250 feet per minute, and the fourth, a capacity of 2,500 lbs. at a rate of 250 feet per minute. These lifts are operated by two-speed switches in the cars. Some of the lifts are provided with compartments below the passenger compartment for the reception of parcels. There are also three service lifts of the standard "Otis" pattern, with push-button control.

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THE UTILISATION OF ELECTRIC POWER IN SALT MINES

By H. R. Speyer

SITUATED in the midst of the Harz Mountains is a group of salt mines owned by the Nordhauser Kali Company and the Immenrode and Ludwigshall Carnallit Companies. The three concerns are distinct from one another, and each is controlled by its own board of directors. A joint board was, however, formed for the purpose of discussing the advisability of erecting a common generating station for supplying the pits with electrical power, and ultimately a site was chosen for this purpose almost midway between the Nordhauser and Immenrode mines, and at the mouth of the Ludwigshall pit adjoining the chemical factory in the position shown in Fig. 1.

Before entering upon a description of the power house and the electrical equipment at the mines, a few notes may be given on the processes the raw material has to pass through before the final product is obtained. The raw material is brought to the surface by electrical main winding engines, and is transmitted to the factory, a distance of some three to four miles, over an electrically driven aerial steel ropeway, and is shot from the incoming trucks automatically by electrical

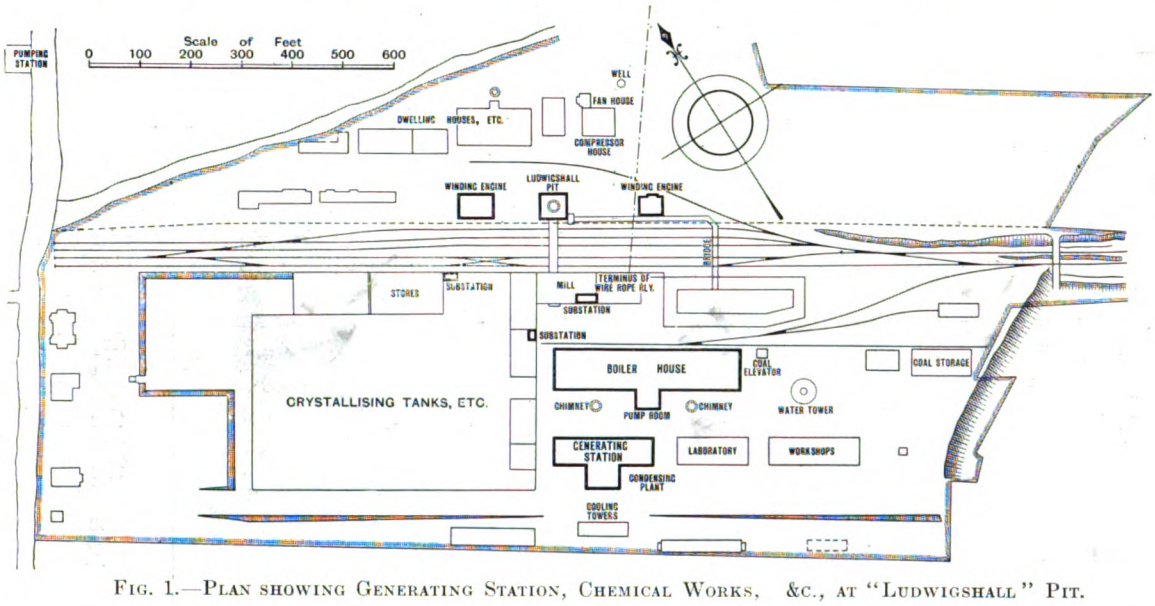

FIG. 1.—PLAN SHOWING GENERATING STATION, CHEMICAL WORKS, &C., AT "LUDWIGSHALL" PIT.

FIG. 2.—MAIN SWITCHBOARD IN GENERATING STATION.

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tippers into the mills. Issuing from these in a pulverised form, it is taken by conveyors to the top of the building, where it is dropped into the live steam-heated boilers containing a solution of calcium chloride. Here the original salt, consisting of carnallite and sodium chloride, undergoes the first chemical change. The carnallite dissolves, and the sodium chloride remains in its solid state. The liquid is drained off and pumped into large open tanks, where the potassium chloride crystallises out. This is afterwards taken to revolving drying pans fitted with spiral blades which discharge it in its dry state into hoppers, for transmission to the stores. The remaining filtrate, after the crystallisation of the potassium chloride has taken place, is pumped through to the vacuum pans, when the process of crysallisation is furthered, and the magnesium chloride brought down. This is taken to the drying pans, and by another set of hoppers and elevators carried thence to the stores. As already mentioned, the sodium chloride and magnesium sulphate pass through the dissolving boilers in a solid state and are afterwards taken over to the stirring pans

Fig. 3.—High-tension Switchgear in Central Station.

and mixed with water, when the sodium chloride dissolves out and the magnesium sulphate comes down in the form of a heavy precipitate, giving a salt known as kyserite. The mixing of this salt with the original potassium chloride in solution produces potassium sulphate. We have thus four commercial salts, potassium chloride, magnesium chloride, potassium sulphate, and magnesium sulphate. The percentages in which they are produced are approximately 80 to 90, 50, and 48 to 70, and 50 per cent. respectively.

As can be seen from the above description, the requirements for producing the commercial salts from the raw material are such that, with the exception of the live steam heating for the dissolving boilers, electricity can exclusively be used. In the first place, the boring operations are carried out electrically; the pit gear, including the underground haulage and winding engines, is driven by electric motors; the transmitting aërial ropeway, the tippers, the mills, the hoppers, elevators, pumps, mixing and storing gear, drying plant, and cranes for loading are in each case driven electrically.

Generating Station.—The power station, when completed, will contain five steam-driven generating sets having an aggregate horse-power of 3,500. At present there are erected and at work on a day and night load four horizontal tandem compound double-crank engines directly coupled to three-phase star-connected high-tension alternators. The two larger engines were constructed by the Hannover'sche Maschinenbau, and each is of 750 h.p. They are fitted with Lentz's patent poppet-valve gear. The two smaller units are each of 350 h.p., and are fitted with ordinary governors. The two larger generators have each a normal output of 550 k.v.a. at 5,250 volts 50 cycles when running at 107 r.p.m. The two smaller generators are designed for an output of 250 kw. at the same voltage when running at 83·3 r.p.m.

The output of these machines, as is usual in such a station, is controlled from a low-tension control board, while all the high-tension is in a separate enclosed chamber. Fig. 2 is a general view of the board, and Fig. 3 shows the high-tension gear. The board consists of 16 sections, comprising five generator, five feeder, two motor-generator, and four spare panels. The high-tension oil switches, potential and energy transformers, and the station main bus-bars are mounted directly behind the switchboard. The method of control from the low-tension switchboard, including the paralleling of the generators, is by relays actuated by press-buttons mounted on the front of the board. The high-tension switches of the generator cables and of the outgoing feeding cables are all actuated by solenoid coils energised from the low-voltage continuous-current circuit (110 volts) and controlled from the low-tension board. In order to enable the switchboard attendant to see at a glance which cables are in use, each panel is provided with two indicating lamps (red and green), one of which is always alight according to the position of the switch. Alarm bells are also provided to call attention to the opening of the circuit-breakers.

The continuous-current switchboard is below the main switchboard (Fig. 2). It controls the lighting circuits, the continuous-current side of the motor-generators, the booster set, and also the exciter circuits. The motor-generators are driven by high-tension three-phase

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asynchronous 60 h.p. motors. Two transformers of 75 and 30 kw. respectively, transforming from 5,000 volts to 110 volts, are provided for supplying various auxiliary motors up to 35 h.p., and in case of emergency for lighting.

The station was planned and erected in a very short time, and the plant has been running without interruption since last July. The running cost per unit with the load factor of about 20 per cent. has averaged 0·46d., and the standing charges, including interest and depreciation, with a diversity factor of 1, work out approximately 0·8d., making a total of 1·2d. per unit. It is hoped that when the plant at the pits is more complete an appreciable reduction on this figure will be possible The electrical equipment of the station was carried out by the Elektrizitäts-Aktien-Gesellschaft, vorm. Pöge, of Chemnitz.

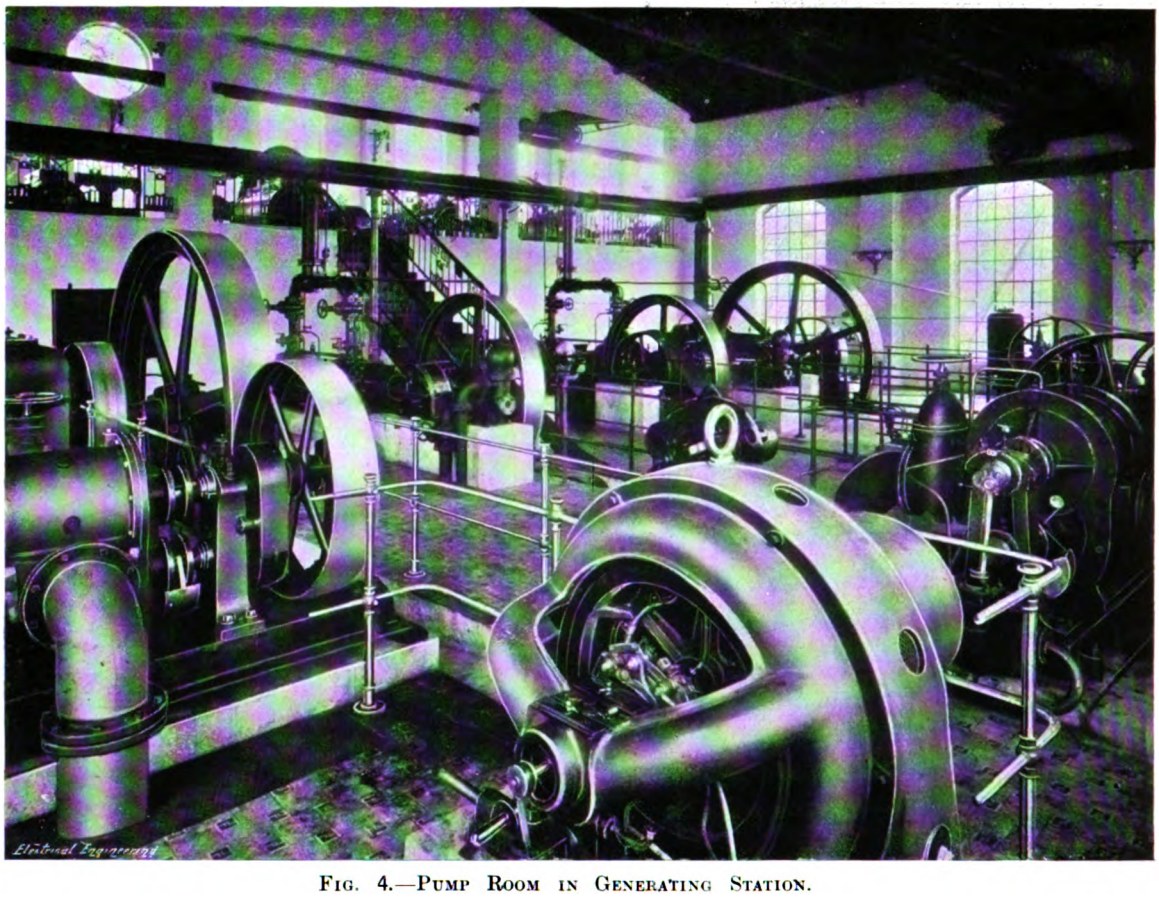

Fig. 4.—Pump Room in Generating Station.

The air pumps of the condensers are not, as is usual on the Continent, driven direct from the connecting rods of the engines, but are grouped together in a separate condenser house adjoining the engine-room. The two main condensers are of the surface type, and are capable of dealing with 8,000 kgs. of steam per hour. They are worked in conjunction with a cooling tower, whose output is 360 cbm. per hour. Each condenser has a cooling surface of 170 square metres. As can be seen from Fig. 4, the driving is through belting. Each motor drives on to an air pump, and back through belting to a cooling-tower pump. The motors are of the 5,000-volt three-phase induction type, each with an output of 45 h.p. when running at 785 r.p.m. The two larger air and cooling-tower feeding pumps seen in Fig. 4, which are driven in a similar way by 80 h.p. induction motors, are those used in connection with the vacuum station. The complete condensing plant was designed and laid down by the Sangerhauser Machine Co.

The boiler-house contains two batteries of boilers, one of eight units for the central station, and one of ten units for supplying live steam to the dissolving tanks. As is generally the case in the salt districts, the natural water contains many ingredients injurious to boiler-plates. For this reason, as well as for the fact that fire-tube boilers have a greater reserve of steam, the Cornish type of boiler was chosen. Each of the eight units put down has a heating surface of 100 square metres, and is worked at a pressure of 10 atm. The fuel used is exclusively "brown" coal. Each boiler is provided with a superheater for raising the temperature of the steam to 280° C. The water from the condensers is passed through an oil separator consisting of baffle-plates and sawdust, and is afterwards used in conjunction with fresh water as feed for the station boilers. An exhaust steam feed heater raises the temperature of the feed-water from 40-50° C. to 75-80° C. The fresh water from the artesian well, before being taken to the boilers, is passed through a "Voran" water-softening plant capable of dealing with 50 cubic metres per hour.

Distributing System and Sub-stations.—In order to minimise the risk of a breakdown, the main high-tension distributing cables are laid in pairs; these are at present, however, worked in parallel, and are controlled from the one switch panel. Arrangements are, however, to be carried out to enable each feeding cable to be dealt with separately. Although this will naturally increase the capital cost per kw. laid down, much increased security against breakdown will be obtained, a point of particular importance when dealing with mining engineering. It may be mentioned here that the station capital cost per kw. laid down, including the boiler, engine, generator, switchboard, and building plant, was approximately £24·6. There are in all five pairs of outgoing main high-tension cables. One pair is laid down between the central station and the Nordhauser Kali Co.'s "Hain" pit, a distance of three to

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four miles, and a similar pair is laid between the station and the Immenrode pit, a distance of about two miles. The cables are of the Felten & Guilleaume-Lahmeyer paper-insulated three-core type, with a copper cross-section of 0·077 sq. in. per phase. The transmitting pressure is 5,000 volts. The remaining three pair of cables, of 0·025 sq. in. cross-section, are laid between the station and the adjoining chemical factory and the Ludwigshall pit.

Sub-stations are erected at the mouths of the "Hain" and Immenrode pits. These are equipped with high- and low-tension feeding and distributing switch-panels, and with static transformers for giving reduced pressure at 500 and 110 volts—the former for small power works, the latter for lighting circuits. The Felten & Guilleaume-Lahmeyerwerke Co., of Frankfort, have been responsible for the equipment of these sub-stations. In addition to these sub-stations, there are also three in the chemical factory. They supply current at a high and low pressure, and serve as energy-distributing centres for the mills, the drying equipment, and the dissolving plant, which, as can be seen from the plan (Fig. 4), cover a considerable area.

Electrical Equipment at the "Hain" Pit.—The electrical equipment at the "Hain" pit, which is 600 metres in depth, comprises electrical main and auxiliary winding engines. The former is on the well-known Ilgner-Ward Leonard system, and the latter is driven by means of a three-phase motor through a double set of reducing gears. The output of the main engine is approximately 82 tons per hour, and that of the smaller engine is 32 tons per hour.

It is not necessary to enter here upon a further description, as a detailed account of the Ilgner system was given by the writer in an article on the Electrical Equipment of the Mansfeld Copper Mines, published in Electrical Engineering, Vol. III., page 609 (see also page 605 of the same volume for a fuller description of the Lahmeyer form of the system). It may be mentioned, however, that owing to the safety of this system the mining authorities allow a speed, when working with the Ilgner system, of 15 metres per sec., as against the permissible speed of 6 metres per sec. when working with other plant. The speeds here refer only to the case of "live" load. Among the many advantages claimed for the Ilgner system as against three-phase motors driving the winding drum or pulley direct or through gearing is the fact that with the Ilgner-Ward Leonard regulating system the speed of the winding unit at any time is absolutely independent of the load, irrespective as to whether this be positive or negative. This is not the case with three-phase motors controlled by rotor resistances, and accidents through overrunning when lowering have occurred in the writer's experience from this cause which would have been impossible with the regenerative action of the Ilgner system. Again, the absence of gearing does away with the noise which frequently interferes with the driver hearing the signals properly. Another advantage accruing in this particular case to the continuous-current direct-coupled winding motor is that when the underground workings of the mine have increased the main winder must be capable of dealing with the increased output. This in the case of the Ilgner system can be easily catered for by mounting a second continuous-current motor on the other side of the Koepe pulley and by erecting a corresponding motor-generator flywheel set. The output in this case would be doubled, *i.e.*, 3,800kg. With a three-phase system, however, additional mechanical as well as electrical plant would be necessary.

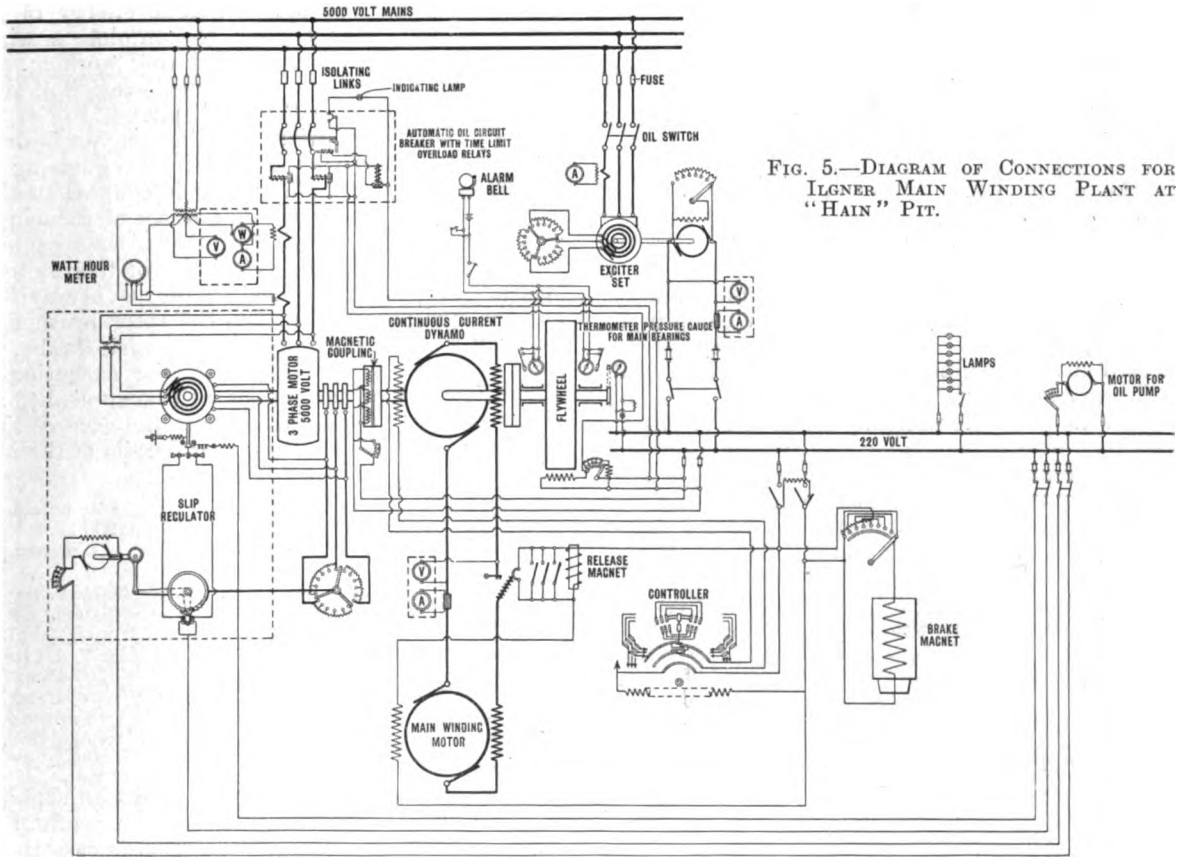

Fig. 5.—Diagram of Connections for Ilgner Main Winding Plant at "Hain" Pit.

It is worth while considering for a moment the comparative efficiency and the capital and running costs of the two systems. These are clearly shown in Table I., and refer to an Ilgner and three-phase plant of the same output, viz., 1,900 kg. per wind. It will be seen from this table that although the actual initial cost of the Ilgner system is more than double that of the three-phase plant, the consumption in energy is less than 25 per cent., and the efficiency nearly 50 per cent. higher.

Table I.

Comparison of Ilgner and Three-phase Systems of Winding.

	Ilgner system.	Three-phase system.
Capital cost—		
Original winding plant for 1900 kg...	100 %	47 %
Extension of capacity to 3800 kg. ...	50 %	100 %

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	Per wind, kw. hours.	Per wind, kw. hours.
Energy consumption—		
For raising ore	7·48	10·1
For lowering live load (*a*)	1·31	7·96
,, raising ,, ,, (*b*)	4·90	9·20
Efficiency—		
Transmission to pit	85 %	85 %
Winding motor (average)	80 %	40 %
Ilgner set	75 %	—
Gearing	—	80 %
Overall	50 %	27 %

The particulars of the main winding engine at the "Hain" pit are as follows:—

Output per hour	81·5 tons (later 163 tons)
Depth	650 metres
Output per wind	1·9 tons
Maximum rope speed when raising ore	15 metres per second
Maximum rope speed when raising men	10 metres per second
Weight of cage	3·6 tons
Weight of empty truck	375 kgs.
Number of waggons per cage ..	2
Number of stages...	1 (later 2)
Duration of run when raising ore	60 secs.
,, ,, with men ...	76·7 ,,
Interval between runs with ore ..	24 ,,
,, ,, ,, men...	28·3 ,,
Diameter of Koepe pulley ...	5 metres
Speed of winding engine ...	57·5 r.p.m.
Weight of rope	4·9 kg. per metre (later 7·8 kg./m.)
Permissible temporary overload.	20 per cent.
Maximum overload allowed ...	40 ,,

The winding engine is fitted with two brakes, one of which constitutes the main brake, the other being used for manœuvring purposes. Both are worked by means of compressed air. The manœuvring brake is controlled through the driver's regulating handle, while the main brake comes into play automatically when one of either the following events occur:—(1) Interruption of the excitation current—Braking occurs through the magnetic clutch placed in the exciting circuit becoming demagnetised and opening the outlet valve of the compressed air cylinder. The main brake then falls by gravity. (2) Through attaining too high a rope speed—The brake is released through a centrifugal governor fitted in conjunction with the depth indicator. (3) When the voltage drop increases beyond a predetermined amount. (4) Failure in the supply of compressed air. (5) By releasing lever placed to the left of the driver.

The essential apparatus to ensure safe working consists of a regulating gear, a depth indicator, two speed cams, and a tachometer. A description of the specified use of each of these devices may be seen in the articles previously referred to.

The Ilgner set comprises a Lahmeyer three-phase asynchronous 5,000-volt 450 B.H.P. motor directly coupled to and mounted on the same bed-plate as the continuous-current dynamo. The flywheel is mounted on its own base-plate, and is fitted with two oil pressure bearings, and an alarm bell is provided which sounds when the bearings exceed a certain temperature or the oil pressure fails by means of automatic thermometer and pressure gauge contacts. The coupling between the two units is of the magnetic type. A three-phase continuous-current 220-volt motor-generator is provided for supplying excitation. Both the machines are fitted with compensating poles. The normal speed of the Ilgner set is 750 r.p.m. The fluctuation of the speed to enable the flywheel to yield up kinetic energy for balancing the varying loads is fixed between 750 and 640 r.p.m., that is to say, between a 15 per cent. limit. As may be seen from the diagram of connections shown in Fig. 5, this speed variation is obtained by automatically increasing and diminishing the value of the resistance between the rotor phases. The principle underlying the working of the form of slip regulation employed may be described shortly as follows:—When the load comes on the hauling motor, the speed of the motor-generator set naturally drops slightly from the normal, with the result that the value of the voltage between the rotor brushes increases and serves to drive the small regulating motor *A* (Fig. 5) in the direction necessary for throwing resistance in the rotor circuit; this naturally, while decreasing the speed of the set, still further increases the voltage of the rotor, with the result that still more resistance is thrown in. When the load is taken off the hauling motor, the motor-generator reasserts itself as regards speed, and correspondingly the value of the rotor voltage drops, with the result that its pressure is no longer high enough to drive the regulation motor *A* against the direction normal to the current flowing in the second set of windings, with which it is provided. When the haulage motor is standing idle, the rotor resistances, therefore, are gradually cut out, and the flywheel set regains its normal speed. The stored kinetic energy of the flywheel is more than enough to complete a wind with a load should the current fail during working. Figs. 6 and 7 show a plan and sectional elevation of the main winder erected at the "Hain" pit.

The auxiliary electrical winding engine is driven by a three-phase 500-volt induction motor having an output of 175 B.H.P. The motor is coupled to the main driving drums through a double set of reducing gears, which reduce the speed from 600 to 32·8 r.p.m. Fig. 8 gives the starting characteristics of this motor. The speed regulation is obtained in the usual way by varying the resistances between the rotor brushes. The depth indicator, manœuvring and main brake, as well as the safety apparatus, with the exception of the eccentric cams, which cannot well be applied to a three-phase system, are the same as in the case of the main winding plant. The output and details of the auxiliary winding engine are as follows:—

Depth	650 metres
Output per wind	1900 kg.
Rope speed with ore	6 metres per sec.
,, ,, ,, men	6 ,, ,,
Weight of cage	2600 kg.
Weight of empty truck	350 kg.
Number of waggons per cage per stage	1
Number of stages	2
Duration of run	150 secs.
Time lost between runs	48 ,,
Diameter of each drum	3 m.
Gearing	1:18 (approx.)
Weight of rope	4·9 kg. per metre.

The cage of this secondary plant has a separate run from that of the main engine, with the result that they can be used simultaneously. In such a case the hourly output of the pit is increased to 113 tons, which output, when the second continuous-current winding motor for the main engine is erected, will be increased to 195 tons per hour.

Two high-tension cables are provided for carrying energy down into the workings of the pit. Here the energy is transformed down to 500 and 115 volts for hauling, ventilating, drilling, and lighting puproses. It may be mentioned here that the maximum circuit-breakers are fitted in all cases with time-limit relays on the train-of-wheels principle, and are set for six seconds. The incoming cables are also provided with reverse current relays on the wattmeter system. As the mines have only lately been developed, the underground plant is not as yet very extensive; plans, however, are being prepared for the electrification of the underground roadways as soon as these are of a length warranting the use of electric machinery. Above bank a great many small motors are used for driving the forge, the smithy, the workshops, and the saw-mills. In addition, there is a three-phase asynchronous 5,000-volt 65 B.H.P. motor for driving the aërial ropeway, which serves to transmit the product of the mine

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straight away in the same trucks as are used underground to the chemical factory over a distance of about three miles.

The Felten & Guilleaume-Lahmeyerwerke were responsible for the electrical equipment of both the main and auxiliary winding engines of this pit. The subcontractors for the mechanical part of the latter were the Zwickauer Machine Co.

The Electrical Equipment at the Immenrode Pit.—The chief electrical equipment of this pit consists, as in the case of the Nordhauser Kali Co.'s "Hain" pit, of a main winding engine on the Lahmeyer-Ilgner system and two secondary winders driven by three-phase motors. One of the latter is at present being used for completing the sinking of a new shaft. The main winding engine is directly driven by a continuous-current motor fed from a three-phase continuous-current motor-generator flywheel set. The safety and braking devices are the same as in the case of the main winder erected at the "Hain" pit, with the exception that

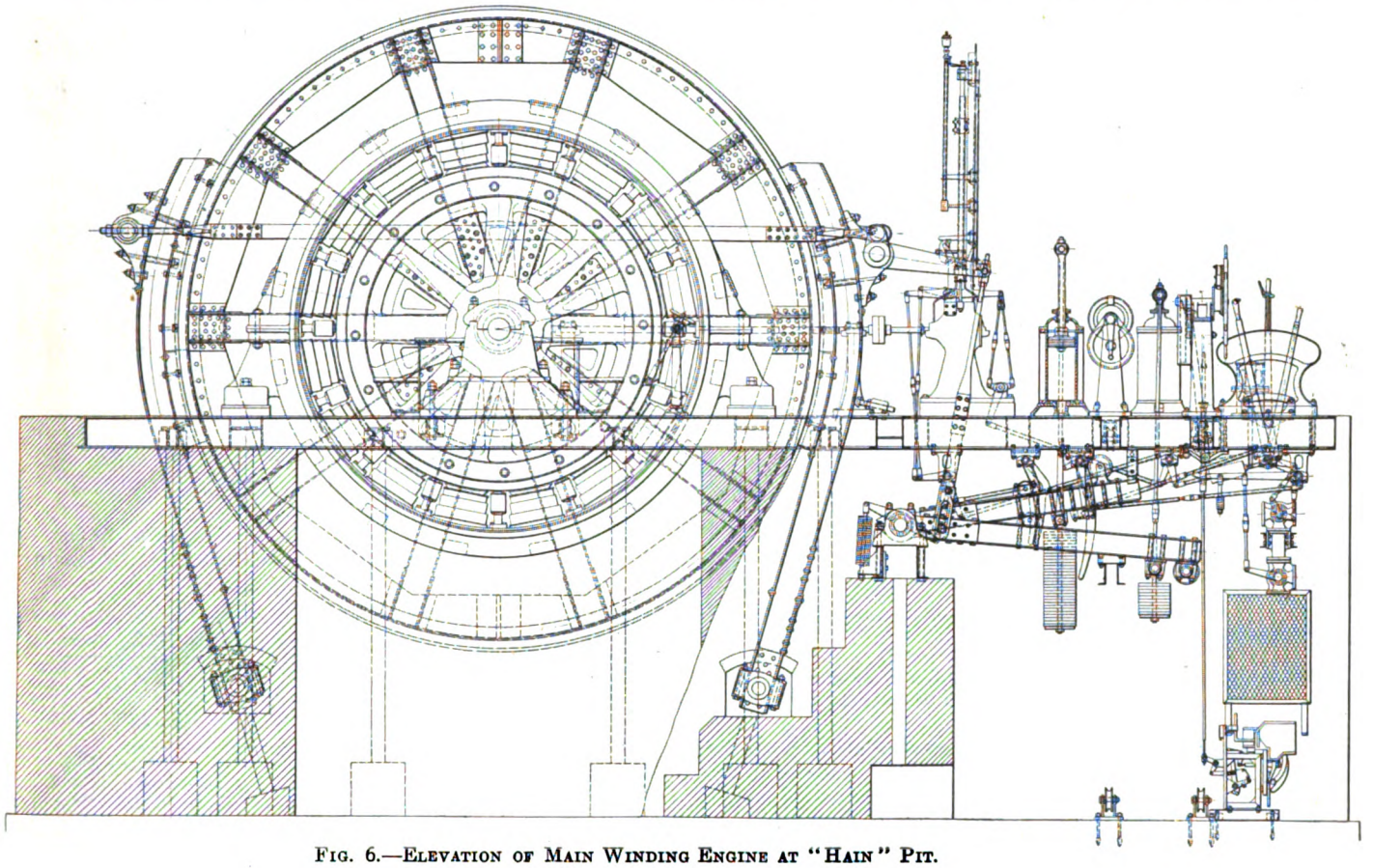

FIG. 6.—ELEVATION OF MAIN WINDING ENGINE AT "HAIN" PIT.

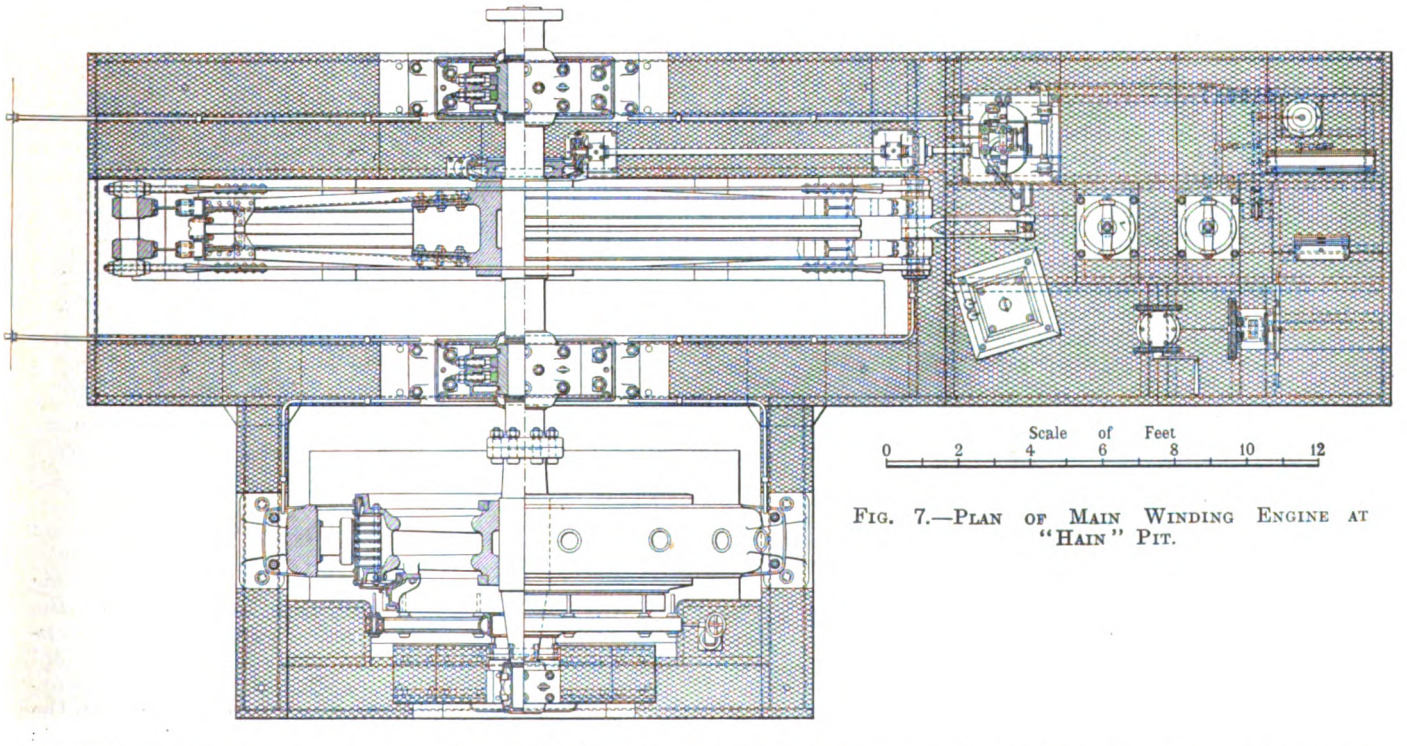

FIG. 7.—PLAN OF MAIN WINDING ENGINE AT "HAIN" PIT.

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electro-magnetic brakes take the place of those actuated at the " Hain " pit with compressed air. The motor-generator set comprises a three-phase asynchronous 5,000-volt motor with an output of 520 B.H.P. at 500/425 r.p.m., and a continuous-current dynamo with compensating poles arranged for separate excitation

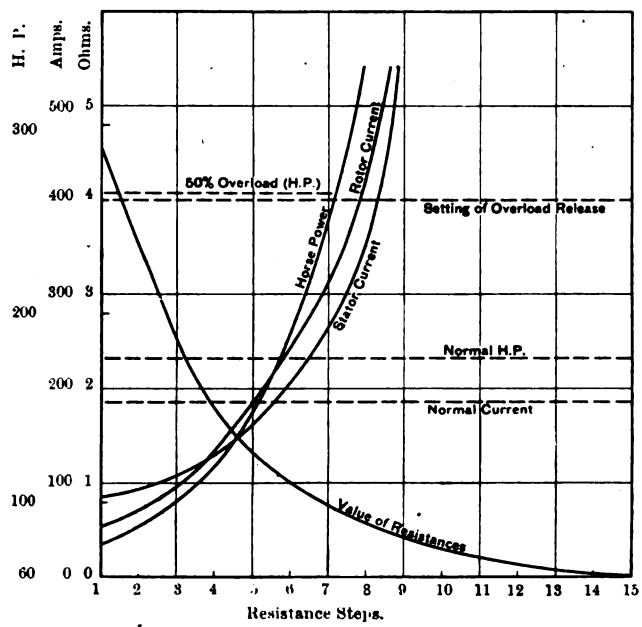
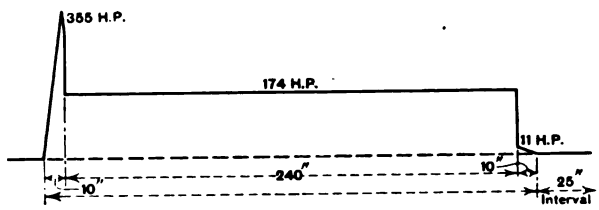


Fig. 8.—Characteristic Curves of 175-h.p. Induction Motor of Auxiliary Winder at Hain Pit.

and capable of delivering energy sparklessly at a pressure of from 0/500 volts. The flywheel is made in one solid piece, with a diameter of 3·5 metres and a weight of 33,500 kgs. The continuous-current driving motor is also provided with compensating poles, and is separately excited from a small 220-volt motor-generator set. The speed of the winding motor is 44·6 r.p.m. The output of this plant, with a rope-speed of 14 metres per second and a Koepe pulley of 6 m. diameter, is 3,200 kgs. per wind. The depth of the pit on completion of the sinking operations will be approximately 1,000 metres. The auxiliary winding gears at this pit are driven by three-phase 5,000-volt asynchronous motors, each with a normal output of 175 B.H.P. when running at 600 r.p.m. The speed regulation is by means of a variable resistance inserted in the rotor circuit. The safety and braking appliances are similar to those used with the auxiliary winding plant at the " Hain " pit. The horse-power curves of one of these motors working under various conditions are shown in Fig. 9, from which also the acceleration and running period per wind may be seen. That and Fig. 10 give the starting characteristics. In addition to the main and secondary winding units described above, there are erected at this pit two high-tension 5,000-volt asynchronous three-phase motors each of 165 B.H.P., used for driving, through belting, two Rideau fans. There are also a number of small motors up to 35 h.p. in use for various purposes. These are driven from 500-volt circuits supplied by two 150 k.v.a. transformers. The latter, as well as one of the 100 k.v.a. capacity, are employed for reducing the incoming pressure of 5,000 volts down to 500 and 110 volts respectively. The latter is used for the lighting circuits.

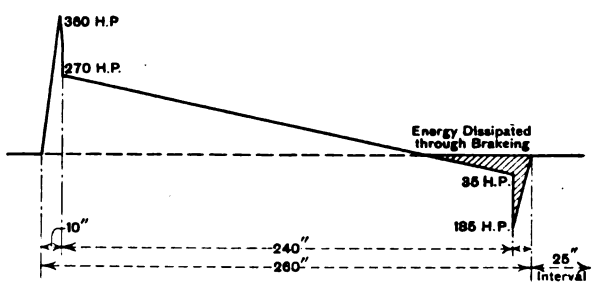
The Electrical Equipment at the Ludwigshall Pit.—The electrical equipment of this pit consists at present only of a few small motors for the workshops, &c., and the lighting. The main and auxiliary winders are at present driven by steam, as the company had in their possession two comparatively new steam engines which had originally been at work at one of the pits which has recently been shut down. Arrangements are shortly to be carried out whereby high-tension circuits will be taken down the pit for power and lighting purposes.

The Electrical Equipment of the Chemical Factory.—The supply of electricity for power purposes in the chemical works is obtained direct at 5,000 volts over three cables from the adjoining central station. The distributing and transforming centres are three in number, and, as mentioned before, one is provided for the rolling mill, one for the drying plant, and the third in connection with the dissolving tanks. The motors



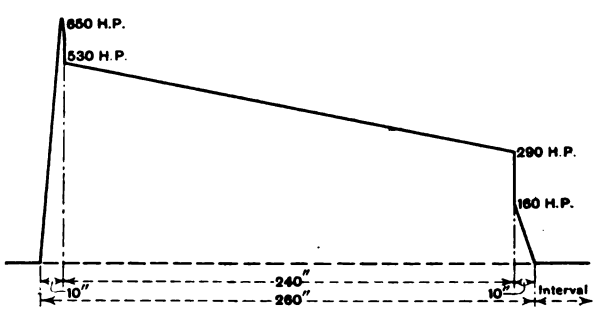
Winding with Balancing Rope.

Depth	1000 metres.	Weight of cage ...	2380 kg
Load	2000 kg.	,, safety catch	700 ,,
Rope speed...	5 metres per second.	,, 2 trucks ...	760 ,,
Weight of rope	4 kg. per metre.		



Winding without Balance Rope (Sinking Operations).

Depth	1000 metres.	Weight of rope ...	2·6 kg. per metre
Load	1000 kg.	,, tipper ...	350 ,, ,,
Rope speed...	4 metres per second.		
Speed	4 metres per second.		



Raising Cage with Two Empty Trucks, using only One Drum.

Depth	1000 metres.	Weight of cage ...	2330 kg.
Rope speed ...	4 ,, per second.	,, safety catch	700 ,,
Weight of rope	4 kg. per metre.	,, 2 trucks ...	760 ,,

Fig. 9.—Power Curves for Auxiliary Winder at Immenrode Pit.

for driving the rolling mills comprise three high-tension 5,000-volt asynchronous motors having an horse-power together of 375. Further motors aggregating some 175 h.p. are employed for the lifts, elevators, and the distributing gear. These run on the low-tension circuit. 5,000-volt motors are used for the stirring apparatus (60 h.p.), the pumps (75 h.p.), and the conveying bands (100 h.p.) in the dissolving house; but the smaller motors up to 35 h.p. used for driving the lifts (24 h.p.), small elevators (70 h.p.), and the sifting motors are all connected to the low-pressure circuit. The electrical equipment in the drying house consists only of low-tension motors for driving the elevators (110 h.p.), pumps (50 h.p.), drying pans (50 h.p.), tippers (35 h.p.), and conveyors (12 h.p.). The horse-power

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connected to the high-tension side of the system and at work in the factory amounts to 610 B.H.P., and the low-tension horse-power to 571, making a total of 1,181 B.H.P., practically all of which is at work continuously on a day and night load.

In conclusion, the writer's thanks are expressed

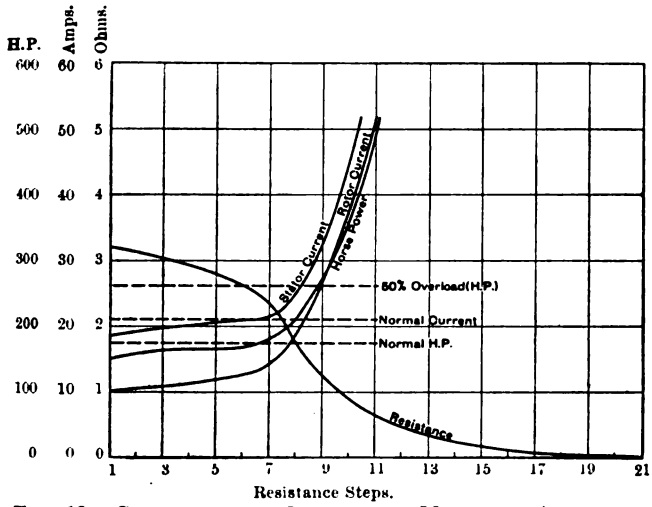


FIG. 10.—CHARACTERISTIC CURVES FOR MOTOR OF AUXILIARY WINDER AT IMMENRODE PIT.

towards the directors of the companies who have kindly allowed him to publish the details of the installation, and to the firms who have courteously placed at his disposal the drawings and photographs, from a selection of which the illustrations have been prepared.

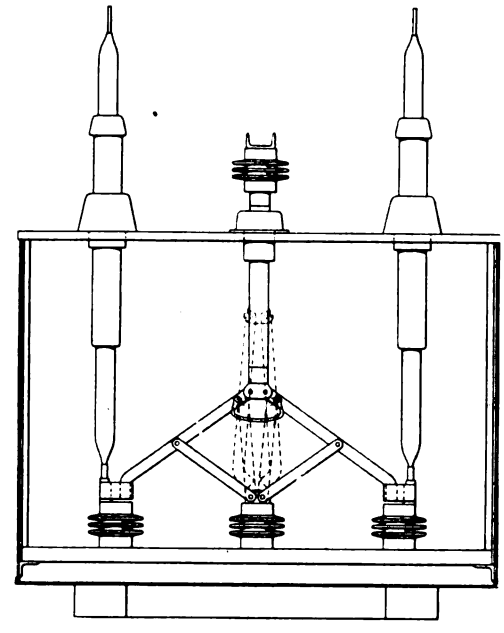
British Association.—The provisional programme of Section G (Engineering) for the forthcoming meeting at Dublin has now been issued, and announces the following Papers:—*Thursday, September 3rd:* Address by the President of the Section, Mr. Dugald Clerk, F.R.S. *Friday, September 4th:* Report of the Committee on Gaseous Explosions to be read and discussed in joint meeting with Sections A and B. *Monday, September 7th:* "Recent Advances in Steam Turbines," by G. Stoney; "Producer Gas," by P. Emerson Dowson; "Suction Gas Producers," by P. W. Robson; "The Utilisation of Peat for Making Gas or Charcoal," by Captain H. Riall Sankey. *Tuesday, September 8th:* "The Laws of Flight," by F. W. Lanchester; "The Causes of Wear in Motor Vehicle Machinery," by F. H. Royce; "On a Fundamental Error in the Theory of Power Transmission by Belts," by W. Worby Beaumont. Other Papers to be read:—"A Clock-driving Mechanism for Equatorial Telescopes," by Sir Howard Grubb, F.R.S.; "Experiments on Rotating Discs," by J. Brown, F.R.S., and Maurice F. Fitzgerald; "Strength of Solid Round-ended Columns," by W. E. Lilly; "Railless Traction," by F. Douglas Fox; "On the Study of Breakages," by W. Rosenhain.

Train Lighting in Australia.—In a recent issue of the *Australian Mining Standard*, the following notes, from a Paper read by Mr. D. C. Jackson, before the Western Society of Engineers, are given. There are three systems of electric lighting on the railways. In the first system steam-driven generators are employed; in the second generators under each car are driven from the car axles; and in the third storage batteries are placed on the cars, and are charged when the cars are not in use. For the first system turbine sets are now mostly in favour, owing to the vibration caused by reciprocating engines. Tests of steam consumption show results varying from 60 lb. to 90 lb. per kilowatt-hour. In connection with axle-driven generators, some typical test figures on the Northern Pacific Railway are as follows:—Duration of test, 31 hours; train above cutting-in speed and generator in operation 23½ hours; lamps lighted 13½ hours; generator output, 28·6 kilowatt-hours; lamp consumption, 14·6 kilowatt-hours; battery charge, 12·2 kilowatt-hours; battery discharge, 4·7 kilowatt-hours; average generator efficiency, 80 per cent.; power absorbed from axle (taking 3 perectnt. loss in belt) 2·1 horse-power. The total efficiency for the test (*i.e.*, ratio of lamp consumption to mechanical energy) is, therefore, slightly under 40 per cent. The third system is the simplest, but requires expensive charging stations. It is most economically operated on short runs, where there is heavy traffic and many cars are so equipped. Even then it is doubtful if it holds its own against the axle drive. Steam-driven generators come next as regards simplicity, but require a considerable amount of attention.

CIRCUIT-BREAKER FOR 75,000 VOLTS

A DESCRIPTION is given in the *Western Electrician* (Chicago) of some 75,000-volt circuit-breakers which have been installed in the sub-stations of the Edison Electric Company's transmission line from Kern River to Los Angeles, and which are said to be the first 75,000-volt automatic oil circuit-breakers operating without the use of series transformers that have been placed in service on any transmission system.

The accompanying illustration shows the construction of the switch mechanism, the movable contacts, which are of the knife-blade type, being part of a simple pantograph, the lower portion of which is pivoted to the metal cap of the central insulator and the upper part to the end of a wooden rod which is attached to a special porcelain insulator secured to the channel iron crossbar. A vertical movement of the cross-bar imparts a horizontal movement to the ends of the blades as they leave the contacts, these ends being brought together in the centre of the tank in the open position of the switch, as shown by the dotted lines. The cross-bar is carried on two guide rods placed in cast-iron frames between the tanks, the vertical movement



OIL SWITCH FOR 75,000 VOLTS.

being given to it by means of a rocker shaft beneath the central tank having two arms which are connected to the lower ends of the guide rods by means of links. The counterweight is also mounted on the rocker shaft. Coil springs for opening the breaker when tripped are placed in each frame, where they operate directly on the guide rods. The tanks are of iron and the covers of marble, made in two pieces, either one or both of these pieces being removable for purposes of inspection without disturbing any other part.

The circuit-breakers are arranged for hand closing, the handle being carried loosely on the rocker shaft and connected to the closing mechanism by means of a short lever and a dog, the dog being released by the action of the tripping mechanism in the event of an overload or short circuit. The tripping mechanism, which is very simple in design, is set in motion by any one or any two of the trip coils independently or by all of them acting together, and is automatically reset each time the breaker opens. The trip coils consist of a few turns of small diameter and are placed directly in the line, being suspended from the insulators of the disconnecting switches and supported by the connection to the switch terminals. The insulation of the coil has a very long creepage surface, approximately 60 in., and a dielectric strength of at last three times the line voltage, thus giving it a higher factor of safety than that of the best series transformer.

Electric Railways in the Alps.—A firm of engineers in Basle has, according to the *Schweizerische Elektrotechnische Zeitschrift*, applied for concessions for the construction and operation of an electric narrow-gauge and cable railway connecting St. Moritz, Silvaplana, and Pontresina. The proposed railway is divided into four sections, two of which are steep gradient cable railways. The other sections will be provided with a service of accumulator cars. The total cost is estimated at £144,000, or £7,120 per kilometer.

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THE MARSEILLES ELECTRICAL EXHIBITION

A DESCRIPTION of some of the principal exhibits in the Palais de l'Energie at the Marseilles Electrical Exhibition is given in *La Revue Electrique*. As already stated in a previous article (Electrical Engineering, July 30th, p. 181) most of the exhibits relating to the heavier branches of electrical engineering are contained in this part of the exhibition.

The exhibits relating to cables appear to be fairly representative, especially as regards impregnated paper cables for high tensions, jute cables for low tensions. There are indications of the tendency to a disappearance of concentric cables, their place being taken by those with two, three, or even four separate cores. Cables are shown, as well as other exhibits of switchboards and telephone apparatus, by the Société Industrielle des Téléphones, and another interesting cable exhibit is that of the Société de Cables Electriques Berthoud-Borel et Cie, who show actual cables under test at 100,000 volts alternating and intermittent unidirectional voltage of over 300,000, obtained by a synchronous revolving contact-maker, designed by M. Delon, which connects the cores of the cable successively with the high-tension transformer in such a way that the voltage waves to which each core is subjected are always in the same direction. Aluminium as well as copper wires and cables are exhibited by the Tréfileries et Laminoirs de Havre. It is interesting to note in this connection that long aluminium power lines are coming into use in Europe, as well as in America, notable examples being found in Bulgaria in a line for the supply of Sofia, and in the South of France on the Mediterranean coast. Apart from questions of the relative prices and conductivity of the two metals, advantages are claimed for aluminium over copper in respect of the lighter supports required to sustain its weight, and its lower coefficient of expansion, although the surface offered to wind pressure is greater. Also, as the diameter of an aluminium wire is greater than that of one of copper of equal conductivity, the inductance of the line is less, and there is less loss from "silent" discharge.

We have already mentioned the electric lorry worked by Edison accumulators, shown by the Bergmann firm. These vehicles are constructed to carry a load of 2 tons at 7½ miles per hour, with a range of about 35 miles, and are provided with a 64-cell battery, with a capacity of 14 kw.-hours. A description of the German form of the Edison iron-nickel alkaline storage battery was contained in Electrical Engineering, Vol. III., p. 695. The cells can be charged in 3 hours and 45 minutes at 65 amperes. It is stated that several of these vans are in experimental use.

Accumulators of the more familiar lead type are shown by the Compagnie Française de Accumulateurs "Union," who have on view specimens of the large cells, such as are used in batteries on tramway systems. Examples of these in actual use are a 6,000 ampere-hour battery at Bordeaux, and a battery for 1,870 ampere-hours in use on the Marseilles tramway system. The French Tudor Co. also exhibit their well-known cells, and show the Soulié vibrating tongue rectifier for charging batteries from alternating circuits. Small ignition batteries are also shown by several makers.

In the section devoted to generators, motors, transformers, &c., many well-known French, Swiss, and other firms take part, most of whom show standard machines of this nature. It is only possible here to call attention to a few of the special exhibits, which present points of novelty or special interest on a few of the stands. A new single-phase commutator motor, the speed of which can be varied by shifting the brushes, is shown by Messrs. Brown-Boveri & Co., and this is used to drive another exhibit, consisting of a special train lighting dynamo, used in conjunction with accumulators. Among the exhibits of another well-known Swiss firm, the Société Aloith, of Basle, are single-phase and three-phase rectifiers on the permutator principle of the system of Messrs. Auvert and Ferrand, the traction form of which is on view on the stand of the P.L.M. Railway in the Palais de Traction. The Fynn-Alioth single-phase motor is also shown. The Bergmann Co. demonstrate their system of printing press driving. The well-known Thury system is represented by a high-tension continuous-current generator, with constant current regulator, driven by a three-phase motor.

Among the large machines shown is a fine vertical shaft three-phase 1,750-kw. 5,500-volt alternator, with 56 poles, for running at 107 r.p.m., manufactured by the French Thomson-Houston Co., and one of eight, made for the power-house of the Société Energie l'Electrique du Sud-Ouest at Tuillière, on the Dordogne. Other exhibits of the same company include mercury-vapour rectifiers and aluminium electrolytic lightning arresters. Another large machine to which attention should be drawn is a 1,100-kw. double-current interpole generator of the Société Alsacienne, of Belfort, for driving by a Pelton wheel. This machine, which runs at 375 r.p.m., generates at 850 volts on the continuous-current side, and 510 volts 25 cycles on the alternating-current side. It is destined for use on the tramway system between Villefranche and Bourg-Madame in the Pyrenees, where the continuous-current side will feed the section of the line near the station, while the current from the alternating side will be stepped up to 10,000 volts for transmission to a distant sub-station. A similar system is in use on the Marseilles tramway system. The French branch of the A.E.G. Co. show a great variety of apparatus, amongst which may be noticed a compact 10-kw. steam turbo-generator for torpedo-boat lighting, train lighting sets on the Rosenburg system, and examples of mercury-vapour lamps in quartz tubes. (See Electrical Engineering, Vol. II., p. 549.) The lamps shown have straight horizontal tubes from 3 to 6 in. long, with bulbs at the ends for the mercury electrodes, provided with cooling ribs. Ballast resistances similar to those used with Nernst lamps are employed. The lamps are made for 3·5 amperes at 220 volts, and 4 amperes at 110 volts, and it is said that the light given is intermediate in appearance between that of the Cowper-Hewitt lamp and the ordinary open arc.

The applications of electric power exemplified cover a considerable range, including cranes, hoists, capstans, conveyors, fans, pumps, and portable tools, and the adaptation of electric motors to the driving of a variety of industrial machinery. Prominent among these are the electrically-driven looms shown by the Compagnie Electrique de la Loire, and in this connection it is interesting to note that of the 28,000 looms in the weaving districts of the department of the Loire and Haute Loire, no fewer than 15,000 are driven electrically by the company, with motors varying from 1 to 1·5 b.h.p.

Other exhibits to which attention should be drawn are steel and concrete poles for transmission lines. These latter are shown by the Société des Ciment prompts et Portland Artificiels de Grenoble. These poles are made on the Delamarchi system, and over 8,000 are already in use in the neighbourhood of Grenoble. It is said that under test one of the reinforced concrete poles, 12 metres high, when loaded at the end horizontally with a pull of one ton, gave a deflection of 60 mm. without breakage 42 days after completion.

High-tension switchgear and apparatus is also well represented, but no great note of novelty is struck. The examples of condensers of the Moscicki type are (Electrical Engineering, Vol. I., p. 565) shown under test pressures of 30,000 volts, alternators should, however, be mentioned. Reference was made in our previous article of the various power companies in different parts of France, including the large relief map of the latest scheme of Messrs. Blondel, Harlé and Mahl, for the supply of electricity to Paris generated by the river Rhône. This scheme is for the utilisation of a fall of 70 metres available at Génissiat, where a 350,000-h.p. station is proposed, transmitting power at 120,000 volts, three-phase, 25 cycles, and at the same time vastly improving the navigability of the river right up to Geneva.

The electrometallurgical and electrochemical section is also of interest, and contains samples of electrically-prepared materials and models of electric furnaces and other apparatus.

A Curious Accident.—A daily paper reports from Basle that a young man, who was flying a kite with an aluminium wire instead of the customary string, was killed through the wire coming in contact with some high-tension overhead conductors.

Melbourne Telephone System.—The work of laying underground the telephone wires of Melbourne is being actively carried on. When completed, the total length of tunnels, according to the *Australian Mining Standard*, will be about 2½ miles. The tunnels are from 25 to 30 ft. from the surface, and the inside measurement is 6 ft. 6 in. high by 4 ft. 6 in. wide. The cables will be carried along the walls on hooks. The magnitude of the undertaking is suggested by the computation that when the whole of the tunnelling has been excavated something like 40,000 tons of material will have been brought up. Access to the tunnels will be gained by means of manholes at intervals along each route, and ventilation is provided for by 9 in. pipes, which will reach the footways. The underground operations are being carried out by electric light, and electric power is employed for the winding gear at the top of the shafts. On the new common battery switchboard, which is to be installed in the new exchange, there will be 90 operators' positions; of these 21 will be devoted to incoming junction lines, and 69 for incoming subscribers' lines. The ultimate capacity of the board will be 11,700 subscribers' lines, but the equipment supplied will be for only 9,000. But as there are at present only about 5,000 subscribers to be provided for, a margin is left for future enrolments for a considerable time. The department already has common-battery switchboards at Sydney and at Hobart, but these are very much smaller than that which is contemplated for the new Melbourne Exchange.

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ELECTROMETALLURGY AND ELECTROCHEMISTRY

ONE of the disadvantages of the electrothermal oxidation of the atmosphere in order to obtain nitric acid is the difficulty in producing it in a concentrated form. It might be supposed that by simply distilling the dilute acid obtained from the absorption towers the concentrated acid could be obtained; this, however, is not the case. Nitric acid of about 40 per cent. strength passes over on distillation at a constant temperature, and therefore no separation from water ensues. The Badische Anilin and Soda Fabrik have endeavoured to get over the difficulty by passing the gases from the electric furnace through hot tubes; this decomposes the higher oxides, and when the gas is subsequently absorbed by caustic soda sodium nitrite is obtained. But there is only a limited use for sodium nitrite in the organic dye and similar industries. As a fertiliser it is no good, but, on the contrary, is harmful, and one of the chief objects in fixing atmospheric nitrogen is to produce fertilisers. B. F. Halvorsen, of Christiania, in the American Patent 892516 (1908) claims to be able to produce it by dissolving the oxides of nitrogen in concentrated sulphuric acid, thereby forming nitrososulphuric acid. This upon decomposition with water, would, under ordinary conditions, produce nitric oxide, which would go off as a gas. But by the terms of the patent the nitrososulphuric acid is treated with water and an oxidising agent, such as ozone, hydrogen peroxide, manganese dioxide, lead peroxide, or chromic acid. The nitric acid can then be distilled off from diluted sulphuric acid, and the oxidising agent regenerated by means of an electric current. Would it not, however, be possible to oxidise the nitrosulphuric acid in the first place electrolytically, and thus avoid the addition of outside oxidising agents?

In the American Patent 890084, of F. W. Morris, an electrolytic method for preparing aluminium oxide in a form suitable for employment in the electric furnace is described. The crude earthy material containing aluminium compounds is treated with sulphuric acid. This converts the aluminium compounds into aluminium sulphate. The solution, which also contains the sulphates of other substances, such as iron, is run off from the insoluble gangue. It is then, after filtration, placed in the anode compartment of an electrolytic cell, the cathode compartment being charged with a solution of sodium chloride. On electrolysing, the aluminium ions, together with the ions of other metals of the same group, pass through to the cathode. Here the aluminium and iron and calcium will not be deposited out as metals, but are thrown out as hydroxides. The sulphuric anion remains in the anode compartment and chlorine from the sodium chloride will also pass into this compartment. The sodium ions will be discharged in the cathode compartment, which will in course of time become strongly alkaline. The alkali hydroxide formed will dissolve the aluminium hydroxide, forming sodium aluminate, but will have no action on the iron and calcium hydroxides, which will remain in suspension. When the electrolysis is finished, the sodium aluminate solution with excess of sodium hydroxide is filtered off from the insoluble hydroxides. It is then evaporated to dryness and calcined. This decomposes the sodium aluminate into alkali and aluminium oxide, which, owing to the calcination, is practically insoluble in the sodium hydroxide solution obtained when it is subsequently leached out with water. The sulphuric acid which was regenerated in the anode compartment can be again employed for leaching out a fresh quantity of aluminium earth. The presence of chlorine, produced by the electrolysis of the sodium chloride, will probably facilitate the dissolving process.

In the *Mining Journal* of August 15th Edmund Spargo contributes a letter upon the "Latest Electric Process for the Direct Extraction of Copper and Iron from their Ores." He incidentally refers to the Cowper-Coles process, and Mr. Coles' prophecy that it will not be long before copper will be produced by electrolytic means directly from its ores. Mr. Spargo states that a process for the production of copper directly from its ores has been in operation for about two years, during which time ore of almost every grade from that containing 50 per cent. to that which only contains 1·74 per cent. of copper have been treated, and apparently with satisfactory results. The process consists of four operations, crushing, roasting, lixiviation, and, finally, deposition, no smelting being required. The ore is first crushed, and, after being mixed with a certain proportion of iron, is roasted in an electric or other type of furnace (we wonder whether an electric furnace has been actually employed). The sulphurous gases produced are taken to a chamber and converted into sulphuric acid. This treatment of sulphurous gases is so often suggested, but so rarely actually done, that one would like to know whether this is more than a paper suggestion. The ore, after roasting, is automatically conveyed to lixiviating tanks, which are arranged so as to facilitate removal of the residues. An important point one would very much like to know is, what is the lixiviating solution—is it the sulphuric acid previously made in the chambers from the sulphurous gases?

The copper solution then passes into the depositing tanks, where it is converted directly into tubes and sheets, the latter being about 40 in. square and 100 lb. in weight. The copper is directly marketable. A quantity of the company's ore at Coniston has recently been treated, and pure electrolytic copper obtained at a cost of £12 10s. per ton, and this product was immediately sold at £62 10s. per ton. The company holding the patents is the Annandale Copper Mines and Smelters, Ltd., the inventor of the process being Mr. T. Scott Anderson.

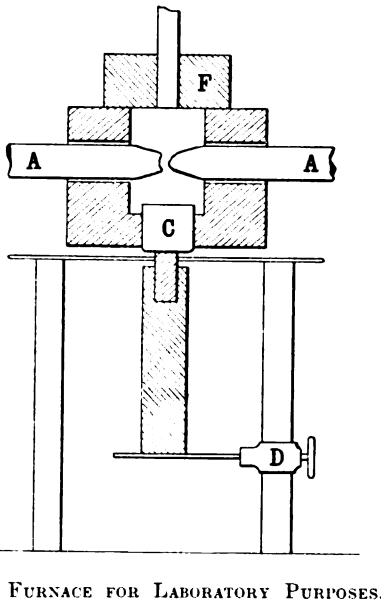
At Coniston there are waste and dump-heaps estimated to contain 200,000 to 300,000 tons, having a copper content of 1·5 to 2 per cent. of copper, and it is claimed that these can be profitably worked by this process. Water power exists on this property, and is included in the company's lease. The Annandale Copper Mines Co. has a nominal capital of £200,000, of which £40,000 is being immediately provided to work the Coniston property.

It is sincerely to be hoped that it will be found feasible to extract copper directly from such poor products as those containing 1·5 to 2 per cent. of copper, but previous experience hardly tends to make one sanguine. Messrs. Siemens & Halske had a very—on paper—good process for extracting copper ores which was actually worked for some time, but it was not found possible to make a commercial success of it. One of the main difficulties to be overcome is the great loss of the leaching liquid in the process. This usually dissolves a great deal more than the copper, and even if these impurities are not deposited along with the copper, they at any rate use up the leaching solution.

According to Mr. Spargo, Mr. Anderson has also a successful process for smelting hæmatite or magnetite iron ore directly in the electric furnace. The ore, mixed with certain proportions of limestone and charcoal, is charged direct into the furnace, and the current switched on. The power required to produce one ton of high grade pig-iron from the ore is 300 h.p. for six hours. By a second operation the pig-iron so produced can be refined to steel of any desired grade.

In the *Electrochemische Zeitschrift* of August Louis Clerc and Adolphe Minet describe a "New Electric Arc Furnace for Laboratory Purposes." When working upon the electric arc for furnace purposes, they found that an arc could be maintained when the electrodes were several centimetres apart, with a current of 40 amperes and a pressure of 50–60 volts. The conditions necessary are to have the diameter of the furnace space corresponding to a certain energy or to a given size of arc. The greater the current density the larger the diameter may be. When the arc is once formed it does not go out by pushing a conducting crucible of graphite or a non-conducting crucible of magnesia into it and the electric constants, current, and potential show very little variation.

The furnace consists of two chief parts, *A A* and *F*, made out of fire-resisting material, such as lime or magnesia. The



Arc Furnace for Laboratory Purposes.

block, *A A*, has a cylindrical hole bored through it to take the electrodes, and from the top a wider cylindrical hole to act as furnace space, this latter having a diameter of 3 cm. and a height of 6 cm. The electrode holes have a diameter of 2 cm. *C* is the crucible in which the reactions are caused to take place. It can be raised or lowered by the ratchet arrangement at *D*.

By employing an energy of 1–2 kilowatts one can carry out a

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variety of observations with this furnace. For example, by keeping the crucible in the position shown in the diagram, reactions can be studied at a low red heat. By pushing the crucible further up so as to be just below the electrodes and drawing them further apart in order to increase the length of the arc, a white heat can be obtained. Finally, by drawing the electrodes still further apart, and pushing the crucible up so that it is in the centre of the electrodes, reactions at the full temperature of the arc can be studied. The electrodes can be drawn out right to the edges of the furnace without the arc being extinguished.

In part ii. of the article Minet describes experiments which he has carried out in order to determine what are best conditions to employ for various classes of work when the arc is enclosed in a small space. Under these conditions so many considerations have to be taken into account. For example, the nature and thickness of the enclosing walls, the form and dimensions of the electrodes, the thickness and length of the arc required, its temperature, the pressure of the gas mantle in which it burns, the potential and the strength and density of the current, the specific resistance of the vapour produced by the reactions, and so on. All of these Minet has endeavoured to study, but in the present article he only touches the fringe of the subject.

ELECTRICAL SCIENCE

British and American

Resistance of Spark Gaps.—In the current number of the *Proc., Roy. Soc., Edin,* R. A. Houstoun gives an account of some measurements that he has made of the resistance of spark gaps, using the method, due to Bjerknes, of taking resonance curves. The oscillating circuit consisted of a condenser, the opposite plates of which were connected by thick copper wires to the electrodes, which were cylindrical, about 4 mm. diameter, 3 cm. long, and had rounded ends. The resonator was made in Drude's form, two parallel tubes, 2 cm. apart, their lower ends being attached to the opposite plates of a condenser; into these tubes rods slide, the upper ends of which were joined by a platinum-constanstan thermocouple connected to a d'Arsonval galvanometer. The length of the resonator could be varied from 58 cm. to 100 cm. The oscillator was excited by means of an induction coil, and the length of the resonator altered until a maximum deflection on the galvanometer was obtained; deflections were then taken for different lengths on both sides of resonance. For such circuits Drude has shown that

$$\gamma_1 + \gamma_2 = \pi \frac{\delta a}{a_m} \sqrt{\frac{J}{J_m - J}}.$$

where J_m is the maximum deflection, a_m the corresponding length of the resonator, J is the deflection for the length $a_m \pm \delta a$, and γ_1 and γ_2 are the logarithmic decrements of oscillator and resonator. Knowing the resistance, inductance, and capacity of the resonator γ_2 could be calculated, and substracting this from $\gamma_1+\gamma_2$, γ_1 found, from which the resistance of the oscillator was obtained. The gaps were varied from 0·4 mm. to 2·4 mm., and eight different metals were used as electrodes, viz., Zn., Al., Cd., Sn., Cu., Fe., Ni., and brass. The smallest resistance recorded was about 5 ohms, but the results are not very consistent. With Al. there is a remarkable decrease of resistance with increase in length of gap, and Zn. always gave a larger resistance when freshly cleaned.

Heusler's Magnetic Alloy.—Since 1903, when Heusler made the discovery that alloys of copper, aluminium, and manganese are strongly magnetic, many Papers have been published dealing with their properties. In the *Proc., Roy. Soc., Edin.*, just issued, J. G. Gray describes some interesting experiments made with an alloy containing 25 per cent. manganese, 12·5 per cent. aluminium, a trace of lead, and the rest copper. He investigated (1) its magnetic properties at temperatures between 0° C. and 400° C.; (2) alteration in magnetic properties brought about by heating and cooling; (3) magnetic properties at the temperature of liquid air after the specimen had been heated and quenched. The magnetometer method of testing was used, the specimens being cylindrical. They were heated electrically in a coil of thin platinum wire wound non-inductively. The specimen was taken through a cycle at the temperature of the room, then heated, and the cycle gone through at various temperatures. The effect of increase of temperature is to diminish continuously the permeability and hysteresis of the material; at 310° it became practically non-magnetic. Next the magnetic field was kept constant, and the temperature gradually increased until the magnetometer deflection became zero; the specimen was then allowed to cool, and magnetometer readings taken. The cooling curve does not coincide with the heating curve, and the difference is most striking when the applied field is weak, the magnetic quality being to some extent destroyed. Subsequent heating and cooling results in a further diminution of magnetic property, and so far as the experiments went there is no appearance of a limit to this. The magnetic properties, when the specimen is quenched from a high temperature, are very remarkable. In the quenched condition it is almost non-magnetic at the ordinary room temperature, but on cooling to the temperature of liquid air, its permeability was much greater than that of the material in the normal or unquenched condition.

Continental

Liquid Anodes.—It is well known that it is impossible to maintain an arc between a cold cathode and a hot anode. The cathode must be hot in order to allow the necessary quantity of electrons to escape through the potential gradient due to the electric double layer at the surface. In the *Comptes Rendus* for August 3rd, G. Athanasiadis studies the conditions under which an arc can be formed between a method and a liquid, more especially in connection with the arrangement adopted in Duddell's singing arc. If a copper-wire 1 mm. in diameter is plunged into a dilute sulphuric acid in which a carbon plate is immersed to form the other electrode, the phenomena observed on applying a high voltage differ greatly according to the direction of the current. When the wire is an anode, and is plunged some 5 c.m. into the liquid, the end of the wire becomes phosphorescent, and the current, rising at first to about 6 amperes, falls to half an ampere, owing to the polarisation of the wire. The current then remains constant, even if the voltage is raised to 220. A white vapour escapes from the anode, owing to the decomposition of the sulphuric acid. On reversing the current an arc is formed, with the wire as cathode, and the latter is rapidly melted. The arc may be obtained also with tin, aluminium, carbon, and other cathodes. Some interesting phenomena are obtained when thicker wires are used. A copper-wire 3 to 4 mm. in diameter, used as an anode, is polarised by bringing its end into contact with the liquid and then slowly submerging it to the extent of 2 or 3 cm. On reversing the current an arc forms round the submerged end of the wire, accompanied by a loud sound and the projection of drops outside the vessel. On increasing the voltage to 220 the current may rise to 8 amperes. The arc is made more brilliant, and the pitch of the sound higher by shunting a capacity of 10 or 20 microfarads across it. This capacity has, however, no effect upon the polarisation of the wire when used as an anode. The effect of the condenser is diminished by inserting inductances in both the parallel circuits. The rate of interruption is 50 to 180 per second, so that something like Duddell's phenomena may be obtained with a liquid anode. It is important to notice that the cell described acts as a valve or rectifier up to voltages of 220. This action is greatly favoured by the incandescence of the wire.

Meteorological Reports by Wireless Telegraphy.—The annual report of the Royal Meteorological Society states that the arrangement for the transmission of reports by wireless telegraphy from his Majesty's ships has been in operation throughout the year, and 146 wireless telegrams were thus received. The greatest number received in any one day was nine. Occasionally, however, no messages were received for several days. Messages were received chiefly from ships crossing the Bay of Biscay, and on many occasions the information has formed a useful supplement to the usual reports from the land stations. In compliance with a request from the International Conference at Innsbruck, a report was prepared for presentation to the International Meteorological Committee at Paris upon the terms upon which reports by wireless telegraphy are available from ships of the mercantile marine. It was estimated that the cost for an adequate number of wireless telegrams to be of practical service in supplementing the land observations for purposes of forecasting and storm warnings would amount to about £1,000 per annum.

The Iron & Steel Institute.—The following are among the Papers down for reading at the forthcoming meeting of the Iron & Steel Institute at Middlesbrough, on September 28th–30th and October 1st and 2nd :—On the scientific control of fuel supply, by Prof. H. E. Armstrong, F.R.S.; on gas-producer practice, by Prof. W. A. Bone, F.R.S., and Dr. R. V. Wheeler; on the production of finished iron sheets and tubes in one operation, by S. O. Cowper-Coles; on some results of experience with electrically-driven rolling mills, by C. Koettgen and C. A. Ablett; on electric power supply, by C. H. Merz; on a test for ascertaining the relative wearing properties of steel rails, by E. H. Saniter. A number of visits to works will be paid, including those of Messrs. Bolckow, Vaughan & Co., Messrs. Dorman, Long & Co., the Linthorpe-Dinsdale Smelting Co., the Cargo Fleet Iron Co., Messrs. Bell Brothers, Ltd., the North-Eastern Steel Co., the Skinningrove Iron Co., Ltd., Sir B. Samuelson & Co., Messrs. William Whitwell & Co., Richardsons, Westgarth & Co., the Darlington Forge Co., the electric power stations erected by the Cleveland and Durham Electric Power, Ltd., and by the Newcastle-upon-Tyne Electric Supply Co., Ltd., the Tees Dockyard of R. Craggs & Sons, Ltd., the Cleveland Dockyard of Sir Raylton Dixon & Co., Ltd., and the works of Messrs. Blair & Co., Ltd. (marine engineers).

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A LARGE AMERICAN WATER-POWER STATION

A DESCRIPTION of a large water power-station in Minnesota, on the St. Louis River, belonging to the Great Northern Power Co., is given in our American contemporary, *Power*. Fig. 1 gives a sketch map showing the way in which the hydraulic installation has been arranged. By means of a concrete dam 38 ft. in height and 1,000 ft. long, a storage reservoir has been formed about three-quarters of a square mile in area, at the south-east corner of which is another concrete dam with racks and head gates to admit water to a canal two miles long, 70 ft. wide, and 15 ft. deep, which ends in a forebay covering 40 acres. The service reservoir is 464 ft. above Lake Superior, and has a gross capacity on its 12 ft. of available draft of 130,000,000 cubic feet of water, which is amply sufficient to accomplish the purposes of conservation and regulation.

The service reservoir has an important function in clearing the water from needle ice. No anchor ice has ever been observed in the river. At the discharge of the service reservoir and forebay are curtain walls with submerged arches through which the water flows. These are of ample section to make the current passing through them quite slow. It is a fact that while the entire surface of the service reservoir may be covered with bark, chips, and other *débris* from saw and pulp mills above, the water coming out of these arches and flowing along the canal toward the power-station is perfectly clean, although the rack screens in the reservoir are coarse. Another series of curtain walls, submerged arches, and a finer rack will perform the same duty at the lower end of the forebay.

The canal into which water from the service reservoir passes is 8,500 ft. long, and has been excavated for its entire length in the slope of a hillside. At the foot of the forebay another concrete dam, with racks and head gates, has been erected, and

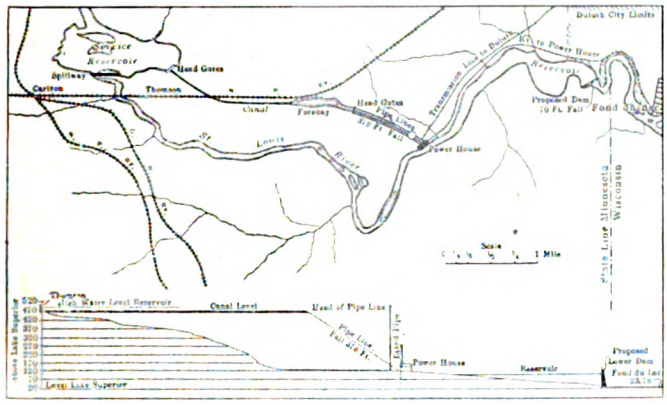

FIG. 1.—SKETCH PLAN OF SYSTEM.

from this start the 7-ft. penstocks, one of which has been installed for each water-wheel. This pipe line is 5,000 ft. long, the upper 4,000 ft. being of wooden stave construction, and the lower 1,000 ft. of riveted steel leading down over a steep bluff to the power-station on the river bank below, giving a working head of 378 ft. It will be noted that the three miles of canal and pipe line cut off five miles of the river, which here makes a curve.

The wood pipe is built of clear red-wood timber staves, tied by ¾-in. steel rods with malleable shoes and turn-buckles. Each wood pipe at its foot passes into a cast bell-shaped section of the steel line, where it is thoroughly calked with lead and oakum. There are similar sections at the upper ends of the wood pipes. The steel pipe is made of plates which are thoroughly riveted and were dipped into hot asphalt when laid. The entire line is laid in a covered trench, and at its lower end the pipe is anchored in concrete built up from bed-rock beneath the power-house. Under normal conditions the pipe lines deliver water at the rate of 335 cubic feet per second, which is equivalent to 10,000 horse-power. The friction loss is equivalent to about 10 ft. of head, and that in the canals when running full is about 6 ft. more.

At the top of the bluff above the power-house the pipe lines are connected to a cross receiver. From this rises a 6-ft. stand-pipe connecting with a tank 30 ft. in diameter and 52 ft. high, the top of which is 250 ft. above the foundation of the structure, and slightly above the level of the forebay. The stand-pipe is for the purpose of maintaining an even pressure in the pipe lines, and to prevent a surge due to sudden in-

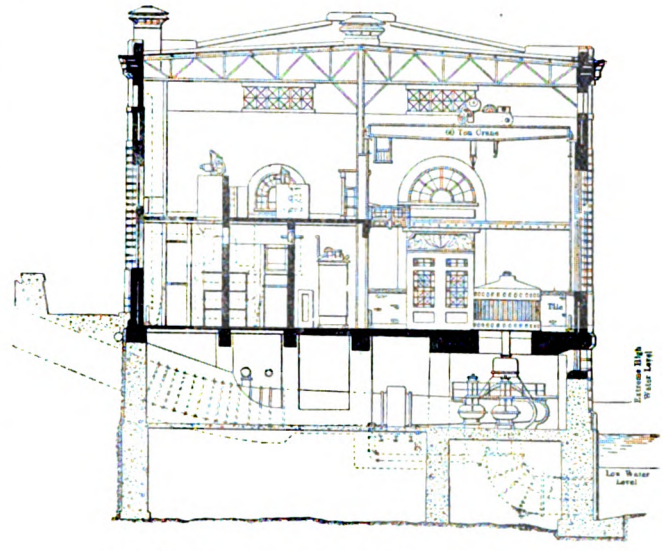

FIG. 2.—SECTIONAL ELEVATION OF POWER-HOUSE.

crease in load; the total quantity of water contained in the pipe, receiver, and tank will be 312,000 gallons, weighing 1,300 tons.

The water passes to the power-house, which is designed to accommodate four turbines. It is now 77×181 ft. in area, and when completed it will be 313 ft. long, and will contain eight generating units, each unit consisting of one 13,500-h.p. vertical reaction turbine of the Francis type built by Allis-Chalmers Co., with a 7,500-KW. vertical three-phase 6,600-volt 25-cycle generator, capable of developing 25 per cent. overload for three hours, and mounted upon the turbine shaft. The sets run at 375 r.p.m. It is claimed that these are the largest turbines of their class ever put into service. The runners are 62 in. in diameter, and run at a very high speed for their size.

A section of the station is given in Fig. 2, from which the relative positions of the turbines and alternators can be seen, and a plan is shown in Fig. 3. In each penstock a 66-inch hydraulically operated gate-valve is provided, and these are said to be the largest ever constructed for such pressures. Two 24-in. pressure regulators are placed on each penstock between the gate-valves and the turbines. These are arranged so that they can be operated automatically by a governor on the turbine, and they can also be set to open when the pressure in the penstock rises above a predetermined amount. Each regulator is fitted with a dash-pot having a time-element release that closes the valve gradually and automatically after the pressure

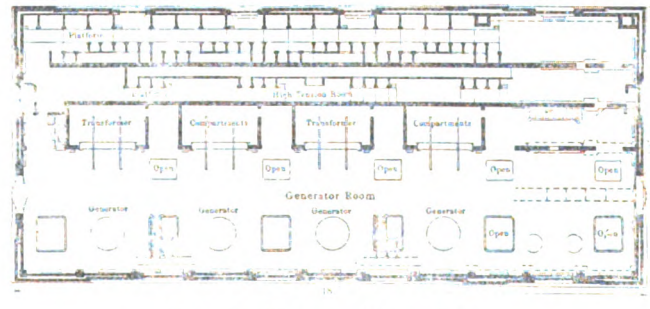

FIG. 3.—PLAN OF POWER-HOUSE.

is relieved, in order to reduce the waste of water. All these pressure regulators are operated in multiple through the cross receiver at the standpipe.

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The quantity of water supplied to the turbines is controlled by the position of series of movable guide vanes or gates surrounding the runner in the turbine casing, and arranged so that they overlap and can be turned to close the opening between them. These vanes are actuated by a centrifugal governor through a system of cylinders worked partly by the water pressure and partly by a high pressure oil supply. The supply can also be controlled by hand.

The turbines are supplied with water from the penstocks through a ring system of 16-in. pipes. Each leg of the ring is connected with each penstock, and is fitted wit.. valves arranged so either wheel can be supplied from any penstock. The water is discharged from these wheels into the river through a pipe in the front wall of the building.

The alternators' rotors are coupled directly to the vertical turbine shafts, and the whole weight of the revolving parts is taken by a film of oil supplied to the thrust bearings under pressure of a special system of pumps.

Excitation for the main generators is furnished by two 250-kilowatt eight-pole 125-volt direct-current generators, each direct-connected to a vertical 500-h.p. impulse turbine built by the Allis-Chambers Co. Each of the generators has sufficient capacity to supply excitation current to all of the eight main units which the station will eventually contain.

The current generated is stepped up for transmission to the sub-station by single 7,500-kw. three-phase oil-insulated water-cooled transformers, which are 14·88 ft. high, 15 ft. long, and 5·88 ft. wide, and contain windings to transform the current to 30,000 or 60,000 volts, as desired. The core and windings weigh about 65 tons, and can be lifted bodily out of the casing. Surface condensers cool the oil, which is circulated by a special motor-pump set. The main switches are all of the motor-operated oil-break pattern arranged for distant control from a benchboard placed on a gallery that gives the operator an unobstructed view of the main units. All low-tension wiring is insulated and carried in conduits laid in the floors, while all high-tension wiring is bare and is hung on insulated supports in brick compartments. Throughout the scheme each set of unit wiring can be carried through any transformer and to any one of the transmission lines, and this plan will be continued as the number of units is increased to the maximum. For the control of the entire 80,000 horse-power there is a switchboard that is less than 19 ft. long, being unusually compact. In the centre of this board is the panel controlling all station lighting and power, and on each side are four panels, one for each of the eight units of the completed plant.

Power is carried to the centre of consumption over wires placed on steel towers, along a right-of-way 100 ft. wide, the property of the company. These towers are spaced from 300 to 1,000 ft. apart, and are from 40 to 60 ft. high, depending on the topography of the country. A voltage of 30,000 is carried on No. oo six-strand copper cables, and an overhead steel cable is carried on the towers as a lightning arrester, also a telephone line running into insulated booths along the high-tension lines.

The main sub-station is at Duluth, 14 miles away, and contains the necessary transformers and switching devices for distributing current at 13,200 volts to the various customers in Duluth and Superior. In this building are located two 1,500-kilowatt motor-generator sets for supplying 550-volt direct current to the street railway. Later, other sub-stations will be built at West Duluth and Superior, and provisions made for conveying current to the great iron mines of the Missabe and Vermilion iron ranges, situated at an average of about 70 miles from the power station.

Part of the 13,200-volt transmission system is underground. The company now has some 12 miles of cable skirting the harbour and railroad lines, as well as 16 miles of overhead circuits additional to the main feeders from the power-station. One of the cables is laid across the harbour to Superior, in a trench dredged 30 ft. below water line, or 8 ft. beneath the keel of the deepest-laden ship that can pass the Sault River.

ELECTRIC SIGNALLING IN AUSTRALIAN MINES

An article in the *Australian Mining Standard* gives some interesting information with respect to the systems of electrical mine signalling employed in the large mines of the Kalgoorlie district. The old mechanical knocker, with its accompanying and somewhat cumbersome system of levers, lines, and bell cranks is still to a large extent in use, but as time goes on, and the mines become deeper, so, no doubt, will the employment of this system become less.

There are two main systems of electrical signalling at present in use in the Kalgoorlie mines, viz., the trembling and the single-stroke bell systems, and, of course, there are several modifications of both. The Kalgoorlie gold mine employs the Siemens-Halske single-stroke bell system. These bells have a 14-inch gong, and each takes 1 ampere at a pressure of 110 volts. The current is generated by a small independent direct-current Ganz dynamo driven by a 2-h.p. three-phase motor, which receives its current from the alternating current power mains. As a standby in case of accident happening to the dynamo, there are installed 140 auxiliary Leclanche cells of large size, each having an output of about one ampere at 1·5 volts. This reserve battery is sufficient to run the entire signalling system for a period of eight hours. A special armoured cable, containing eight well-insulated wires, is used in the shaft, the wires being so well protected as to be quite immune from the effects of water or of shocks caused by blasting.

A cheaper but rather unsatisfactory method of protecting the wires in use on some mines is that of placing them in ordinary gas piping, secured to the side of the shaft with staples. This piping is connected at each level to water-tight junction boxes by means of a gland and stuffing box, and it is in these junction boxes that trouble is likely to occur. The water in the Kalgoorlie mines is notoriously heavily mineralised, and if any of this, or even the slightest dampness caused by this saline solution, finds its way into the junction boxes, severe electrolytic action is set up, and trouble follows. The necessity, therefore, of having these boxes absolutely damp-proof is apparent.

Returning to the Kalgoorlie gold mine system, it may be mentioned that two pairs of wires branch off from the junction box on each level. Each pair is connected to a bell and a sliding-contact-type press. There is at present no intercommunication between the levels, and consequently, if one level wishes to communicate with another, the signal has to be transmitted to the driver, who then retransmits it to the particular level desired. It is intended later on, however, to put in the necessary connections for intercommunication between the levels. Five levels only can be connected with the system by means of an 8-wire cable. One wire is used as a return, and is common to all levels. There are five wires for the five levels, each level having its independent circuit. The other two wires are in circuit with the engine-driver's bell and the presses in the levels. The driver has before him a sliding contact level indicator, which enables him to throw into circuit any level to which he desires to signal. He has also an indicator exhibiting the number of knocks rung, thus doing away with the possibility of mistaking a signal. When it is desired at any time to extend the system to more levels, another cable will have to be put down in addition to the one now in use, as already all of the eight wires in the present cable are employed.

With the system in use on the Great Boulder mine, polarised bells are employed, which are rung with a 15-volt alternating current transformed down from a 550-volt pressure in the mines. The principal objection, however, to the use of an alternating current for working mine signals appears to be the extreme electrolytic action that such a current induces in the connections, it being far more active in this respect than a continuous current.

Telephones are useful as an adjunct to a signalling system, but their employment in West Australian mines is very limited, as it is not always considered advisable, for various reasons, to place the men underground in too intimate communication with the surface.

An India-rubber Exhibition.—An International Exhibition of the Rubber and Allied Trades will be held at Olympia, from September 14th to 26th. Exhibits will show how rubber trees grow and are tapped, and the various processes in the manufacture of the material. We are informed that exhibits are being received from a number of Continental countries, as well as from the United Kingdom, and also from the various rubber-growing countries, which will be officially represented. "Living pictures" on the manufacture of rubber in England and America, &c., will be shown. Gutta-percha will not be excluded, and growing gutta-percha trees will be exhibited, and also the treatment of this material. A large number of manufacturers are, of course, also represented. Mr. H. C. Pearson, the editor of the *India-rubber World* of New York, will give lectures on various subjects connected with the manufacture of rubber goods, crude rubber production, and on synthetic rubbers on certain days during the fortnight.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Aug. 20th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

9,950. **Variable Frequency, Constant Speed Polyphase Alternators for Marine Propulsion.** H. A. Mavor and Mavor & Coulson, Ltd. In systems of electrical marine propulsion in which turbo-alternators drive polyphase motors directly coupled to the propeller shafts, the speed variation of the motors is best obtained by varying the periodicity of the generated alternating current. The object of the present invention is to provide means whereby the turbo-generator set may be capable of generating an alternating current of variable periodicity, although the steam turbine runs at a constant speed. One method of doing this is to mount the secondary element of the alternator so that it can revolve concentrically around the primary element (the rotor field system), which is directly coupled to the steam turbine. The periodicity of the generated current can then be decreased or increased by revolving the secondary element in the same or opposite direction respectively to that of the primary element or usual rotor. The secondary element may be revolved by gearing operated from the rotor shaft, or by means of an electric motor. The starting of the main motors may be effected by gradually raising the periodicity from zero. Other similar methods of producing a variable frequency with constant turbine speed are described in the specification. Eight claims, three figures.

28,494. **Protective Device for Transmission Lines.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). A spark-gap protective device, provided with means for maintaining a flow of insulating fluid along the electrodes and across the gaps. The rate of flow of the fluid is caused to be greater than the velocity with which the vapour from the electrodes moves across the gaps. This allows the system to be relieved of any excessive charge, but prevents the formation of arcs across the gaps. If the electrodes are made of platinum the vapour will move across the gap at the rate of 1,400 ft. per second, in which case the insulating fluid would be forced across the gap at a velocity of about 2,000 ft. per second. The fluid between the electrodes, which has been ionised by the discharge, is continually swept away and replaced by fresh, cool insulating fluid, so that the discharge ceases directly the voltage of the system becomes normal. A small compressor pumps the insulating fluid at the necessary pressure through a pipe with branches to all the spark gaps. Three claims, one figure.

28,494. **Prevention of Falling of Tramway Trolley Wires.** A. G. Boon and F. Mellaerts. In overhead tramway fittings, such as points or section insulators, the conductor always vibrates most at the point where it is joined to the fitting, as the latter is more rigid than the conductor itself. It is at this point that most breakages occur. According to the present invention a joint is provided on each side of the fitting, consisting of a sleeve of rivetted sheet-iron enclosing the conductor. A wedge with saw-like teeth prevents the conductor from slipping in the sleeve. A steel wire attached to the sleeve, and also to the fitting, prevents the conductor from falling in case of breakage. One claim, three figures.

1908 Patent

3,096. **Speed Control of Single-Phase Commutator Motors.** British Thomson-Houston Co. (*Allgemeine Elektricitäts-Ges.*). In the driving of machine tools, such as planing machines, it is desirable to have one speed for the working stroke, and another for the return or idle stroke. The working speed should be independent of the load, and the return speed greater than the working speed. According to this invention, when a single-phase commutator motor is employed for such work, the motor is given a shunt characteristic during the working period, while during the return or idle period it runs with a series characteristic. The change over from one characteristic to the other is obtained by operating a two-way switch connecting one of the exciting brushes to a fixed point on the stator winding, or one of the short-circuiting brushes respectively. This switching operation may be performed automatically by the machine tool. To prevent the tool from entering the work at too great a speed the change over may be performed before the end of the idle stroke is reached. Three claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

17,458, Hickley. Electrolytic current rectifiers.
17,526, Trainor. Electrically-propelled vehicles and boats.
17,661, Dowsing. Electric switch for series lighting.
17,683, Lake (*Newhall*). Supports for telephone and telegraph wires.
17,718, Deutsche Beck Bogenlampen Ges. Arc lamps.
18,053, Jahoda, Von Loti, Von Loti, & Latzko. Manufacture of filaments for electric lamps.
19,157, Imray (*Glühlumpen-Fabrik "Union" Ges.*). Manufacture of filaments for electric lamps.
20,110, Kelman. Switch and circuit breakers for high potential circuits.
21,475, Basset. Electric battery.
21,904, Eckstein, Heap & Mellis. Automatic circuit breakers
22,457, Duncan. Electrically connecting dynamo - electric machines with their supply circuits.
27,289, Galletti. Methods of producing electric oscillations.
27,569, Johnson (Firm of *W. C. Heraeus*). Electric resistance thermometers.
27,825, Felten & Guilleaume Lahmeyerwerke Akt.-Ges. Electrical igniters for internal-combustion engines.

1908 Patents

899, Siemens Schuckertwerke Ges. Electric cable boxes or troughs.
1,705, Schanschieff. Sparking-plugs
1,773, Alexanderson. Electric motor control.
3,231, Iversen. Device for regulating power supply in hoisting plants.
4,257, Firm Robert Bosch. Electrical ignition devices for internal-combustion engines.
4,762, Allgemeine Elektricitäts-Ges. Electrodes for arc lamps.
6,105, Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*). Means for ozonising air.
7,006, Porsche. Electric power transmission for motor vehicles.
7,231, Brush Electrical Engineering Co. & Acland. Tramway trucks.
7,401, Otis Elevator Co. (*Otis Elevator Co.*). Safety apparatus for lifts.
8,415, Noeggerath. Dynamo-electric machines.
8,996, Soc. Anon. L'Electricité Moderne. Apparatus for storing the heat furnished by a source of electricity.
9,092, Mason. Sparking or ignition plugs.
9,235, Allgemeine Elektricitäts-Ges. Process for extracting nitrogen peroxide from nitric oxide air mixtures.
10,023, Eisenstein. Condensers of the "Leyden jar" type.
13,489, Kuhlo. Metal armouring for electric conductors.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1907 Patent

19,672, Ges. für Verwertung Chemischer Produkte Ges. Metal filaments for electric lamps.

1908 Patents

7,328, Allgemeine Elektricitäts-Ges. Arc lamps.
11,710, Siemens & Halske Akt.-Ges. Manufacture of a plastic mass from tungsten compounds.
12,876, Siemens-Schuckertwerke Ges. Device for starting combustion motors.
16,096, Siemens & Halske Akt.-Ges. Telephone installations.
16,272, Belin. Apparatus for reproducing at a distance pictures or designs.
16,296, Müller. Miners' safety lamps.
16,446, Siemens & Halske Akt.-Ges. Telegraph apparatus applicable to fire-alarms.

Expiring Patents

No patents of electrical interest expire during the current week.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10¼—10¾ xd	
Do. 4½% Cum. Pref.	10	4½	4½%	9½—10 xd	
Do. 6% Cum. Second Pref.	10	6	6%	10⅝—10⅝ xd	
Do. 4½% Debenture, Red.	Stock	4½	4½%	100—103	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5⅛	—	4⅛—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co.,Ld.	5	10	5%*	6¾—7¾ xd	
Do. 7% Cum. Pref.	5	7	7%	6⅝—7⅞ xd	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	3½—4 xd	
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½ xd	
Do. 4% Deb. Red	Stock	4	4%	95—98	+½
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3⅞—4	
Chelsea Electric Supply Co., Ltd.	5	4½	—	3—3⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	5%*	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	11½—12½	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4½	
County of London Elect. Sup. Co. Ltd.	10	5	—	7½—8½	
Do. 6% Cum. Pref.	10	6	6%	10⅝—10¾	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	+1
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	+1
Edmunson's Electricity Corp., Ltd.	5	—	—	⅞—1	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—66	+1
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7¾—8¾ xd	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E.L. Cos. Db.Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	2½	2/6	⅞—1⅜	
Do. 6% Pref.	5	6	6	4½—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4½—5	-¼
Do. 4½% Cum. Pref.	5	4½	4½%	4⅝—4¾	-⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. D	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	5	2/6*	5½—5¾	
Do. £2 Paid	5	8	4·85d.*	3½—3¾	
Do. 5% Pref. (fully paid)	5	5	2/6	5⅝—5¾	+⅛
Do. £2 Paid	5	5	4·85d.	3⅛—3¼	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	12—13	
Oxford Electric Co., Ltd.	5	7	2/6	5⅝—6⅛ xd	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5/-	7—8	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—¾	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅝—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅞	
Do. 7% Cum. Pref.	1	7	—	1—1¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	—	¼—1½	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5/-	7½—8½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	92—94	+1
Central London	Stock	3	3%*	67—69 xd	-1
Do. 4% Preferred	Stock	4	4%	85—87 xd	
Do. Deferred	Stock	2	—	50—53 xd	-1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	82—84	
City and South London Cons.	Stock	4½	1½%	32—33	
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—1	
Gt. Northern, Piccadilly & Brompton	10	4	3¾*	7—7½ xd	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	½	1%	35—36 xd	-½
Do. 3½% Preference	Stock	3½	3½	84—87 xd	-2
Do. 3½% "A" Pref.	Stock	3½	3½%	73—76 xd	-1
Do. 3½% Convertible Pref.	Stock	3½	3½%	70—73 xd	
Metropolitan District	Stock	—	—	10½—11½	-½
Do. 6% Perp. Deb.	Stock	6	6%	113—118	
Do. 4% Deb.	Stock	4	4%	71—76	
Do. Perp. Extension Pref. (5%)	Stock	—	—	19—23	-3
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	47—51	+1
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	—	39—43	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅜—½	
Do. 4½% Deb. Red.	Stock	4½	—	86—91	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅛*	
Do. 6% Cum. Pref.	10	6	3/-	4—4½ xd	
Do. 5% Perp. Deb.	Stock	5	5%	94—97	-1
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	6/-	12—13	
Do. 6% Pref.	10	6	6/-	12½—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3½—3¾	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	+1
London Street Tramways Co.	4	4/6	2/-	⅞—1⅛	
London United Trs., Ld., Cm. Pf.	10	5	—	6½—7¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	79—84	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜ xd	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	6d.	⅝—¾ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	93—96	
Provincial Tramways Co. Ltd.	10	4	3/-*	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	7½d	¾—1	
Do. 4% Deb. Red	Stock	4	4%	76—80	
Sunderland Dst. E.Trs. 1st Mt. Db. Rd.	100	5	5%	78—82	+1
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	3⅛—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	15/-*	58—61	
Do. 6% Pref. Ord.	Stock	6	30/-	103½—104½	
Do. Def. Ord.	Stock	1	—	16—16½	-½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	84—87	
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	9/-*	13½—13⅝	-⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	99—101	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99—101	
Do. do. (Mauritius Sub.)	25	4	—	100½—102½	+½
Eastern Ext. Australasia & China	10	7	2/6*	12⅜—13⅛	-⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	99⅝—101½	
Eastern Telegraph Co.	Stock	7	1½*	135—138	+1
Do. 3½% Pref.	Stock	3½	3½%	84—86	
Do. 4% Mort. Deb.	Stock	4	4%	101½—103½	
G. N. Tel. Co. (Copenhagen)	10	20	5/-	28—30	+1
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	107—109	+½
Do. Deferred	Stock	6	6%*	120—122	+2
Do. 6% Cum. 1st Pref.	10	6	6%	10—12	
Do. 6% Cum. 2nd Pref.	10	6	6%	10—12	
Do. 5% 3rd Pref.	5	5	2/6	5⅜—5⅛	+1/16
Do. 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red.	Stock	4	4%	103—105	+½
Western Telegraph Co., Ltd.	10	7	3/-*	13¾—14¼	
Do. 4% Deb.	Stock	4	4%	100½—102½	+½
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅜	
Do. 6% Cum. Pref.	1	1/2⅞d.	1/4¼d.	⅛—⅜	
Babcock & Wilcox, Ord.	1	20	—	3⅞—4⅛	+1/16
Do. 6% Pref.	1	6	—	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	3/-	6¼—6⅜	
Do. 6% Cum. Pref.	5	6	—	6—6¼	
Do. 4¼% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	+1
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	93—98	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	70—75	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ltd.	5	15	—	9¼—10⅜	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—108	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	3/-	1⅜—1⅝	-⅛
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	90—93	
Dick, Kerr & Co., Ltd.	1	10	—	1½—1⅝	
Do. 6% Cum. Pref.	1	6	6%	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A," £3 paid	5	2/6	—	⅜—¾	
Do. do. (fully paid)	5	4/2	—	1⅛—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	⅞—1⅛	
Do. 7% Cum. Pref.	2	—	2/9⅜	1⅜—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	66—71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	86—90	+2
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	—	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5¼	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	5/-*	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98½—100½	
Tel. Const. & Maintenance Co.	12	17½	12/-*	31⅜—33½	
Do. 4% Deb. Bds. Red.	100	4	4%	100—102	
Willans & Robinson, Ord. Shres	1	5	—	3—1¼	
Do. 6% Cum. Pref.	5	6	6%	2½—3	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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LOCAL NOTES

ABERDEEN: *Proposed Electrobus Service.*—At a meeting of the Town Council last week, a letter was read from the London Electrobus Co., intimating that they propose to apply for a licence for opening in the City of Aberdeen a service of electric omnibuses on certain routes where the city is not served by electric tramways.

ABRAM: *The Maypole Colliery*—Messrs. Pearson & Knowles Coal & Iron Co., Ltd., of Warrington, were putting down powerful electrical plant at their Maypole Collieries, Abram, near Wigan, at a cost of between £30,000 and £40,000; but it is feared that the work will be somewhat interfered with owing to the disastrous explosion there on the 18th inst., and the subsequent flooding of the mine. We understand, however, that the generating station which was being built near the No. 2 pit escaped damage.

AUSTRALIA: *Victoria: Malvern-Prahran Electric Tramways.*—According to the *Australian Mining Standard*, the Victorian Executive Council has empowered the municipalities of Malvern and Prahran to proceed with the construction of an electric tramway connecting the two places. The first portion of the new line must be completed and ready for opening within two years, and other portions within ten years of the date of payment of a sum of £13,000 to the Railway Commissioners in respect of the necessary regrading work. The speed of cars equipped with hand-brakes is to be limited to fifteen miles an hour, but in cases of cars with approved power brakes the limit is extended to 20 miles an hour.

BARGOED: *Telephone Service.*—At the Bargoed Chamber of Commerce on Tuesday, a letter was read from the Postmaster-General, stating that instructions had been given for extensions of the telephone system to the Post Office in Hanbury Road. It is reported that efforts are being made to obtain a trunk line direct between Bargoed and Cardiff.

BELTURBET: *Electric Lighting Scheme.*—It has been decided to accept the offer of a firm of electrical engineers and contractors of Dublin to submit a detailed report, free of expense to the Council, on a scheme for electric lighting of the town.

BRAZIL: *Electric Lighting.*—A British Consular report on the district of Santos remarks that the town of Curityba is lighted by electricity supplied by a German company. This company has been doing well for several years, and in 1907 obtained a further concession to exploit the Cayacanga waterfall on the Yguassú River for the production of electric power. The towns of Paranagua, Antonina, and Ponta Grossa also possess electric light machinery, all being bought through German firms.

CHILE: *Large Water-power Scheme.*—According to an American Consular report, the Empresa de Tracción y Alumbrado Electricos, of Santiago, is installing a 22,000-h.p. hydraulic electric power plant at La Florida, whence the current is to be transmitted to the city over an underground cable at a tension of 12,000 volts.

DARTFORD: *Street Lighting.*—At the last meeting of the U.D.C., Mr. Wooller moved that the General Purposes Committee be instructed to go into the matter of street lighting, and bring up a scheme for the reduction of the yearly expenditure of £1,868, or about £5 per electric lamp. In 1905 the price was £1,360, and in 1906 it was £1,586, while last year it rose to £1,868. He did not want to do the undertaking any harm, but he was quite sure the Council would never pay such prices to a contractor. Then, again, there was 120 gas lamps at £4 5s. each, while Crayford was only paying £3 3s. 10d. In reply to a question, the electrical engineer said he did not agree with the statement that the electric lamps cost £5 per annum each, and Mr. Putland pointed out that of the £1,868, between £250 and £300 was for lamp columns, &c. The resolution in the result was negatived.

DUBLIN: *Proposed extension.*—A report has been submitted by the Lighting Committee on the capital expenditure on the city electrical undertaking, and considering in some detail the various applications for extension of mains which have been received from different districts. Considerable extensions are recommended, and recommendations are made to apply for a loan to cover the following items:—Extension of mains of Blackpits district, £9,600; extension around Ringsend Dock, £10,500; completion of Drumcondra extension, £9,000; deficit on loans in connection with Mr. Hammond's scheme, £10,925; extension in streets not in original area of supply already carried out, £3,000; extension of distributors to be made as required, £5,000; services and meters, £5,000. The improvement of street lighting is also dealt with, and it is stated that the cost of lighting and maintaining 100 c.p. metal filament lamps on routes where mains are already laid would be £4 each. The proposed extensions in this direction are put at £3,500, bringing the total loan recommended up to £69,705. The report was discussed at a meeting of the Corporation last Friday, one member stating that the electric lighting earnings only produced 3 per cent. on the capital outlay. Another member said that that was due to the enormous expense incurred by the provision of electric lighting for Clontarf and Kilmainham districts, which they might ask Parliament ultimately to cut off from the city. Finally, it was resolved to ask for a joint report from the Lighting and Finance Committees.

DUNFERMLINE: *Electricity Supply.*—The Town Council have finally approved the agreement with the Fife Electric Power Co., whereby the Provisional Order for lighting is handed over to the company, who undertake to work the Order for a period of thirty years, at the expiry of which the Corporation on certain payments may re-acquire the Order and obtain the customers got by the company during the currency of the agreement. The company further agree to pay "all proper expenses" incurred by the Corporation in securing the Order.

EALING: *Col. Yorke's Inspection.*—In reply to the protest of the Mayor of Ealing that Col. Yorke's recent inspection of the tramway track was insufficient, the Board of Trade has promised that full consideration shall be given to the matter (see ELECTRICAL ENGINEERING, August 20th, page 274). A movement is on foot against the retention of the present centre standards in some parts of the borough, which are considered to be a danger to traffic.

ESSEX: *Light Railway Order.*—The Board of Trade have recently confirmed the undermentioned Order, made by the Light Railway Commissioners:—Central Essex Light Railway (Amendment and Extension of Time) Order, 1908, amending the Central Essex Light Railway Orders, 1901 to 1907.

FINCHLEY: *Accident Attributed to Centre Tramway Poles.*—A fatal accident attributed to the presence of tramway poles in the centre of the road is reported from Finchley. It appears that a pony, drawing a light trap, took fright at a steam roller coming in the opposite direction, and collided with a centre tramway pole, with the result that the driver of the trap was thrown out in front of the steam roller, by which he was run over.

GREENOCK: *Electricity Accounts.*—The report and accounts show an increase of 41 per cent. in the units supplied to private consumers, and the income from private lighting has risen from £13,011 to £16,874. After a contribution of £4,705 to the sinking fund and of £465 to the depreciation fund for free wiring and hired motors, and paying interest amounting to £3,415, the year's working shows a net surplus of £384 to be added to the balance of £266 carried over from the previous year.

HASLINGDEN: *Tramways.*—The Town Clerk has been instructed to apply to the Board of Trade for a renewal of the license to use steam on the tramways within the borough for the time being, the present license expiring on September 7th.

KINGSTON-ON-THAMES: *Extensions and Street Lighting.*—A Local Government Board inquiry was held last week with reference to an application by the Town Council to borrow £12,600 for the electricity undertaking. Amongst the items making up the total were the following:—£1,150, engine-room works; £2,898, mains; £2,850, services; £1,890, transformer kiosks; £340, transformer sub-stations; £600, high- and low-tension disconnecting pillars; £300, arc lighting; £264, incandescent lighting. Mr. J. E. Edgcome, electrical engineer, said there were 100 incandescent street lamps now installed, and it was proposed to install an additional 200. The annual cost of the gas incandescent street lamps was £3 8s. 6d., including painting, and the Council credited the undertaking with a similar sum for each incandescent electric lamp, which price, he believed, covered the cost as it worked out at 2d. per unit. The arc lamps were charged £20 per annum each. In the course of the inquiry it was stated that there was a deficiency last year of £884. The undertaking was established in 1894, and the deficit up to the present, £10,739. In reply to the Inspector, Mr. Edgcome said the present loss was due primarily to the great increase of the price of coal, and also to reductions in the charges for current.—The Inspector: Were you justified in making the reductions?—Mr. Edgcome: We could get nobody to take current for power at 3d., and I think we have justified the 1½d. price by the increased day load.—The Town Clerk: The number of consumers for power and heating has increased from 66 to 104 in a single year.—The Inspector: You have more consumers, but is it paying you?—Mr. Edgcome said that with coal at the price it was last year the charges were not paying, but at the present time the charges just about paid. A ratepayer who was present said it was clear to him that the present generation could not hope to get any relief from the burden which the undertaking imposed on the rates. Alderman Clarke urged the Inspector to do what he could to allow the whole of the labour of the contemplated works to be charged to capital account, and so relieve the present ratepayers. At the close of a long inquiry, the Inspector visited the works.

LA PLATA: *Electric Railway.*—The *Review of the River Plate* reports that the Pacific Railway Co. have acquired the

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concession granted to Sr. O. Franke for an electric railway between Retiro and La Plata.

LINCOLN: *Proposed Inclined Railway.*—A proposal has been made to construct an electric railway up the steep hill in Lincoln on which the cathedral stands. The line would have a total length of 1,000 ft. and a rise of 142 ft. A part of the route would be in tunnel. Alternative schemes are being considered for the rack and wire rope systems. It is stated that the originator of the scheme, Mr. W. R. Lilly, Sheriff of Lincoln, has been for the last 20 years acquiring property on the route with a view to selling it at cost price to the Corporation. The lower terminus is to be at the corner of St. Martin's Old Churchyard, and the upper terminus in Exchequer Gate.

LONDON: *L.C.C. Tramways.*—According to the *Times*, all difficulties in the way of the electrification of the remaining horsed tramways in Battersea and Wandsworth have been practically removed. In regard to the Queen's Road and Chelsea Bridge Road, a financial agreement has been come to, and the work will be proceeded with at once. As to the line from St. John's Hill to Vauxhall, a tentative agreement has also been arrived at, subject to confirmation by the Borough Council at its meeting in September and the L.C.C. when it resumes. It is expected that this will be accorded, and the work will then be put in hand. Both lines will be on the conduit system, but in Queen's Road, owing to the very low railway bridges, only single-deck cars can be used.

Hammersmith: The Workhouse Lighting.—It is reported that three of the Poor Law guardians have been surcharged by the Local Government Board auditor a sum of £93 16s. 3d. in connection with the electric light installation at the new workhouse.

Paddington.—In his annual report, the Medical Officer of Health (Dr. R. Dudfield) says that the removal of the Great Western Co.'s generating station from the borough has, to some extent, brought about diminution in the amount of "black smoke."

LYONS: *Proposed Automatic Telephone Exchange.*—It is announced that an automatic telephone exchange is being established in Lyons, and will be in working order by September 5th. Two hundred selected subscribers are to be connected up at first, and experiments with public call-boxes are also to be tried.

MELBOURNE: *Electricity Accounts.*—The annual report states that the units sold during the year were 6,796,180, and the gross revenue was £92,364. The working expenses amounted to £42,765, and of the balance, £16,144 was absorbed by interest and £4,400 by sinking fund, and £20,858 was carried to depreciation account. The total capital expenditure on the undertaking has been £424,273.

MEXBOROUGH: *Electricity Accounts.*—The net revenue for the past year has amounted to £1,894, as against £1,981 for the previous year, and the net profit for the year has been £427, which is considered satisfactory for an undertaking only four years old in a town of not more than 13,000 inhabitants.

NEWPORT (Mon.): *Tramway Accident.*—A collision occurred between an electric tramcar and two runaway railway waggons at a level crossing near the G.W.R. locomotive yard. Several persons were injured, but not seriously.

PORTPATRICK: *Fire at Electricity Works.*—A fire occurred last week at the generating station at Craigoch Dam, belonging to the Portpatrick Electric Supply Co. It contained an oil engine set, as well as a water power plant, and considerable damage was done. It is reported that within forty-eight hours of the fire Messrs Lowden Bros., electrical engineers, of Dundee, had set up an engine and dynamo near the distributing station in the town, and that since then the supply to the town has been maintained from this plant in a satisfactory manner.

RUSSIA: *Electric Furnaces in Steel Works.*—An American Consular report states that the Magnesite Co., owners of the ironworks on the River Ural, have decided to build a new factory equipped with electric furnaces for dealing with chromium iron ores. The new works will be on the River Satka, about 20 miles from the present works, and current will be obtained from the water power station in the district.

SHEFFIELD: *Automatic Tramway Point Controllers.*—The number of automatic point controllers on the tramway system has gradually increased from one to nine, and two further controllers are to be installed. It is said that each apparatus, which costs about £100, effects a saving of £120 to £140 per annum in wages of pointsmen.

SOUTHEND: *Power Rates.*—An application from a laundry company, stating that they were prepared to take power if the Corporation would agree to a charge of 1d. per unit between 6 a.m. and 6 p.m., was discussed last week by the Council. The electrical engineer, however, recommended the following charge from April to September, inclusive—6 a.m. to 7 p.m. (day), 1½d. per unit: 7 p.m. to 6 a.m. (night), 6d. per unit. From October to March, inclusive—6 a.m. to 6 p.m. (day), 1½d. per unit; 6 p.m. to 6 a.m. (night), 6d. per unit. After some discussion the recommendation was adopted.

STRICHEN (ABERDEEN): *Street Lighting.*—Some estimates have been put before a local sub-committee regarding the comparative cost of gas and electric street lighting. It is assumed that a complete plant, comprising oil engine dynamo, 30 lamps of 30 c.p., with overhead wires on poles, would cost £250, and that the annual interest on the capital would be £10. The actual cost of the power for the 30 lamps for 500 hours is put at £6 5s., and a remaining £4 per annum for attendance and cleaning brings the total up to £20 5s. This would show a saving on the £21 14s. 2d. paid for gas lighting last year. The scheme is to be considered at a meeting on next Wednesday.

THETFORD (NORFOLK).—According to the *Daily Mail*, owing to a quarrel with the local gas company, the supply has been cut off and the market-place is lighted by Chinese lanterns.

TURKEY: *Electrical Imports.*—The Board of Trade Journal announces that the prohibition of the importation into Turkey of electrical instruments has been withdrawn. With the improved state of affairs considerable electrical engineering developments may be expected. It is reported that three concessions have been granted for electric lighting and the construction of tramways in Constantinople and its suburbs, and that the Kaifa Dera section of the Hadja railway is also to be worked by electricity.

WORKINGTON: *Revocation of Order.*—The Board of Trade give notice that they have revoked the Workington Electric Lighting Order, 1901, as confirmed by the Electric Lighting Orders Confirmation (No. 5) Act, 1901, as to the whole of the area of supply, as from the 14th day of August, 1908.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA (VICTORIA).—The lighting of the townships of Terang and Camperdown by electricity, has been decided upon, and tenders will shortly be required for the installation.

BELGIUM.—The *Bulletin Commercial* (Brussels) announces that tenders will be opened at 11 a.m. on September 2nd, at the office of the Société Nationale des Chemins de Fer Vicinaux, Rue de la Science 14, Brussels, for the supply of electric cables and the laying of conduits required for the Brussels-Grimberghen section of the local line from Brussels to Humbeek. Tenders must be enclosed in registered envelopes addressed to the Director-General of the Société, and must reach the above address not later than the day preceding that appointed for the adjudication. Plans and specifications (*cahiers des charges*) may be consulted at the same address, or may be obtained at the "Bureau des Adjudications (Musée Commercial)," rue des Augustins, 15, Brussels. The price of the specification is 1 franc per copy, and of the plans, 16 francs.

BLACKBURN.—The Electricity Committee invite tenders for the supply of steam coal for the nine months ending June 30th, 1909. Tenders close on August 24th.

FROME.—Application is being made to the Local Government Board for a loan of £11,000 to carry out extensions to the electricity undertaking.

HASLINGDEN.—It has been decided to apply to the Board of Trade for sanction for a loan of £7,200 for the purpose of providing the necessary machinery, &c., required to provide electrical power to work the tramways in this borough.

KINGSTON.—The proposed loan of £12,600, into which Mr. H. Shelford Bidwell made a Local Government Board inquiry last week, is to include the following items:—£1,089 for excess capital expenditure already incurred; work at the engine-room, £1,150; mains, £2,898; services (including mains, fuse-boxes, &c.), £2,850; transformer kiosks, £1,890; extra transformers, £340; high- and low-tension disconnecting pillars, £600; arc lighting, £300; incandescent electric lighting, £264; converting 160 gas lamps as above, £928; cost of application, law charges, plans, &c., £250 10s. 8d.

MANSFIELD.—Application is to be made to the Local Government Board for sanction to the following loans:—£2,500, repayable in 30 years, for electricity mains; £500 for electricity meters.

PERTH.—Tenders are invited for the electric lighting and power installation in connection with the erection of the new City Hall. Particulars from Mr. H. E. Clifford, 225 St. Vincent Street, Glasgow (deposit 10s. 6d., returnable). Tenders by Saturday, August 29th, to the Town Clerk.

SALFORD.—The Electricity Committee invite tenders for the supply and delivery of lighting and power feeder and distributor pillars. Specification and form of tender may be obtained on application at the office of Mr. Victor A. H. M'Cowen, Borough Electrical Engineer, Frederick Road, Pendleton. Tenders to be sent to the Chairman of the Electricity Committee by noon, Monday, September 14th, 1908.

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STIRLING.—Application is to be made to the Secretary for Scotland for powers for a loan of £3,000 for new feeder cables.

WHITEHAVEN.—With reference to the application which has been made to the Local Government Board for a loan of £1,700 for the following purposes, condensing plant £1,200, battery switchboard and boosters £300, main extensions and auxiliary plant £200, the committee have been advised that the last-mentioned sum is insufficient for the purpose, and it is now proposed to increase this item to £500, and apply to the Local Government Board for leave to increase the amount of the loan for which sanction is asked from £1,700 to £2,000.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Alterations to Gracechurch Buildings, Gracechurch Street, E.C. Builders, Halliday & Greenwood, 144a Loughboro' Park, Brixton, S.W.

N.E.—Installation of electricity (light and power), telephones, &c., in additions to Homerton Infirmary. F. B. Coles, Clerk to the Guardians, Sidney Road, Homerton, N.E.

N.W.—Rebuilding piano factory for Moningham & Weston, Bayham Place, Camden Town, N.W.

W.—Extension National Gallery, Trafalgar Square (£15,979). Builders, F. and H. F. Higgs, Hinton Road, Loughboro' Junction, S.W.

Rebuilding 144 and 146 Great Portland Street. Builder, D. Prosser, 23-25 Charlotte Street, Fitzroy Square, W.

Alterations to drapery premises of Stagg & Mantle, Leicester Square. Builders, Hall, Beddall & Co., Waterloo Bridge, S.E.

Rebuilding business premises, 65 Wigmore Street. Builders, T. H. Kingerlee & Sons, Oxford, and Shepherd's Bush.

Rebuilding business premises in James Street. Builders, Meech & Goodall, Streatham Hill, S.W.

PROVINCES.

BARNET.—Rebuilding three shops and one house in High Street (destroyed by fire), for Harbord & Co. W. J. Wells, Peake & Baughen.

BARNSTAPLE.—Secondary school (to be commenced in February). S. W. F. Brown and G. W. P. Brown, Secretaries.

Garage, Old Red Lion Hotel.

Wesleyan School. Architect, W. A. Quarmby, Imperial Chambers, Grimshaw Street, Burnley.

BIRMINGHAM.—New gymnasium and club, Haden Street, for the Pelican Buildings, Ltd.

BRISTOL.—Police station and fire station (£3,028) and police station (£690). T. H. Tabbicom, City Engineer and Surveyor, Town Hall.

BURNLEY.—Six houses. Builders, Smith Bros., Ltd., Eastham Place, Turfmoor, Burnley.

CARDIFF.—Additions, &c., steam laundry. Architect, Henry Budgen, 95 St. Mary Street, Cardiff.

CARLISLE.—Turkish baths. H. C. Marks, City Engineer and Surveyor, 36 Fisher Street, Carlisle.

CATERHAM HILL.—Additions to school (£2,994). Architects, Jarvis & Richards, 10 Queen Anne's Gate, Westminster, S.W.

CHATHAM.—School (£10,250). Architect, Kent County Council.

CHICHESTER.—The engineer of the Electric Light Co. has been asked to prepare a report as to the cost of wiring the workhouse for electric light.

CLEETHORPES.—Twenty-nine houses and shop. Builder, J. Nutley, Mill Place, Cleethorpes, Great Grimsby.

CORK.—New technical schools. Architect, Arthur Hill, 22 Georges Street, Cork.

DARTFORD.—Extension of chemical department at Wellcome Chemical Works, for Burroughs, Wellcome & Co., Snow Hill Buildings, E.C.

DARWEN.—The Education Committee have decided to proceed with the erection of a new school at Ellison Fold. This will be followed by a new school in Cyprus Street.

DUDLEY.—Workhouse extension. Architect, C. E. Bateman, 81a and 83 Edmund Street, Birmingham.

DUNDEE.—Electrical engineering laboratory at University College. Architects, Mills & Shepherd, Clydesdale Bank Chambers, Dundee.

GREAT YARMOUTH.—Additions to premises, Primitive Methodist Church, Welholme Road.

HAMPSHIRE.—Proposed new asylum. H. Barber, Clerk to County Council, Winchester.

HARROGATE.—Extension of baths (£14,000). E. Bagshaw, Surveyor to the Corporation.

HASTINGS.—Nurses' home at workhouse infirmary. Architects, A. W. Jeffrey and Son, 5 Havelock Road, Hastings.

HINCKLEY.—New infirmary, and laundry block and alterations to workhouse. Architect, W. T. Grewcock, 8 New Street, Leicester.

HOYLAKE (CHESHIRE).—School (300 places). Architect, E. Ware, 45 Imperial Buildings, 20 Exchange Street, East Liverpool.

HUDDERSFIELD.—Warehouse. Architect, J. Berry, 3 Market Place, Huddersfield.

IPSWICH.—New offices, Queen Street, for Prudential Assurance Co., Holborn Bars, E.C.

LINCOLN.—Shops, Silver Street, for Lincoln Co-operative Society.

Additions to offices for Rusten, Proctor & Co., Anchor Street.

New showroom for Laurence & Son, High Street.

MAIDSTONE.—School (1,000 places). T. F. Bunting, Borough Surveyor.

MANCHESTER.—Jewish Hospital, Elizabeth Street and Sherborne Street, Cheetham.

Addition to St. Mary's School, Upper Mass Lane, Hulme.

Addition to Women's Home, Egerton Road, Rusholme.

NEWPORT (MON.).—New building and alterations to existing premises for Y.M.C.A. Architects, C. E. Compton & Habershon, Fawckner & Co., High Street, Newport.

OXFORD.—New Church of St. Stephen. Architect, A. M. Mowbray, 117 St. Aldate's Street, Oxford.

PENDLETON.—New Baptist church (£4,000). Architects, Cook & Son, 39, 44, and 44A Victoria Buildings, Victoria Street, Manchester.

ROTHERHAM.—Shops and houses, Masborough Equitable Pioneers' Society, Ltd.

Eight houses. Builder, T. Green, 46 Greaseborough Road, Rotherham.

SLIGO & LEITRIM.—Tenders are invited for the lighting of the Sligo & Leitrim District Lunatic Asylum with electricity or "petrol gas." Approximate number of lights, 450. Particulars from Anthony Scott & Son, architects, 49 Upper Sackville Street, Dublin. Tenders by September 15th.

STANNINGLEY.—A Methodist Chapel in Richardson Lane is to be lighted electrically, and if the installation proves satisfactory it is to be extended to the new Sunday School.

ST. ANNE'S-ON-THE-SEA.—Villa. Architect, J. D. Harker, St. Anne's-on-the-Sea.

Extension of Roman Catholic school; four houses; pair of villas. Architect, A. England, Carlton Chambers, St. Anne's-on-the-Sea.

SHEERNESS.—New Masonic hall. Architect, E. J. Hammond, 21 Balmoral Road, Gillingham.

SOUTHAMPTON.—Australian Emigration Offices (£5,000). Architect, Guy Prendergast, Scholing, Southampton.

STOCKPORT.—Carnegie Library (£10,000). R. Hyde, Town Clerk.

SUNDERLAND.—Stone buildings. Architect, J. W. Moncur, Town Hall, Fawcett Street, Sunderland.

Branch library. Architect, Hugh Hedley, 40 West Sunniside, Sunderland.

Warehouse, &c. Architects, W. & T. R. Milburn, 20 Fawcett Street, Sunderland.

Extension of ropery. Architects, W. & T. R. Milburn.

WESTON-SUPER-MARE.—Baptist Church, Clarence Park (£6,000).

WOKING.—School at Goldsworth. Education Architect, County Hall, Kingston-on-Thames.

Miscellaneous

ARGENTINE.—Several new telegraph lines are to be built in the Province of Salta, at a cost of $150,000 paper.

DUBLIN.—Tenders are invited for the supply of 500 single-phase meters and 100 three-phase meters. Particulars from City Electrical Engineer, Fleet Street, Dublin (fee £1, returnable). Tenders to the Chairman, Lighting Committee, 3 Cork Hill, Dublin, by Friday, September 4th.

HACKNEY.—Tenders are invited for the provision of electric light and power fittings, and electric-bells and telephone installations, at the extensions, now in the course of erection, of the infirmary at Homerton. Particulars from Mr. F. R. Coles, Clerk to the Guardians, Sydney Road, Homerton, and tenders by Monday, August 31st.

LAURENCO MARQUEZ (S.E. AFRICA).—An American Consular report states that tenders to supply electric cranes for the Gorjao Wharf at that port can be submitted for some months to come before the final adjudication is made.

MERTHYR TYDFIL.—Hills' Plymouth Co., Merthyr Tydfil, invite tenders for stores, including electrical appliances for the twelve months ending September 30th, 1909. Forms of tender may be obtained upon application in writing, enclosing stamped addressed foolscap envelope, and must be sent in not later than September 21st.

SOUTH AUSTRALIA.—Tenders are required by October 21st, for power plant for charging accumulators for telegraph purposes at the General P.O., Adelaide.

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TASMANIA.—Tenders are required by the Postmaster-General's Department by November 2nd for material for accumulator equipment for telegraph purposes.

WESTERN AUSTRALIA.—Tenders are required by October 6th for the supply of telegraph and telephone material. Tenderers must state the country in which the articles tendered for have been made or produced, and in the case of manufactured articles where the material has been made or produced. Tenders must include Customs duty, if any. Copies of specifications, general conditions, and schedules of tender may be obtained at the General Post Office, Perth (where sealed patterns can be seen), and at the General Post Offices, Adelaide, Melbourne, Sydney, Brisbane, Hobart, and the Commonwealth Office, London.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—Nine tenders, varying in value from £58,240 to £43,641, have been received for the construction of a complete central battery switchboard for the new telephone exchange at Melbourne, and the tender of the Western Electric Co. at the latter figure has been accepted. It is stated that 93 per cent. of the work will be of British origin, and the remaining 7 per cent. by the Belgium and American manufacturers.

BAHAMAS.—The tender of Messrs. Crompton & Co., Ltd., for an electric installation at Nassau, the capital of the Bahamas, has been accepted, in the face of great American competition.

DARTFORD.—The Urban District Council has accepted the following tenders :—Chamberlain & Hookham, Ltd., for the meters required up to June 30th; S. W. Gibson & Co., wiring for condenser pumps and bath pump, £22 15s. 6d.; Hodgson & Stead, Ltd., maintaining weigh-bridge at refuse destructor, £3 per annum.

DUBLIN.—At the meeting of the Corporation last week, the following tenders for the new electrical plant recommended for acceptance by the Electricity Committee were discussed :—Messrs. Ferranti, switchgear and feeder panels at £829 and £185 respectively; British Electric Transformer Co., transformers at £1,698; Messrs. Richardson, Westgarth & Co., boiler plant at £7,071. The Lighting Committee recommended the tender of Messrs. Babcock & Wilcox for plant as the lowest, but Messrs. Richardson, Westgarth & Co. wrote stating that an opportunity had been afforded to Messrs. Babcock & Wilcox to amend their tender, and asked for a like opportunity to put in a revised tender. Mr. Hutchinson said that it was against the principle of fair play to allow any tender to be amended, and he moved the matter be sent back to the Committee with instructions to advertise for fresh tenders. This was seconded and passed.

GLASGOW.—The acceptance of the following tenders is recommended by the Electricity Committee.—The Temperley Coal Transporter Co., at £2,520, for a coal transporter; Messrs. Donald Clarke & Sons, coal bunkers at Port Dundas station, at £550: British Thomson-Houston, for two Tirrill regulators, at £1,630, one for Port Dundas Station and one for St. Andrew's Cross station.

MELBOURNE.—The tender of Messrs. Johnson & Phillips for the supply of insulated cables at £240 has been accepted. The tender of Messrs. Lawrence & Hanson for a 500-kw. motor generator has been recommended by the Electric Supply Committee for acceptance.

COMPANIES' MEETINGS AND REPORTS

ABERDEEN SUBURBAN TRAMWAYS CO.—The report for the half-year ended July 31st gives the net profits of £855, giving, with the addition of the amount carried over from the last account, a balance of £2,422. The negotiations with the Corporation of Aberdeen for a supply of electric energy, after the expiry of the present agreement, have now reached an advanced stage. Arrangements are being made for a reference to an arbiter to be appointed by the Board of Trade to fix the price at which the current will be supplied. The directors recommend a dividend of 2 per cent. on the paid-up capital, with £1,000 transferred to renewals and depreciation account, and £755 carried forward.

BRIGHTON AND ROTTINGDEAN SEASHORE ELECTRIC TRAMROAD CO.—The report of the Brighton and Rottingdean Tramroad Co. for the year ended December 31st, 1907, states that the balance of revenue at December 31st, 1907, was £2,132. Sundry creditors absorbed £714, debenture interest £984, and the amount due to capital account was £434. The meeting is to be held on October 3rd, at Brighton.

DUBLIN & LUCAN ELECTRIC RAILWAY CO.—The half-yearly meeting was held last Thursday, Mr. W. Mooney presiding. The available balance, after providing for debenture interest, was £868, and a half-yearly dividend on the 5 per cent. preference shares would absorb £475, leaving a balance of £393, which it was proposed to carry forward. The Chairman said that the working of the lines was satisfactory, and the receipts had increased by 15⅔ per cent. as against the preceding year. The expenses had, however, increased, mainly owing to the rise in the price of coal by an amount more than sufficient to pay a dividend of one per cent. on the ordinary shares. The report and accounts were adopted.

LANARKSHIRE TRAMWAYS CO.—At the ordinary general meeting last Friday, Mr. A. R. Monks, who presided, stated that the company was in a position to pay a dividend at the rate of 6 per cent. per annum on both the share capital issued prior to January 1st, 1908, and the new issue of shares from date of payments of instalments to June 30th, 1908. The traffic receipts had exceeded by over £4,000 the income for the corresponding six months of 1907. The shares offered in February last had been fully subscribed for by the shareholders, and the proceeds had been utilised in constructing the recent extensions, which, however, owing to delays in passing the plans by the local authorities and late delivery of certain materials, had not been opened as early as had been anticipated. It was not proposed to incur further capital expenditure on plant extensions at the generating station, and negotiations were pending for a supply of current for the new lines from another source. The and accounts were adopted.

SOUTH AMERICAN LIGHT & POWER CO.—Mr. F. H. Jackson presided at the fifth annual meeting last Friday. The company were to be congratulated on having reached the dividend-paying stage. The net amount at the credit of profit and loss account was £2,309, and they proposed to pay 2 per cent. But for certain items with which the directors had had to deal the dividend would have been larger. The balance to be carried forward was £167. The report and accounts were adopted.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £62 10s. to £63 per ton (last week, £62 to £63).

ARMORDUCT MANUFACTURING CO.—We are informed that the company can now supply from stock ceiling rose fittings fitted with the Wilton grip continuity system.

BANKRUPTCIES, LIQUIDATIONS, &c.—The examination in bankruptcy of James Allan Wilson, electrical engineer and mill furnisher, of Kilmarnock, was held last Thursday. Assets were given as £310 and liabilities at £2,450. The debtor had started business about five years ago with obligations for borrowed money to the extent of £400 or £500, and stated that about £800 of it was never in the business at all, part of it having been borrowed to pay accommodation bills, and there were about £200 of bad debts. He believed he had lost a good deal by leaving mill furnishing alone and trying to develop the electric business, which had never paid him.

The statement of affairs of Mr. W. T. Garnett, of Undercliffe House, Bradford, who carried on business as an electric cable and wire manufacturer at Barkerend Mills, Bradford, as W. T. Garnett's Cable Company, shows liabilities are estimated at £94,942, of which £31,330 are expected to rank. The assets are estimated to produce £8,129. The debtor attributes his failure to depreciation in the value of real estate, heavy bank charges, unsuccessful trading owing to the Eastern crisis, lack of working capital, and fluctuation in the price of copper; also losses on investments, and the initial expenses of commencing and developing certain businesses.

A petition has been presented for the winding-up of Electrical Instrument Manufacturers, Ltd., by W. J. Berrill and A. E. Berrill, trading as Gordon & Gotch, advertising agents, and will be heard at Edmonton on September 14th.

It has been resolved to wind up the Private Telephone Co., Ltd., voluntarily. A meeting of creditors of this company was held at 29 Chancery Lane yesterday.

Creditors of the Blackpool Electric Tramways (South), Ltd. (in liquidation), are requested to send particulars of their claims to Andrew McGowan and J. McWilliam, 43 Castle Street, Liverpool, before October 5th next.

EDISON & SWAN UNITED ELECTRIC LIGHT CO.—In a competition held at Leyton on Bank Holiday, the Ediswan Fire Brigade were successful in winning the fourth prize in the One Man Manual Drill, also first prize in the Five Men Manual Drill. They also tied with Wanstead Fire Brigade for the "Vincent Challenge Shield," but lost this in the re-drill. The "Vincent Challenge Shield" is held for one year by the brigade making the fastest time in the Two Men and Five Men Drills.

MISCELLANEOUS CITY NOTES

ASCOT DISTRICT GAS & ELECTRICITY CO.—An interim dividend at the rate of 5½ per cent. per annum has been recommended for the half-year.

CAMBRIDGE ELECTRIC SUPPLY CO.—An interim dividend at the rate of 5 per cent. per annum has been recommended for the half-year.

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ELECTRICAL ENGINEERING IN GERMANY

Sir Francis Oppenheimer's Consular Report

THE following are extracts from Sir Francis Oppenheimer's Consular report on the Frankfort district :—

The Proposed Government Monopoly for Electrical Power.—A Government monopoly for the supply of electrical power has been suggested. In the electric industry combinations have taken place for years, but they have been combinations for the manufacture of electrical appliances. When the electrical industry was still the spoilt child of the German investor, electrical works (compelled uninterruptedly to increase their production to cope with the increasing demand) was readily supplied with the necessary capital, but after the first seven fat years a crisis ensued because the reduced consumption revealed a critical overproduction, which naturally led to underbidding and financial collapses. The crisis was overcome chiefly with the aid of combinations. These combinations were effected either by connecting various branches of manufacture in one concern, or by the combination of several works in the same branch of manufacture; the former effected a reduced cost of production—the latter chiefly a reduced cost of administration and general expenses. Such is the origin of those gigantic combinations mentioned in former reports : Allgemeine Electricitäts Gesellschaft with Union; Siemens with Schuckert; Felten Guilleaume with Lahmeyer. Like the important combinations in the mining and iron industries, these combinations in the electrical industry had undoubtedly a great bearing upon the combinations in the banking world, the gigantic credits often required by these industrial combinations being beyond the capacity of any of the older individual banks.

Of syndicates proper there are comparatively few in the electrical industry on account of the great variety of manufacture, nor does it appear that the public has been sufficiently accustomed in the various branches to certain recognised standard articles. Where such standard goods have been insisted upon, syndicates have been established, *e.g.*, in incandescent lamps, cables, &c. In other branches, such as electrical motors and apparatus for continuous current of great power, there are at best loose price conventions. The nearest approach to a trust exists among the manufacturers of accumulators.

There is no doubt that the electrotechnical industry, suitable to the German frame of mind, has become essentially a German industry; it is claimed that the German success is due to a very keen inter-German competition. So far as the suggestion of a State monopoly for electrical power goes, fears are raised from within the industry; such a monopoly must interfere with the freedom of motion within the industry. The great argument so far put forward in favour of the scheme of a Government monopoly lies in the easy decentralisation which could thus be effected in the interests of industry at large, for wherever a Government power station is established there any industry could, of course, obtain cheap power; such stations would undoubtedly become numerous in view of the extended railway system which probably would be the first to profit from such a monopoly.

The substitution of electrical power for steam power on railways with extended systems has already become the subject of official inquiry, and quite recently the Bavarian Government has worked out statistics showing the quantity of power needed. The Prussian State railways intend to introduce electrical power in place of steam on certain lines, but the change will not be effected for some time to come. The financial aspect of this scheme of a general Imperial monopoly has not yet been definitely examined, but it is believed that the various State railway systems obtaining the necessary power from the Imperial power monopoly would alone yield a sufficient basis to vouch for a satisfactory Imperial balance-sheet in future.

New Attempt to Use Motion of Tide for Production of Electricity.—Statistics have repeatedly been published to show how soon the coal supply in the various coal-producing countries will be exhausted if the demand continues to increase proportionately to the past. Such reports animate a further search for the utilisation of electrical power in preference to steam. Even the motive power of electrical works is replaced by water power. Heretofore this has been chiefly effected by the natural water power of rivers. Recently new endeavours have been made similarly to utilise the motion of the tide. In Hamburg a company has been started (capital £2,000) styled the "Wasserkraft Anlage" to work a new electrical plant with the aid of the tide. The works are to supply Cuxhaven with electric light and to run an electric railway. According to present calculation the electric current ought to be supplied at a greatly reduced price.

The French Association for the Advancement of Science.—Among the Papers read before the Congress of the French Association for the Advancement of Science at Clermont-Ferrand were the followding :—The transmission of energy from the Rhone to Paris, by MM. de la Brosse and Blondel; electric locomotives, by M. de Marchena; two Papers on wireless telegraphy, by Lieut. Tissot; the electric arc, by M. Cheneveaux; photometry, by M. Guillez; and a report by MM. Bergonié and Turpain on the measurement of high-frequency currents.

ELECTRICAL NOTES IN CEYLON

(By Our Own Correspondent at Colombo.)

CEYLON, at the present moment, is enjoying a wave of prosperity, and steady development is taking place in all the staple industries, with the inevitable result that public means of communication are also expanding. The telegraph system of the colony shows a steady growth, but, of course, the more rapid expansion is seen in the telephone system. Colombo now possesses a fair overhead system, comprising two central exchanges with 300 subscribers and 30 miles of route. Cheap flat rates are in vogue, and since in the tropics a telephone is much more of a necessity than at home, a large future growth may easily be predicted. It is reported that next year the Government intend to put in an underground system in the more central parts of the town.

* * *

Of recent years there has been an agitation in favour of telephone systems for the hill capital of Kandy, and also the famous health resort of Newera-Eliya. It is now reported that next year a commencement will be made with the provision of exchanges for these two towns, as well as the provision of trunk lines to Colombo, a distance of 75 and 135 miles respectively.

* * *

An electric lighting scheme has recently been put forward for Newera-Eliya. It is but a small scheme, and it is believed that this has been sent home for report by the Government experts in London.

* * *

There are, of course, the existing installations of electric tramways in Colombo, and the lighting system by the same company, but these do not show any signs of rapid expansion. Perhaps the fact that overhead distribution in the suburbs is not allowed, and that 50 cents (8d.) per unit is charged for private lighting, may have something to do with this. At a place like this the new metal-filament lamps should have a very good field, but for some reason—not, let us hope, because this is only one of our Colonial possessions—the possible trade in such lamps appears to have been quite overlooked by British firms.

NEW COMPANIES

MERSHON INSULATOR (HIGH TENSION) SYNDICATE.—This company was registered on August 8th, with a capital of £20,000 in £1 shares, to acquire certain rights in connection with an invention relating to improved high-tension insulators and to carry on the business of an electric power and supply company in all its branches. The subscribers are M. McQueen and St. J. G. Miller. Private company. The first directors (to number not less than two nor more than seven) are R. D. Mershon (permanent, subject to holding 500 shares), H. W. Fox, M. F. Armstrong, W. A. Wills, W. Praeger, and A. Scott. So long as Earl Dysart is a shareholder he may nominate one director, W. Praeger being his first nominee. Remuneration, one guinea each per board meeting attended, and 5 per cent. of the net profits dividend.

SPARKS (SHEFFIELD).—This company has just been registered with a capital of £1,000 in £1 shares, to carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electric, magnetic, telephonic, telegraphic, and other appliances, and apparatus, &c. The subscribers are :—E. C. Clayton, B. Lake, Mrs. M. J. Horton, H. T. Magness, E. Swinden, J. M. Mason, J. B. Kesteven. Private company. The number of directors is not to be less than two nor more than five; the first are Mrs. M. J. Horton, E. C. Clayton, and B. Lake. Registered offices, 111 Broomhall Street, Sheffield.

THORPE METER SYNDICATE.—This company was registered on August 13th, with a capital of £9,000 in £1 shares (3,000 founders'), to acquire from W. B. Thorpe an invention relating to an electricity meter, and to turn the same to account. The subscribers are :—W. B. Thorpe, 3,000 founders'; H. P. Miles, 1,000 ordinary. Private company. The first directors are J. M. Gatti, H. P. Miles, and E. A. de Paiva, J.P. Registered office, 11 Victoria Street, S.W.

W. SEYMOUR.—This company was registered on August 14th, with a capital of £1,050 in 1,000 preference shares of £1 each, and 1,000 ordinary shares of 1s. each, to adopt an agreement with W. Seymour, to acquire the business carried on at 1 and 7 Ellis Street, Sloane Street, S.W., and to carry on the business of electrical, mechanical, sanitary, gas, hot water, and motor engineers, founders, smiths, workers of electricity, &c. The subscribers are :—Mrs. E. G. E. Seymour, A. F. Davies. Private company. Table "A" mainly applies. Registered offices, 1 Ellis Street, Sloane Street, S.W.

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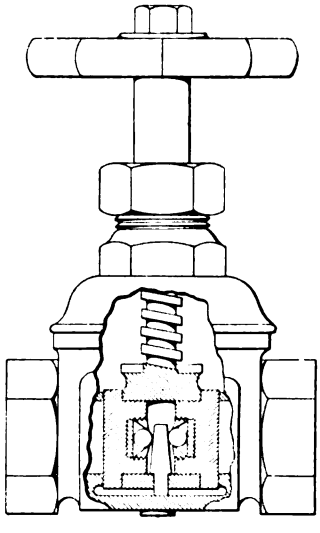
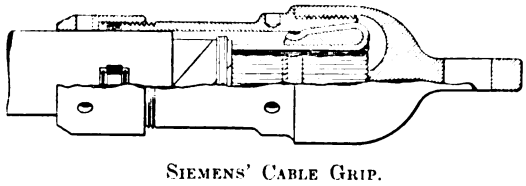
CATALOGUES AND PAMPHLETS RECEIVED

BOILER MOUNTINGS, &c.—A well-got-up and illustrated catalogue of steam specialities is to hand from Messrs. Joseph Shaw & Son, Ltd., of Albert Works, Huddersfield. One of the principal features of the list is the series of Shaw patent improved steam valves in various forms. In these valves, the valve seat is made of a specially prepared metal calculated to resist the action of steam, and, being considerably harder than the valve, cannot easily be injured by grit or other material coming between the seat and valve. If from any other cause the seat should get damaged, it can be reground or replaced with a new one at a trifling cost, without removing the body from its position. The valve is made separate from the spindle, and, being in a concentric form, it makes a most reliable metal-to-metal joint that will resist any pressure. The valve is simple and strong, and not liable to get damaged; it will always find its true centre on the valve seat, as under all conditions it will accommodate itself to any variation in the spindle caused by wear or strain. Attention should also be drawn to the parallel pattern of valve shown in the accompanying figure. In the valve, which has a straight full thoroughfare equal to the capacity of the pipes, the discs are pressed to the seats by a wedge operating on the ball bearings, fixed in the centre of the discs, thus giving an equal pressure on both faces, and in a simple manner making a perfectly fluid-tight joint. All these valves can be fitted with valves and seats of a special alloy known as "Nico" metal when they are required for highly superheated steam. Other boiler accessories in the list include asbestos-packed cocks, water gauges, fusible plugs, steam traps, and a variety of other apparatus.



Shaw Patent Parallel Steam Valve.

CABLE ACCESSORIES.—A very complete new catalogue of cable accessories has been issued by Messrs. Siemens Bros. & Co., Ltd., of London and Woolwich. The introductory portion comprises well-arranged tables of conductor sizes, weights, resistances, &c., and other useful figures, after which is a fully illustrated section including all kinds of jointing material. The portion devoted to tools and cable-laying appliances is also very complete. We illustrate a special form of cable grip which the firm have introduced to obviate the danger which sometimes occurs of damaging heavy lead cables whilst drawing through conduits. The use of these grips ensures that the strain of pulling-in comes direct upon the conductor and not on the lead casing of the cable. At the same time they ensure that the end shall be kept perfectly watertight by a rubber-packed gland, so that the cable can be drawn through water without any risk. The conductors of the cable, after having been bared, are passed through the loose cone piece, turned over and then bound down, and it will be seen from the illustration that the wires thus turned over are held between the cone and the steel of the grip; therefore, the greater the strain put on the cable the tighter the grip will hold. Attention should also be drawn to the special insulating material, known as "Ohmulite," which

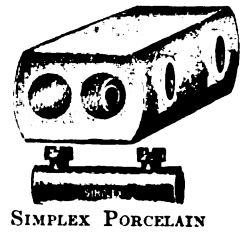


Siemens' Cable Grip.

the company manufacture for all kinds of electrical work. It can be moulded into any form required or made up into sheets. It can easily be drilled, sawn, or worked on a lathe. The material does not become soft or plastic at any temperature, but takes a slight impression at 80° C. It is quite non-hygroscopic, insoluble to all ordinary solvents, practically unaffected by water, sea water, mineral oil, castor oil, and dilute sulphuric acid, and it will not readily ignite. Ohmulite has a tensile strength of about 2,000 lb. per square inch of sectional area, and a dielectric strength of about 150 volts per mil. The latter portion of the catalogue contains particulars of testing sets and instruments, which are dealt with more fully in separate lists.

CEILING ROSES.—A new leaflet relating to ceiling roses is being issued by Messrs. A. P. Lundberg & Sons, whose specialities in the way of wall plugs we had occasion to refer to last week. The newest pattern is known as the "Biflex" ceiling rose. This is fitted with a novel type of terminal, which allows the fitting to be threaded on to the leads, and in the case of the loop-in type plenty of slack to be brought through, and the ends of the wire twisted and properly attached without cutting, as is often necessary with the ordinary types of pillar terminals used for looping-in purposes. Another pattern is the "Triplex," with three contact plates, and can be used for a variety of purposes with two-way switches, &c., and similarly a quadruplex ceiling rose is made with four contact plates. In the "Multiplex" design, there is a common contact plate in the centre, with provision for five track circuits. An arrangement which should be useful in some circumstances is the "detachable" ceiling rose, in which the flexible cord is connected to a detachable piece, with pin contacts similar to an ordinary wall plug, and provided with fuses, the whole being enclosed in the ordinary ceiling-rose cover. With this arrangement, in renewing a fuse there is no need to work in an inconvenient position on the top of a ladder, but the fuse-carrying part may be detached and the renewal done away from the base. During wiring or re-decoration of the ceiling, only the base need be fixed, and the other parts kept out of the way of the workmen and re-attached on completion. A ceiling rose, combined with a "Dot" wall plug, is also listed.

DISTRIBUTION BOARDS AND INSULATED CONNECTORS.—The latest progress sheet issued by Simplex Conduits, Ltd., contains particulars of an inexpensive pattern of distribution board, with bridge fuses in teak case and brass front, and with tumbler switches for each circuit outside the case. Another item is the porcelain connector illustrated herewith, which should be found useful in many installations for making connection between small wires. These connectors will fit into any simplex standard rectangular or circular box. They may also be used behind back plates for making connection to fittings and brackets.



Simplex Porcelain Connector.

CONTACT VOLTMETERS, SIGNAL LAMPS, &c.—We have received from the Union Electric Co. an advance copy of a list which they are issuing devoted to contact voltmeters, relays, signal bells, and lamps, of Messrs. Hartman & Braun's manufacture. There has always been a demand for a reliable contact voltmeter, and the present apparatus, with its carefully designed contacts and oil damper, fulfils all the requirements, both for direct- and alternating-current circuits. In order to excite solenoids, &c., requiring a considerable current, it is necessary for the contacts in the voltmeter to be relieved from the full duty, and this is achieved by the use of special relays, having very ample contact surfaces, and thus permitting heavy currents to flow and be interrupted without harm or loss of reliability. In order to show either that the contact voltmeter is on the maximum or minimum pressure contact, a signal bell has been designed, combined with coloured signal lamps.

INSULATORS, &c.—A new price list is being issued by the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., of insulators, fittings, and tools for telegraph and telephone lines. A large number of porcelain insulators for overhead lines are illustrated, including special iron-hooded insulators. Other items are brackets, iron poles, and fittings, and various tools and appliances for use in erecting aërial lines.

TROLLEY WIRE.—A new leaflet from the British Insulated & Helsby Cables, Ltd., contains illustrations representing the Prescot non-fouling trolley wire, fitted with a straight line mechanical ear. The special advantages claimed for this wire are non-fouling fittings, no bumping or arcing, no crystallisation of the trolley wire, reduced pressure on the trolley boom, considerable saving in trolley wheels and wire, and low cost of maintenance.

WIRES AND CABLES.—The latest cable catalogue from Simplex Conduits, Ltd., contains particulars of three qualities of cables and wires, described respectively as "competition quality," "equal to best grade association," and "chemically, electrically, and mechanically equal to association cable." Several patterns of flexibles are listed, including a special "weather-proof" twin cable covered with thick seamless rubber tubing. Jointing material, Leclanché cells, and dry cells are also dealt with, and also special bell and telephone cables and wires.

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SUMMARY

The annual report of the Chief Engineer of the British Engine, Boiler, & Electrical Insurance Co., Ltd., for the year 1907 contains a large amount of information of much interest to manufacturers and users of electrical machinery. The rate of breakdown was rather lower among generators and dynamos, and rather higher among motors, than in 1906. Continuous-current machines broke down more frequently than alternating-current machines, but the average cost of the breakdown was much less for the former cases than for the latter. Details of twenty-four representative cases are included in the report. Much interest attaches to the detailed reports that are published, explaining the causes of these accidents, which, it is said, are quite typical. The rate of breakdown among steam engines during the year was considerably less than during the previous year. The reduction in the number of main shafts broken is remarkable. Among gas and oil engines there is a serious increase in the number of breakages of valves and valve gears, but there is an encouraging reduction in the number of broken cylinders and pistons. Two explosions of boilers in electricity works are recorded. The loss of life caused by the fracture of pipes through water-hammer effects was heavier than usual. (Page 347.)

Some experiments have been made recently in Berlin on an electrically-propelled fire-engine. The results of these experiments show that the cost of running and maintaining an electric engine is somewhat less than that for a steam engine, and very much less than that for a horse-drawn engine. The engine was equipped with hub-motors on the back wheels, and much trouble was experienced with the tyres on these wheels. Four further engines are being constructed. (Page 352.)

The new twin-screw steamer *Orcoma* of the Pacific Steam Navigation Co. has a very complete electric lighting and power installation. The generating plant consists of four 65-kw. 100-volt continuous-current generators, direct coupled to high-speed engines. Some 1,500 glow lamps are employed, and a large number of fans driven by motors of from 8 h.p. downwards are installed. The applications of electric power in the galleys and sculleries are very numerous, and include electric plate and glass washers, knife- and boot-cleaning machines, and potato-peelers. (Page 352.)

The effect of the revocation clause of the new Patents Act which came into force last Friday is reviewed, and the procedure necessary in order to obtain the revocation of a patent which is not worked in this country is outlined. The same article deals with the

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present position of metal filament lamp manufacture in this country. (Page 353.)

THE first single-phase railway to be constructed in Norway was opened in July last. Power is obtained from a water-power station at 15,000 volts three-phase, and converted to 6,600 volts, 25 cycle, single-phase for the contact line. The rolling stock comprises three Westinghouse single-phase locomotives, and one motor-car. A large proportion of the traffic consists of truck-loads of copper ore from the copper mines in Meldalen. The power station also supplies power to the mines and towns in the district. (Page 355.)

MESSRS. DICK, KERR & Co. are introducing an interpole traction motor, particularly intended for heavy service and where extensive use is made of electric braking. The leading features in the design are described. (Page 357.)

A DESCRIPTION of Messrs. J. H. Holmes & Co.'s works at Newcastle is given on p. 358.

THE "Medhurst" field telephone set is described on p. 361.

AT a large electrically-driven rolling mills in Sweden an interesting method of equalising the demand on the generating plant is employed. The supply is three-phase, and a battery is employed in connection with the load-equalising arrangement. A wattmeter relay in the alternating mains regulates the field of the exciter of a booster connected with this battery in accordance with real power variations of the load, and not, as is usual, with the current. A D.C. machine is connected to the battery 'bus-bars, and this is coupled to a synchronous machine connected to the three-phase 'bus-bars, from which the mill motor circuits are taken. Either of these machines can act as a generator or motor, and thus the battery is charged when the load drops and discharges when the load rises, supplying the surplus energy required through the A.C. machine. (Page 363.)

A SHORT illustrated article gives particulars of the telephone exchange system at Messrs. Debenham & Freebody's. (Page 365.)

WE publish a list of exhibitors at the Manchester Electrical Exhibition, supplementary to the list printed in our issue of August 20th. The total number of exhibitors is now about 230. (Page 365.)

IN a recently issued British Consular Report, containing a collection of notes from various parts of Mexico, there are a few statements of some interest to manufacturers of electrical machinery. Repeated references are made to the futility of sending out catalogues in the English language and with English prices, and the scarcity of British commercial travellers is commented on. (Page 365.)

SOME information with regard to applications of electricity in agriculture in Germany is furnished in an American Consular Report. Motors are employed which can be utilised for a variety of purposes, and are not always permanently connected to one machine, as each class of work is only done for a limited period each year. The applications include oil-cake breaking, pumping, threshing, chaff-cutting, bruising, haulage, unloading hay, smithy and cartwright work, ploughing and reaping. (Page 366.)

Two of the patent specifications which were published last Thursday relate to the problem of increasing the specific resistance of metal filaments in order that the length of the filament for a given pressure can be reduced; the object of this is, of course, to render possible the manufacture of high voltage, low candle-power lamps. The first patent describes a method of obtaining alloys of tungsten with other refractory metals, by mixing powdered tungsten with their oxides also in the form of powder, and forming filaments with the help of a binding agent which is subsequently volatilised. The introduction of silver into the tungsten filament is proposed in the second of these specifications. (Page 367.)

MR. R. G. BLAINE writes us with regard to the review of his book on the slide rule. (Page 367.)

AN article in an American contemporary describes some experiments made on a tungsten filament lamp, to determine the nature and extent of the alleged "overshooting" or excessive brilliancy on switching on the lamp when cold. Conclusive evidence of a considerable rush of current and a corresponding excessive brilliancy lasting for about one-tenth of a second is given. An oscillograph record of the brilliancy and current on a 25-cycle alternating-current circuit showed not only the same excessive current kick and rise in brilliancy, but also the alternate heating and cooling of the filament. (Page 367.)

UNDER ELECTROMETALLURGY AND ELECTROCHEMISTRY we give abstracts of two German patent specifications relating to processes for the manufacture of oxides of nitrogen by electrical methods. The influence of the silent electric discharge on explosive gas mixtures, according to some recent experiments, appears to be greatest when one of the constituents of the mixture is oxygen. This is probably due to the formation of ozone. There is little effect upon mixtures such as hydrogen and chlorine. There are a large number of electric furnaces now working; some of these require over 1,000 electrical horse-power. A new form of cadmium cell for experimental work is described. An electrical process for the production of hypochlorite disinfecting fluid has given great satisfaction in Poplar. The theory of the E.M.F. of primary cells is also among the subjects dealt with in this section. (Page 368.)

THE patent specifications which were published by the Patent Office on Thursday last include one by M. J. MCVITTIE for an electromagnetic safety device for holding up a lift car on breakage of the ropes or other means of suspension. The DEUTSCHE BECK-BOGENLAMPEN GES. have a patent relating to an improved lifting magnet for use in connection with arc-lamp mechanisms, and another by A. ECKSTEIN and others describes a reverse current circuit breaker, which, it is stated, will operate even with very heavy reverse currents without danger of reversal of polarity. The control of single-phase traction motors suitable for working with both alternating and continuous current is the subject of a specification by E. F. ALEXANDERSON, and one by F. PORSCHE describes a system of petrol-electric transmission for motor vehicles, by which the demand for power is automatically regulated by a decrease in the speed of the motor owing to an automatically produced reduction of the motor air-gap. Two patents relating to alloys for metal lamp filament are dealt with separately. No patents of electrical interest expire during the current week. (Page 369.)

WE give Colonel Yorke's report upon his recent inspection of the Ealing tramways. No fault is found with the condition of the track. Some information with regard to the position at Ealing between the London United Tramways, Ltd., and the Council is also given. (Page 346.)

EXHAUSTIVE life tests are being carried out at Beckenham on metal filament lamps for street lighting, the lamps being run night and day.—The Local Government Board has refused to sanction a loan to the Brighouse Corporation in connection with the replacement of the generating

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plant by transforming plant; the Council has abandoned generating electricity itself in favour of taking a bulk supply.—A scheme of decorative electric lighting at the Scottish National Exhibition was inaugurated last week.—The National Electric Construction Co. are endeavouring to secure consent to the use of the overhead trolley system instead of the surface-contact system upon the Folkestone, Sandgate, and Hythe Tramways.—The differences between the Battersea Borough Council and the London County Council with regard to tramways in Battersea have been overcome.—Public telephones have been installed in fourteen branch libraries in Manchester.—Electricity supply is now given in Northfleet by the Gravesend Corporation. A short while ago, after signing an agreement, the Gravesend Corporation desired to withdraw, but were threatened with a legal action.—A 50-c.p. 220-volt metal filament lamp is to be placed in each of the 1,045 lamp-posts in Wimbledon. (Pages 371-3.)

The East Indian Railway Company require a 600 kw. three-phase alternator, together with gas engine. —Tenders are invited for large quantities of telephone and telegraph material in Australia.—The Salford Corporation require lighting and power feeder and distributor pillars.—Tenders amounting to over £12,000 have been accepted by the Adelaide Municipal Tramways Trust. (Pages 373-4.)

The General Electric Company of Russia have declared a dividend of 4 per cent. for the past year against 3 per cent. for the previous year. (Page 375.)

A company, called the Deutsch Südamerikanische Telegraphengesellschaft, has been formed in Cologne with the object of laying and working a submarine cable from Germany *via* Teneriffe to the German colonies on the west coast of Africa and the east coast of South America. The cable will be made by the Nord-deutsche Seekabelwerke of Nordenham, and be subsidised by the German Government. (Page 376.)

The descriptions of typical breakdowns, which are included in the annual report of the Chief Engineer of the British Engine, Boiler & Electrical Insurance Co., Ltd., for the year 1907, should prove a useful supplement to the accumulated experience of manufacturers and users of electrical machinery. Of the twenty-four examples selected by the Chief Engineer, Mr. Michael Longridge, as representative of the accidents to motors and dynamos which have come under his notice, there must be some which will either warn the designer or manufacturer of previously unrecognised sources of danger, or will suggest improvements for avoiding the occurrence of any particular accident in the future. It may also happen that light will be thrown on a nearly forgotten breakdown, the cause of which was never ascertained. Many of the breakdowns described only emphasise more strongly suggestions of improvement which previous experiences have given rise to; for instance, the further protection of open and semi-enclosed motors by a fine meshed network cover, so as to prevent the many accidents due to the presence of foreign bodies in the gap; and, again, the use of pure mica in preference to micanite for the insulation between commutator segments. Among the accidents due to bad mechanical construction, two or three are mentioned as being caused by relative movement between armature and commutator; there thus appear to be still cases of the mechanical design of the armature having been left to men unacquainted with the exact nature of the magnetically produced stresses acting on the armature conductors and transferred from these to the core. A particularly interesting case of breakdown is that of a continuous-current shunt-wound motor-transformer, which, when started up one evening, attained to such an excessive speed that the steel binders were broken by reason of the centrifugal force. On examination it was found that one end of the shunt winding had slipped out of its terminal; and it was presumed that an attendant, who had cleaned the machine in the morning, had pulled it out with a duster. For this to have been the case, the fuses must have been inordinately heavy, for the motor would have to have started up without any field except the residual magnetism, and the cross-magnetising effect of the armature would have tended to wipe out any residual magnetism. There is also the possibility that the brushes were accidentally shifted to give a lead instead of a lag, so that the magnetising effect of the armature would provide the necessary field; this may be regarded as very improbable. We therefore incline to the opinion that the shunt winding was, at any rate, lightly connected at first, so as to allow the motor to speed up, and that as the speed rose the vibration shook the wire off the terminal. We cannot remember an accident of this nature before; presumably in most cases the overload release on the starter or the fuses would have protected the motor. The necessity of adequately protecting the field connections of continuous-current shunt motors is emphasised, however, and this simple detail of construction hardly receives the attention it deserves.

The meeting of the British Association for the Advancement of Science opened at Dublin yesterday, and to-day the real work of the various sections begins. In the Engineering Section, papers on a variety of subjects are down for reading and discussion, but the time has not yet arrived when this annual meeting is of equal importance to engineers as it is to physicists and to that portion of the general public which takes keen interest in abstract science. The meeting of the British Association is recognised by the leading men of science as an occasion for the discussion of new discoveries and on the significance of the latest research. Hypotheses are put forward tentatively to receive destructive criticism or to be promoted into the ranks of working theories. The various schools of scientific thought engage in friendly duels, and the result of their being brought into contact is that divergent views frequently become convergent, and the object of the Association, the advancement of science, is always clearly attained at each meeting. On the other hand, the Engineering Section can do far less to advance the science of engineering. The engineer is essentially a commercial man nowadays, and he looks on his profession mainly from the revenue-earning aspect; it is not to be expected that he will give the world the benefit of any undeveloped or partially developed ideas before he has placed himself in a position to earn the full reward to which he naturally considers himself entitled. Thus it is that the papers in "Section G.—Engineering" are largely on work and subjects that are not new to the engineering world. Many contributions are sent in by authors with axes to grind, and they are too often no more than a *réchauffée* of papers that the authors have previously read before their own engineering societies, presented

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with a view to obtaining the further publicity hospitably accorded by the daily press in the latter end of the summer. We do not desire to suggest that any of the papers down for reading this year have been submitted with these objects; on the contrary, there are some of considerable general interest and precisely of the character suitable for a British Association meeting. It would, however, be of great advantage if the larger proportion of the papers discussed were of a broad nature, dealing with general tendencies in the engineering professions and industries rather than the particular constructive work of individuals or firms. Subjects should be chosen which are of simultaneous interest in several branches of engineering, and the papers coming within the domains of any particular section of the engineering industry should be of such a character that they invite discussion by men whose work lies in adjoining territories. Nowadays, the successful engineer must be a specialist during his working hours, but he can derive enjoyment himself, and extend benefit to his neighbours, by allowing himself this relaxation during the British Association holiday week.

IT has been thought desirable in certain cases on the Continent to connect up the tramway systems of two or more industrial towns by a double line of track through the surrounding country, and to keep up a light but fairly frequent service of cars between these towns. The case of the line between Vienna and Baden may be cited as an example. This line, which we described some nine months ago, is about 18 miles long, and in order to take advantage of the economies to be effected by alternating-current transmission and operation, the cars were equipped with alternating-current commutator motors of the compensated series type which work equally well when supplied with continuous current. The cars were thus enabled to run on the tramway systems in both towns, as well as on the twelve-mile long alternating-current section of the line. If, however, the motors are operated as series motors on both direct and alternating current, the pressure of the alternating-current supplied to the motors must ordinarily be lower than that permissible when the motors are operating on direct current, because of the increased commutation difficulties met with in alternating-current operation. This leads to many undesirable consequences, one of which is the necessarily increased size of connecting wires, controller contacts, and switch gear. A solution of this problem has been put forward by Mr. C. F. W. ALEXANDERSON, who, it will be remembered, read a paper some few months ago before the American Institute of Electrical Engineers on a new single-phase motor. The principles of his system are given in the brief abstract of a patent specification in our Patent Record of this week's issue. Mr. Alexanderson proposes to use commutator motors so constructed that they can work as ordinary series motors when supplied with continuous-current, but as repulsion motors when supplied with alternating current. As explained in our abstract of the patent specification, the change-over is effected by short-circuiting the armature for alternating-current working. Commutation difficulties do not become so overwhelming on an increase of voltage when repulsion motors are used, and so a terminal pressure of double the terminal pressure for continuous-current working may be employed, the possibility of extra strain on the insulation of the stator windings being avoided by earthing the middle point of the secondary of the main transformer, and connecting the terminals of the motor circuits to points on the winding on opposite sides of the earthed point. The working alternating-current pressure may thus be twice the working pressure for continuous-current. Special arrangements are provided whereby the proper proportions of the compensating and inducing ampere-turns, for continuous-current and alternating-current working respectively, are maintained, and as the short-circuiting of the armatures is done without breaking the series connection between the armature and the field windings, the short-circuit connection between the armature brushes has to carry only the difference between the armature current and that in the field windings. The same advantages can be obtained if an auto-transformer is used instead of a double winding transformer for transforming the contact line pressure down to the motor pressure. The combination of continuous and alternating current traction has considerable application for inter-urban tramways and light railways, for even in cases in which the towns or villages to be connected have no tramways at present running, the high-tension trolley line of the single-phase systems will hardly be allowable in the streets, although it may be used to advantage on the outside roads.

FROM an article which we publish this week, it is seen that investigators are actively engaged in endeavouring to find an alloy with a higher specific resistance than tungsten or tantalum for use as a filament in metal filament lamps. Doubtless a considerable amount of tedious experimental work will have to be gone through before something absolutely satisfactory is arrived at, but we should by no means despair of success in the near future, which will enable a 200-volt lamp to be put on the market with a filament of reasonable length and not of too microscopic a diameter. Alloys are notoriously inconsistent with regard to temperature coefficients. While the best resistance materials for measurements are "german silver" alloys, which can be made to have no variation in specific resistance within the ordinary ranges of temperature, a very different condition of affairs occurs when alloys are raised to white-hot temperatures, so it is not merely a question of finding an alloy which has a high specific resistance and a high melting point. At these high temperatures, also, many alloys are unstable. Although the problem is difficult, however, it is, as we have said, one about the early solution of which we need be by no means despondent.

Telephony in the Alps.—Last night's *Evening Standard* and *St. James's Gazette* states that Italy will shortly possess the highest telephone station in the world. Work has been commenced on the new telephone line to the Margherita hut, near the summit of Monte Rosa, 15,217 ft. The new observatory on the Col d'Ollen will be first connected with the Lombardy valley, and then the line will be continued to the summit of Monte Rosa. Queen Margherita of Italy, who contributed largely to the erection of the observatory and hut which bear her name, has been the chief supporter of the Alpine telephone line. Swiss critics, however, state that the innovation will be a failure, as it is impossible to plant posts in glaciers and masses of ice which are ever in a state of slow motion.

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SOME TYPICAL BREAKDOWNS AND THEIR CAUSES

THE annual report of the Chief Engineer of the British Engine, Boiler, and Electrical Insurance Company, Ltd., for the year 1907, contains one section devoted entirely to accidents that have happened to electrical machines. This section includes descriptions of twenty-four representative cases. In his introductory remarks to this section of the report, Mr. Michael Longridge (the Chief Engineer) says:—

The fact that the breakdowns of dynamos and motors in 1907 exceeded the number in 1906 by 18·1 per cent. in number, and by 16·3 per cent. in cost, proves that the insurance of electrical machinery is a benefit to the user, while the further fact that the number of machines insured at the end of 1907 exceeded the number insured at the beginning of the year is evidence that the benefit is appreciated. The rate of breakdown was rather lower among generators, and rather higher among motors, than in 1906. The exact figures are 1 in 18·7 among generators, and 1 in 7·9 among motors. The corresponding figures for 1906 were 1 in 16 and 1 in 8·2. Again, as in 1906, the rate among continuous-current machines was much higher than among alternating, but, on the other hand, the average cost of each breakdown was much less, so that the company's practice of charging practically the same rates of premium for both types of machine has been justified.

The proportions in which the various parts of the machines are thought to have caused or initiated the breakdowns of 1907 are tabulated below:—

Description of Part which is believed to have failed first.	Generators.		Motors.	
	1906.	1907.	1906.	1907.
	Per cent.			
Armatures and rotors	50	35	44	38
Magnet coils and stators	11	7	14	14
Commutators and brush gear	20	34	28	30
Miscellaneous	19	24	14	18
	100	100	100	100

Starting Switches and Controllers.	1906.	1907.
	Per cent.	
Resistance Coils	48	60
Contacts and switch arms	10	8
Automatic apparatus	17	13
Miscellaneous	25	19
	100	100

The causes of these breakdowns were probably as follows:—

	Dynamos.		Motors.		Starters.	
	1906.	1907.	1906.	1907.	1906.	1907.
	Per cent.					
Accidental	15	8	9	4	22	9
Dirt and neglect ...	14	25	19	28	11	16
Age and deterioration	21	23	25	23	23	27
Bad work or design	23	21	18	18	9	8
Overloading	0	0	2	1	7	5
Unascertained	27	23	27	26	28	35
	100	100	100	100	100	100

The following examples have been selected from each class as illustrations of the causes and results of breakdowns. They are said to be quite representative of the daily experiences of the Company's inspectors:—

1.—*Protected three-phase alternating* 50-*h.p. motor, one year old, taking current at* 500 *volts, and running at* 750 *revolutions per minute.* The inspector found that six of the stator coils had been completely stripped, and about 15 of the rotor coils badly damaged. He supposes that some foreign substance got into the machine when it was running, and simply demolished all the coils which were in its path, for the case was full of small bits of copper. The rotor was damaged just in one place, and from the nature of the damage great force had been expended at that point. He surmises that something caught in the rotor winding, and went round the coils. Although the motor was of the protected class, the inspector said it was quite possible for things capable of doing the damage to get in. There was no question of the rotor windings having been lifted by centrifugal force, as the binders were intact.

2.—*Two-pole shunt-wound enclosed motor for driving the scrapers of an economiser, marked* 4·5 *amperes,* 230 *volts,* 1,300 *revolutions.* The insulation had been rubbed off the windings at the driving end of the armature by some hard substance which had got wedged between them and the back flange of the frame. Twelve coils were burnt, and on stripping these off others below were seen to be charred, so that the armature had to be rewound. The inspector found nothing wrong with the frame, except that the flange was broken off one of the vulcanite bushes in the front plate, through which the leads from the brushes were carried to the main terminals fixed on the outside of the frame. This piece may have caused the damage.

3.—*Four-pole totally-enclosed series-wound* 8-*h.p. motor, two years old, driving a winch in a shipyard with current at* 480 *volts; speed,* 700 *revolutions per minute.* The fuse, a No. 16 S.W.G. tin wire, having melted, one of the company's inspectors was sent for to examine the motor. He found the solder all round the end connections of the armature conductors partly melted, and on taking out the armature four coils were seen to be completely burnt out. Wedged into the space between two of the conductors and the end of the core was a piece of cinder, which no doubt was the cause of the trouble. How it got there in an enclosed motor is a mystery. It is suggested that the armature must have been set down upon it or rolled over it at some time when taken out, and that movement of the conductors while the motor was running had caused it to rub through the cotton covering and short circuit the coils.

4.—*Semi-enclosed two-pole centre-hung shunt-wound* 2½-*h.p. continuous-current motor, taking current at* 500 *volts, and driving a fan in a smithy at a speed of* 2,400 *revolutions per minute.* According to the statement of the attendant, a belt of flame ran round the commutator when he started the motor. When he stopped it he found the remains of two rats wedged between the armature and the frame, but could discover no injury to the conductors. By testing, however, the company's inspector found a break in one of the end connections, close to the commutator, which had no doubt caused the sparking. Whether one of the rats was accountable for the breakage was uncertain, but the attendant decided to guard against a similar mishap in the future by covering the motor with a "rat-proof box."

The following case, however, shows that a box is not an infallible protection:—

5.—*Alternating-current* 12-*h.p. motor, protected by shield fastened to the frame, and enclosed in a water-tight iron box.* The insulation of the top coil of the stator winding, carrying current at 250 volts, was burnt, and the coil "earthed." The cause of the damage was saturation of the coil by soft soap. The box, like other similar boxes in the works, had no lock, and had been appropriated by the workmen and used as a locker for stowing away tools, aprons, dinners, plates, and cans, and, among other things in this particular box, a handful of soft soap, which had been stuck on top of the framing of the motor, and had run down on to the stator windings through the joint between it and the protecting shield above referred to.

6.—*Two-pole totally-enclosed shunt-wound* 4-*h.p. Lundell motor, taking current at* 230 *volts, and running at* 1,100 *revolutions per minute.* The company's inspector was sent for because smoke was issuing from the joints of the carcase. He examined it, ran it, and tested the insulation without discovering any fault. He then had it opened, and discovered that the smoke had come from the ignition of a quantity of oil, dust, and dirt which had accumulated upon the bottom of the circular magnet coil by sparks from the brushes, and that the sparking had been caused by one of the carbon blocks getting jammed in its brush holder. The insulation of the magnet coil was also slightly charred. This was patched up, the brush gear put in order, and the motor cleaned and started. Since then it has given no further trouble.

The above is said to be quite a typical case. Fires inside motors started by the ignition of collections of fluff and dust are not uncommon. The following is a case of bad construction aggravated by neglect:—

7.—*Four-pole shunt-wound semi-enclosed motor, about two years old, giving* 80 *h.p. at* 500 *revolutions per minute with continuous current at* 500 *volts, and protected by two No.* 16 *S.W.G. copper wires fusing with* 332 *amperes or* 2½ *times the maximum current supposed to be carried by the machine.* The fuse melted, and on examination two of the armature coils were found burnt. The remaining coils were saturated with oil and very dirty. The insulation of the commutator segments was also burnt close to the spokes through oil and dust settling between the spokes and short-circuiting them. This insulation,

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instead of being carried up a short distance, say, ¼ in. or so between the spokes, ceased at the ends of the bars, leaving very narrow wedge-shaped openings between the edges of the spokes to hold oil and dust. The machine was so damaged by dirt and neglect that the armature had to be entirely rewound, and the commutator rebuilt and re-insulated. It was only accepted for insurance about 11 months previous to the breakdown, and was then in good condition. It seems, however, that it had then just had the benefit of a thorough repair in consequence of a similar breakdown at the end of its first year's work.

8.—*Two-pole continuous-current shunt-wound motor transformer, working in a sub-station of a lighting supply, receiving* 44 *amperes at* 1,080 *volts, and transforming to* 110 *volts. Normal speed,* 470 *revolutions per minute.* When started from the central station on the evening of the breakdown, the armature gained sufficient speed to break one of the steel binders at the high-tension end, and spread the conductors till they jammed themselves fast between the pole pieces. On examination it was found that one end of the shunt winding had slipped out of its terminal. One of the attendants who had cleaned the machine in the morning declared that the wire was then in place, and suggested that it must have been shaken out of the terminal by vibration when the machine was started. It is far more likely that he pulled it out with the duster or waste he was using, for the wire had simply been slipped under the binding screw, and not bent round or over the terminal block.

The case is mentioned because the number of shunt wires broken or pulled out of their terminals proves that such wires ought to be better protected and more efficiently secured than they generally are.

9.—*Two-pole compound-wound dynamo,* 10 *years old, giving* 1,000 *amperes at* 120 *volts, driven direct by a Willans engine, running at* 350 *revolutions per minute.* The armature bars were connected at the end next the engine to "butterflies," or pieces of copper shaped like commutator segments, with two lugs of unequal length, alternate bars being connected to the long lug of one butterfly and to the short lug of the next. The butterflies were clamped between a collar and clamping ring in the same way as ordinary commutator segments, and insulated from each other and from the clamping rings and frame by micanite sheets and rings. The machine was first insured in 1901. Early in 1906 the insulating ring at the outer end of the butterflies broke down, and, being accessible, was easily repaired. About a year later flashing was seen inside the armature behind the butterflies, but it became necessary to unsweat the armature bars and take off the butterflies to get at the inner insulating ring, where the fault appeared to be. As the commutator was worn very thin, the owners decided to have it replaced at the same time, and accordingly it also was disconnected from the armature bars. The covering of these was then seen to be completely pulverised, and incapable of bearing the least disturbance, so it became necessary to renew it. Thus through the deterioration resulting from 10 years of nearly continuous running day and night, the repair of a small defect in the insulation of the butterflies necessitated complete rewinding of the armature.

The following examples show that pure mica is preferable to micanite for the insulation between commutator segments:—

10.—*Two-pole shunt-wound open-type* 12-*h.p. motor, three years old, driving the hoisting winch of a* 10-*ton crane with current at* 220 *volts.* Owing to the melting of the solder joining the armature coils to the commutator lugs, the armature was sent to the makers for repair, and at their works the inspector saw it. The insulation of the armature coils proved on testing and careful examination to be quite satisfactory, but the commutator segments were short-circuited by carbon dust, which had worked in between the flakes of mica of which the micanite plates between the bars were made. The short-circuits were not only at the surface, but extended into the interior of the commutator.

11.—*Four-pole compound-wound dynamo, three years old, giving* 90 *amperes at* 250 *volts when running at* 850 *revolutions per minute.* The commutator contained 153 segments, insulated with one exception by mica plates. The exception had micanite. The two coils in connection with this segment were burnt out and had to be replaced. The cause was a short-circuit across the micanite insulation, produced by carbon dust and oil which had penetrated into the micanite. The other segments were quite as dirty, but the mica plates between them had kept up the insulation.

This is not the only trouble with commutators, as will be seen below.

12.—*Four-pole shunt-wound enclosed motor, about three years old, rated to take* 150 *amperes at* 110 *volts at* 750 *revolutions per minute; in use on a* 15-*ton crane.* The commutator was built on a cast-iron sleeve, to which the segments, 76 in number, were secured by an iron clamping ring, 4⅜ in. diameter, and a nut the same diameter, and ¼ in. thick, as shown by Fig. 1. The ring was provided with a keyway to prevent it

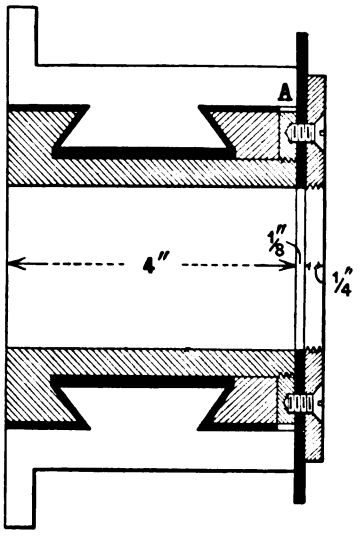

FIG. 1.—SECTION THROUGH COMMUTATOR, SHOWING CAVITY A, INTO WHICH CARBON DUST WORKED.

from turning when the nut was tightened, but no key had been fitted, nor was there any corresponding keyway in the sleeve. The micanite ring for insulating the copper segments from the iron clamping ring was carried over the edge of the ring, but not over the nut. Outside the nut there was a micanite washer, 6½ in. diameter and ⅛ in. thick, and outside this again an iron washer 5⅜ in. diameter and ¼ in. thick, held by six ¼-in. screws. The figure shows clearly that any slackening of the clamping nut or shrinking of the micanite washer would allow carbon dust to get into the space under the ends of the commutator bars, whence it could not be removed. As might be expected under such conditions, short-circuits were established between the commutator bars, and the fuses melted. The inspector who was sent for to examine the motor found short-circuiting had occurred between the copper bars and the iron clamping nut, as well as between the bars themselves. Eighteen bars in all were burnt, most of them at the point *A*, showing that the clamping nut had slackened, or that the micanite ring had shrunk and allowed carbon dust to penetrate between it and the ends of the copper bars. The clamping nut was also severely burnt. Inquiry by the inspector elicited the information that this motor and others similarly built had broken down in the same way before. In rebuilding the commutator care was taken to fix the clamping ring, lock the nut, and continue the micanite insulating ring over it as well as over the clamping ring.

13.—*Four-pole series-wound motor, two years old, rated at* 110 *amperes* 240 *volts, driving the live rolls in front of a rolling mill, and consequently reversing several times per minute.* Two of the armature conductors were burnt. The armature was sent to be repaired. When tested, after the repair, a large number of short-circuits were found between the commutator bars. As these could not be cleared the commutator was taken off, and it was then seen that the bars were from 1/16 in. to 1/8 in. deeper than the mica plates between them, and that in many places arcs had formed across the spaces. These short circuits had no doubt caused the damage to the armature coils. It was seen that one of the driving lugs on the sleeve which carried the commutator was broken, and that the armature spider was very loose upon the shaft. When the two taper pins which were driven in at each end, half into the spider and half into the shaft, were slackened, and the armature lifted, the shaft dropped out. Its diameter was 1/32 in. less than that of the armature bore. A new shaft had to be fitted, and the commutator had to be rebuilt.

14.—*Series-wound motor of the same size as that described in the last paragraph.*—This was constructed by the same makers, and used for the same work, but in this case the spider was secured upon the shaft by two taper keys, instead of two taper pins, one at each end of the hub, and by a set

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pin through the hub at the driving end. After working about two years a crack was noticed in the driving end of the hub, and the hub was seen to be loose on the shaft. On taking out the set pin the shaft dropped out of the armature. Measurement showed that the bore of the hub was nearly 1/32 in. larger than the diameter of the shaft, and examination of the surfaces showed that the two had been in contact and rubbing diametrically opposite to the two keys, and not elsewhere, and that the sides of the keys were worn by movement. It is uncertain when or how the end of the hub was first cracked, but it seems likely that the time was when the shaft was put into the armature, and that the cause was over-driving the tapered key. That is probably also the reason why the set pin was put in. A new shaft was made and fitted into the old spider, the cracked end of the hub being hooped to save rewinding the armature.

15.—*Two-pole overhung compound-wound dynamo, about seven years old, driven at a speed of* 940 *revolutions per minute by a belt from a gas engine, and rated to give* 110 *amperes at* 250 *volts.*—The armature had a smooth core drum wound with bar conductors, which were soldered direct to the commutator lugs. The commutator, 7 in. diameter and 7½ in. long, consisted of 68 segments built upon a cast-iron sleeve fixed by a feather key ½ in. broad and ¼ in. thick, sunk ⅛ in. into the shaft. Attention was called to the machine by sparking at the brushes, and one of the commutator lugs was found broken at its junction with its base. When the commutator was taken off, seven other lugs were seen to be partly broken, the feather key to be badly fitted, and the cast-iron sleeve to be slack upon the shaft. The armature bars, strange to say, showed no signs of movement upon the core. The breakages were evidently caused by relative movement between the armature and commutator resulting from slackness of the latter and vibration set up on the belt by varying angular velocity of the engine flywheel.

16.—*Series wound six-pole enclosed motor, driving a* 10-*ton overhead travelling crane, rating* 30 *amperes,* 500 *volts,* 400 *revolution per minute.*—The armature was taken out on account of the fuse melting. The coils at the pinion end were found to have been rubbing against the back end plate of the carcase, and two of them to have fused. To replace them it was necessary to rewind the armature. The damage was caused by motion of the latter along the shaft. The spider on which armature core and commutator were built was held only by a one gib-headed key 14 in. long, ½ in. wide, and 5/16 in. thick, bedded upon a flat on the shaft. There was no collar or nut. The jerks caused by reversing the motion of the crane and the vibration of the gearing had loosened the key and left the armature free to slide along the shaft.

17.—*Four-pole shunt-wound* 4-*h.p. motor, eight years old, running at* 600 *revolutions per minute, and taking current at*

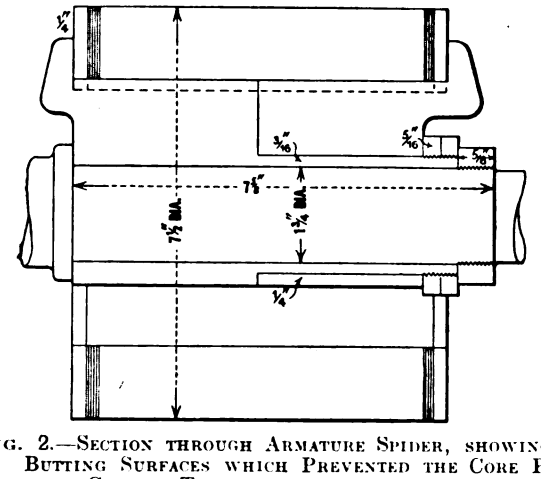

FIG. 2.—SECTION THROUGH ARMATURE SPIDER, SHOWING THE BUTTING SURFACES WHICH PREVENTED THE CORE PLATES BEING GRIPPED TIGHTLY.

400 *volts.*—The motor drove a 5-ton travelling crane. There were frequent breakages of the connections between the armature conductors and commutator, which, it was thought, were probably due to relative motion between the armature core and commutator owing to one or the other being loose on the shaft. The owners were advised to send the armature to the makers to have the loose part secured; but, wishing to use the crane, they kept the machine at work. However, it again broke down, and was sent to the makers to be repaired. The inspector found that all the leads to the commutator were either broken or had been broken and repaired, and ordered the armature to be stripped. It then appeared that the spider which carried the core plates was made in two pieces as shown by Fig. 2. The longer piece was fixed by a key and secured by a nut, the shorter by two weak nuts each 5/16 in. thick. Thus the only driving force upon the core plates was the friction resulting from the pressure of the two flanges of the spider upon them. Had the spider been properly constructed with a slight gap between the ends of the two pieces, this pressure could not have exceeded the maximum which one of these weak nuts could have exerted, but as the ends of the two pieces touched it may have been much less. It is little wonder, therefore, that the core plates moved and carried the conductors with them. The spider was also loose on the shaft, for when the nut at the end was unscrewed the shaft dropped out. The advantages of this system of construction are not self-evident, but, if used, the two pieces should be made like the two halves of a claw coupling and forced together by a good strong nut.

18.—7-*h.p. three phase motor of foreign manufacture, driving the hoisting winch of an overhead crane with alternating current at* 190 *volts.*—The three leads to the slip rings were fused. On examining the rotor it was found that the core plates had been threaded upon the shaft and a ring shrunk on at each end to hold them. There was no key or feather to prevent them turning. The conductors were led over the ends of the core through a hole in the shaft, which was hollow, and out at the end to the slip rings. This hole had sharp edges and was not bushed with insulating material. The consequence was that the rotor got loose and rocked upon the shaft, rubbing the insulation of the leads where they entered the shaft and short-circuiting them.

19.—*Two-pole underhung compound-wound dynamo, five years old, giving* 350 *amperes at* 115 *volts when running at its normal speed of* 750 *revolutions per minute.*—The dynamo stood in the engine-room and was driven by ropes from a counter shaft. The rope drive was outside the engine-room, and the shaft which carried the driven drum was supported by a bearing in a wall box in the engine-room wall and joined to the end of the armature shaft by a face coupling with four ⅝ in. bolts. The clear distance from the end of the coupling next the armature to the bearing for the armature shaft was 1¾ in. The diameter of the end of the shaft where the coupling was keyed was 2½ in., and the keyway was ⅝ in broad and 5/16 in. deep. The shaft was of steel. It broke close to the coupling in a plane at right angles to the axis, as though cut by a saw held against the coupling. The fracture was partly old, and had evidently commenced at the circumference and gradually extended. The cause cannot be stated with certainty, but it is suggested that during the five years the machine had been at work the bearing had got a little out of level and allowed the shaft to bend slightly while running, and that the edge of the coupling had thereby been pressed into the skin of the shaft and started a skin crack, which, after the manner of slight cracks or scratches in steel under alternating stresses, had gradually worked its way through the cross-section of the shaft. Had the shaft been enlarged or grooved where it entered the coupling, the skin of the shaft could not have been indented by the edge of the coupling.

20.—*Four-pole shunt-wound ventilated motor,* 7-*h.p.,* 14½ *amperes,* 400 *volts,* 1,000 *revolutions per minute, driving machine tools.*—Fuse when insured, one No. 16 S.W.G. tin wire, subsequently replaced by a cartridge "Mordey" fuse of 25 amperes. The inspector, after the breakdown, found that two of the armature conductors were broken, one close to the commutator lug, and the other so close to the core as to necessitate lifting the coil, and as this could not be done without lifting the other coils the repair meant rewinding the armature. He also learnt that the makers had been sent for some months before on account of bad sparking, and had then warned the owner that the machine was overloaded. The inspector measured the current required to run all the machinery which the motor drove, and found it to be 20 to 21 amperes. The owners afterwards admitted that they had added some machines since the insurance was effected.

21.—*Four-pole compound-wound enclosed motor,* 11-*h.p., driving a hammer with current at* 210 *volts.*—Fuse, two No. 22 S.W.G. copper wires, subsequently replaced by one of No. 20 S.W.G. When the inspector was making his usual periodical call he found the motor in a very unsatisfactory state, and the fuse red-hot, but not melted. He told the owner that the armature ought to be taken out and thoroughly repaired, and that the machine should be more lightly worked. The next day he called again to see what had been done, and found the motor still working with the fuse wire red. He had it

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stopped and opened for examination. The armature and field coils were so hot that he could not keep his hand upon them; indeed, the latter were just on the point of burning. All the armature connections were completely or partly unsoldered from the commutator lugs, and the solder was splashed about the inside of the casing. The commutator segments were short-circuited in several places and badly fused. How the motor could have run in such a condition is extraordinary. The owner declared that the motor could not be overloaded, as he had been advised that a 5-h.p. motor would be sufficient for the work, and moreover the fuse had not melted. To this the inspector replied that the evidence of overload was that the fuse was habitually red hot, and that but for the intermittent character of the load it would have melted. This resulted in a dispute between the company and the owner, which was finally settled, the hammer being given lighter and less continuous work, and with the exception of some flats on the commutator and an occasional broken armature connection the motor has worked without serious trouble.

22.—*Two-pole centre-hung shunt-wound enclosed motor, four years old, running at* 1,000 *revolutions per minute and receiving current at* 500 *volts from the outer wires of a three-wire supply.*—The motor was used for driving a hoist in a six-storeyed building, and was placed in the basement close to the bottom of the lift well with the commutator end of its spindle about 6 in. from the wall. The frame was earthed, and two lamps were connected in parallel with the field coils to act as a discharge-resistance. These should have been fully alight so long as current flowed through these coils, but for some days previous to the accident they had occasionally shown a dull red light, indicating an intermittent "earth" on the field coils. One day, when the cage, which was descending loaded, had nearly reached the ground, a loud explosion was heard, and the front end plate of the carcase, which carried the bearing for the commutator end of the armature shaft, was fractured round the circumference and blown along the shaft till arrested by the wall, on which it left its mark. The rocker for carrying the brush spindles was also broken, and the oil blown out of the oil well at the driving end of the armature shaft. The armature conductors were not broken, but subsequent inspection showed that their insulation was damaged and that the lower field coil was saturated with oil, its insulation deeply burned, and the coil earthed to the former on which it was wound, and to the frame. The state of this coil had no doubt caused the intermittent glowing of the lamps. Most likely it was the cause of the explosion also, for in default of any other explanation it is suggested that a combustible gas must have been given off while the insulation of the field coil was being burnt away, and that this gas must have been ignited by arcing or by sparking at the brushes. The nature of the material was not ascertained, as the stuff was unfortunately thrown away by the firm employed to rewind the coil before the inspector could secure it, and the firm from whom the machine was originally bought (it was of foreign make) either would not or could not obtain the information. The oil used for lubricating was castor oil.

23.—*Four-pole shunt-wound motor, taking* 22 *amperes at* 400 *volts. The armature ran at a speed of* 1,000 *revolutions per minute and drove a printing machine through back gear.*—While working the armature began to wobble, bringing the steel binding bands into contact with the pole faces. It was taken out and put into a lathe, where one of the company's inspectors examined it and came to the conclusion that it was loose on the shaft or that the shaft was broken. The latter turned out to be the case. The crack commenced at the square end of the keyway and extended more than halfway through the shaft in a plane nearly at right angles to its axis. The shaft was 2 in. in diameter, and the keyway $\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. deep. Whether the sharp corner at the end of the keyway started the crack is uncertain; if it did it is probable that the vibration set up by the speed-reducing gear extended it, for the gear ran very badly.

24.—*Four-pole series-wound* 3-*h.p. enclosed motor, one year old, driving the cross-traverse motion of a* 15-*ton travelling crane with current at* 240 *volts. Fuse, copper,* 26 *amperes.*—The four field coils were totally burnt out, but the armature was uninjured and the fuse did not melt. No cause for the damage could be found, but the inspector was informed later that the armature had always started with a jerk, and had run at the same speed on all the contacts of the controller. It seems clear, therefore, that there must have been some intermittent fault in the controller, which was of the drum or tramway type, cutting the resistance and armature out of circuit and leaving the field coils short-circuiting the mains. The inspector ordered four new coils from the makers of the motor and left the owners to slip them on to the pole pieces and connect them. In due course these arrived and were put on, but the motor would not run, so the inspector was sent for again. On testing, he found that the sequence of the four poles was N.N.S.S. instead of N.S.N.S. The mistake was easily corrected by turning the two top coils round. When this had been done the motor started and ran well in one direction, but on turning the controller in the opposite direction to reverse the motion the armature refused to move, and the contacts sparked furiously. After some trouble in tracing out and making a diagram of the connections to the controller, the inspector found them to be as shown in Fig. 3, so that when running forward the current, after all resistance had been cut out, passed through both field coils, controller, and armature by the path $+abcdefghi-$, but when the controller was moved in the opposite direction the current took the path $+abcji-$. The armature was thus cut out of circuit, and the field coils left connected across the mains. Hence the refusal of the armature to start and the sparking at the controller contacts. He altered the connection i and f as shown in Fig. 4,

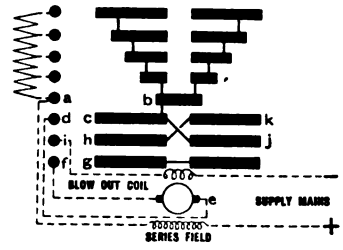

FIG. 3.—INCORRECT.

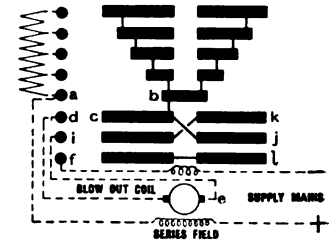

FIG. 4.—CORRECT.

Diagrams showing Motor Controller developed, with incorrect and correct Connections.

so that the path of the current when the motor was reversed became $+abcjiedklf-$. This case shows the importance of providing clear diagrams of connections with all kinds of starting switches and controllers. Without such diagrams many mistakes are certain to be made.

That section of the report which is devoted to breakdowns of steam, gas, and oil engines is of more general interest, but the following summary of the accidents reported and their causes is of interest:—

The rate of breakdown was 1 in 11·7 among steam engines and 1 in 11·1 among gas and oil engines, as against 1 in 8·1 and 1 in 12·4 last year. The proportions in which the various parts of the insured engines which broke down in 1907 caused or initiated the breakdowns are given in the last columns of the following tables. The other columns give the percentage for 1906 and the average for the previous 24 years:—

STEAM ENGINES.

Description of parts which are believed to have given way first.	24 Years previous to 1906.	1906. Per cent.	1907.
Valves and valve gear	21·0	23·3	28·0
Spur gearing	14·8	12·0	10·2
Air-pump motions	10·4	9·9	10·2
Air-pump buckets and valves	7·3	6·9	4·0
Columns, entablatures, bedplates, and pedestals	6·9	8·6	7·7
Cylinders, valve chests, and covers	5·2	6·1	7·2
Bolts*	4·7	0·0	0·0
Parallel motions and links	4·5	2·7	5·6
Main shafts	4·4	5·2	2·6
Pistons, with their covers, rings, and bolts	3·2	3·4	5·6
Governors and governor gear	2·6	1·7	2·0
Connecting rods, straps, and bolts	2·4	5·6	2·0
Piston-rod crossheads	2·3	2·7	3·6
Flywheels	2·0	1·7	2·0
Air pumps and condensers	1·9	2·1	3·1
Piston rods	1·8	2·7	2·0
Crank pins	1·3	0·4	1·6
Cranks	1·1	0·0	1·0
Beams and side levers	0·9	0·4	1·6
Gudgeons in beams	0·8	0·8	0·0
Main driving ropes or belts	0·2	1·3	0·0
Total wrecks, cause not ascertained	0·2	2·1	0·0
Second motion shafts	0·1	0·4	0·0
	100·0	100·0	100·0

* These bolts do not include bolts in pistons, air-pump buckets, valves, connecting rods, valve gear, and other moving parts, the bolts in these parts being tabulated with the parts to which they properly belong.

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GAS AND OIL ENGINES.

Description of parts which are believed to have given way first.	Average previous to 1906.	1906.	1907.
		Per cent.	
Valves and valve gear	32·5	28·7	43·3
Cylinders and cylinder ends	16·6	16·7	13·5
Pistons	11·7	6·5	2·7
Connecting rods and their bolts	11·2	12·0	8·1
Main shafts	5·0	15·7	4·7
Governors and governor gear	4·4	7·4	7·4
Silencing boxes and exhaust pipes	4·4	2·8	1·4
Flywheels and driving drums	4·3	4·6	4·7
Clutches and couplings	3·5	0·0	0·0
Frames and pedestals	2·8	0·0	4·0
Bolts*	2·6	0·9	1·4
Total wrecks, cause not ascertained	1·0	1·9	0·0
Main driving ropes or belts	0·0	1·9	0·0
Miscellaneous	0·0	0·0	5·4
Gas-producer plants	0·0	0·9	3·4
	100·0	100·0	100·0

* These do not include bolts in pistons, connecting rods, valve gear, and other moving parts, the bolts in these parts being included with the parts themselves.

The causes of these breakdowns may be roughly classified as under :—

	Steam Engines.	Gas Engines.
	Per cent	
Accident or causes unascertained	27	44
Old defects or deterioration by wear and tear	38	17
Weakness, bad design, workmanship, or material	19	18
Negligence of owners or attendants	16	21
	100	100

The following comments are made on the above table :—

The increase in the number of breakdowns of steam engines traceable to failures of valve gears is probably the result of increase in speeds and number of parts. The reduction in the number of breakages from spur gearing is the natural consequence of the substitution of rope and direct driving for the older system of transmission. The steady increase in broken cylinders is due principally to the use of steam at temperatures and pressures higher than the parts can safely bear. The reduction in the number of main shafts broken is remarkable and inexplicable. In gas and oil engines the increase in breakages of valves and valve gears is not satisfactory, and demands the serious attention of makers of these engines. If all side shafts were fitted with ring lubricators and levers made of wrought iron or good cast steel the percentage in the table would be reduced. The reduction in broken cylinders and pistons is encouraging, and marks the progress which is being made. Connecting rods proved less destructive than usual, probably because of improvement in design, particularly as regards strengths of bolts. Breakages of crank shafts were fewer than in 1906.

The two following examples are of particular interest :—

High-speed inverted vertical triple-expansion engine, running at 383 revolutions per minute, with cylinders 14 in., 20½ in., and 30 in. diameter by 14 in. stroke, direct coupled to a dynamo.—The exhaust steam from the condensing cylinder was led through a valve in the exhaust pipe to a jet condenser, or, alternatively, when this valve was closed, through an automatic atmospheric valve to the atmosphere. The condenser was cleared by a pair of Edwards air pumps, driven by an electric motor, receiving current from the dynamo driven by the engine. It drew its own water from a pond, whose surface was about 15 ft. 7 in. below the middle of the cylinders. Thus, in the event of the air pumps ceasing to clear the condenser the water from the pond would be forced into the low-pressure cylinder if the pressure in it were more than 6·7 lb. per square inch below that of the atmosphere upon the surface of the pond. The usual practice in shutting down was to close first the engine stop valve and then the valve in the exhaust pipe to shut off the condenser. On the evening of the breakdown this practice was adhered to, but the engine, instead of coming gradually to a standstill as usual, stopped suddenly as the driver was about to close the valve in the exhaust pipe. The cause of the sudden stoppage was an inrush of water from the condenser into the low-pressure cylinder, which bent the piston and stretched the bolts in both ends of the connecting rod. It is commonly believed that some special guardian protects children and drunken men. Surely that guardian must have drawn this engine also under the covering of its wings; otherwise it could hardly have escaped disaster during the 12 months it had run. Every day there must have been a race between the water and the man. Would the water reach the cylinder or the man the valve in the exhaust pipe first? It must have been a really sporting chance on which it would have been hard to obtain odds from anyone "in the know." No; the least reflection would have shown the driver that the valve he closed first was precisely the valve he should have closed last. If he had destroyed the vacuum, either by closing the injection cock or by shutting off the condenser, or by opening the atmospheric valve before touching the engine stop valve, the accident would not have happened.

High-speed inverted vertical non-condensing double-acting two-crank engines, with cylinders 9 in. and 15½ in. diameter by 8 in. stroke, direct coupled to a dynamo running at 425 revolutions per minute; boiler pressure 140 lb. per square inch.—The engines were started in 1900. In 1905 the crank shaft was found to be slightly bent and was replaced, the old shaft, however, being kept as a spare after being made true by skimming up the bearings in a lathe. In 1907, after having run less than two years, the new shaft broke through the web of the crank next the dynamo, and a third shaft was ordered, the spare shaft above mentioned being used to keep the engine running. The cause of the breakage was not ascertained. The company's inspector thought the shaft was hard and brittle. The makers of the engine replied that it was made from the same quality of steel, about 32 tons tensile strength, as they always used for shafts. They further gave it as their impression that the breakage must have been caused by the bearings for the engine and dynamo shafts being out of line or level, and advised that these bearings should be aligned and adjusted before the new shaft was put in. The dynamo armature was accordingly lifted; the brasses were relined with white metal and levelled, and the new shaft bedded upon them. Eight weeks afterwards the new shaft broke in the same place as the old one. The two surfaces of the fracture were quite close when the inspector saw the broken shaft, but when it was taken out two patches of white metal were found embedded in the crack. Of course, they must have come from the bearing next the flywheel, but it is difficult to understand how they got into the position where they were found. The makers of the engine again attributed the breakage to the bearings being out of line; but Mr. Longridge thinks they were mistaken, and that it resulted from some wrong treatment of the steel during manufacture. He adds, however, that it is possible, with a speed of 425 revolutions per minute, that it might have been the result of excessive stress produced by cumulative vibrations synchronising with the period of the engine.

According to the information given in the section dealing with boiler explosions, collapses, and other sundry mishaps, there were eight boiler explosions during the year. Two of these occurred in electricity works, and resulted in three deaths and injury to eight persons. The loss of life caused by the fracture of pipes or valve-casings by water-hammer was heavier during the year 1907 than is usual. Six men were killed in this way, three of them by one explosion. The following description of an accident to a water-tube boiler in an electric generating station may be of interest to our readers :—

Babcock & Wilcox water-tube boiler, with nine rows of headers and ten tubes to each header, 90 tubes in all; working pressure 200 lb. per square inch.—The boiler was numbered 3 in a group of four, of which two only, Nos. 3 and 4, were in use, supplying steam to engines generating electricity for lighting. In addition to the usual mountings, the boilers had automatic isolating valves to cut either off from the steam main in the event of the pressure falling below that in the others. On receipt of a telegram reporting an accident to No. 3 boiler, an inspector attended to ascertain the nature and cause of the damage. He found that the tubes in the four lower rows had been red hot, and those in the bottom row partly melted. The cause was clearly deficiency of water, for, apart from the absence of any deposit likely to cause such serious overheating, the blow-off cock was found open. On inquiry, it transpired that the fireman had come on duty at 10 p.m. the evening before, and after that hour he and a switchboard attendant had been left in charge of the machinery. The latter stated that the fireman had not attended to the engines as usual, and that he had been obliged to go to the stokehole several times to complain of insufficient pressure, the justice of the complaint being vouched for by the automatic pressure recorder. Strange to say, he did not notice anything unusual about the man's behaviour until the steam fell rapidly

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and the lights went out. He then found that the man had emptied No. 3 boiler through the blow-off cock, neglected to feed No. 4 till the water had gone out of the glass, and then drawn the fires of both. The isolating valve on No. 3 had closed and prevented an explosion when the tubes in the bottom row failed. It may be mentioned that some of the tubes which had been red hot were taken out, cut up, and tested by bending, and were found to be perfectly ductile and apparently unhurt.

EXPERIMENTS WITH AN ELECTRICALLY-PROPELLED FIRE-ENGINE IN BERLIN

A REPORT on some experiments on an electrically-propelled fire-engine for the Berlin Fire Brigade is abstracted in a recent number of the *Elektrotechnische Zeitschrift*. The engine, which weighed about 4,500 kg. complete, was provided with a battery of 78 accumulators, with a total capacity of 195 ampere-hours on a five-hour discharge rate. Experiments were also carried out on a steam-propelled engine, built by the same firm as that which supplied the electrically-propelled engine. A petrol-propelled engine was considered unsafe on account of the inflammable nature of the fuel. The electrically-propelled engine was first constructed with a single motor and chain drive on to the back wheels, but experiments with this equipment showed an energy consumption of 84 watt-hours per ton-kilometre, and with this consumption the battery only allowed of a 46-km. run being made on one charge. The single motor and chain drive were then replaced by two hub motors in the front wheels. Each motor had a continuous rating of 7·5 h.p. at 225 r.p.m. With these motors the energy consumption was reduced to 56·4 watt-hours per ton-kilometre, with an average speed of 36 km. per hour. At this rate of discharge the batteries permitted of an 86-km. run being made on one charge. The chief trouble experienced was the wearing of the rubber tyres of the front wheels. After 5,000 kilometres, the outer covers of the front tyres had to be renewed, whereas those of the back wheels were in good condition, although they carried approximately the same load. The tyres were of different makes, but nevertheless the results may be taken to confirm the fact that the unsprung weight of the hub-motors has a bad effect on the life of the tyres.

The engine ran about 108 km. per day on the average; the greatest distance run in one day was 154 km. The battery remained in good condition up to the end of the specified length of test-run, *i.e.*, 10,000 km. After running a further 2,470 km., a capacity test on the battery showed that the capacity had fallen to 117 ampere-hours at a 39 ampere discharge rate, and it was then decided to renew the positive plates.

The following yearly working costs and maintenance charges are based on the results of the experiments made with the two engines. They represent a total distance travelled during the year of 1,500 km. (The average distance travelled by horse-drawn engines is about 1,000 km. in the year.)

	Steam Engine.	Electric Engine.
	£	£
Working costs ... ... (In the case of the electric engine including cost of current and maintenance of battery and motor.)	35·81	30·11
Cost of holding in readiness	20·64	—
Rubber tyres	22·85	22·85
Non-skid covers	5	5
Repairs to engine	2·25	2·25
Total	£86·55	£60·21

The annual cost of running and maintaining the electrically-propelled engine thus works out at £26 less than that for the steam-propelled engine. The annual cost for a horse-drawn engine has been on an average £226, so, in the event of the substitution of electric for horse-drawn engines, a considerable saving would be effected.

It has been proposed to equip the steam-propelled engines already constructed with two small hub-motors and a 150-kg. battery. This would render it unnecessary to always keep the boilers under steam, as the engines could be started out on the battery, and then, after about ten minutes, the steam pressure would be sufficient to run the engine. The favourable results of the experiments have resulted in the city authorities granting £6,675 for the construction of four electrically-propelled engines, and if these prove satisfactory, a larger number may be ordered.

ELECTRICAL EQUIPMENT OF THE PACIFIC STEAM NAVIGATION CO.'S R.M.S. "ORCOMA"

THE following is a brief description of the main features of the electrical equipment of the Pacific Steam Navigation Co.'s new twin-screw steamer "Orcoma." This magnificent vessel of 11,532 tons, the newest and largest of the Company's fine fleet, marks an advance in size and equipment which will make her the finest steamer in the West Coast trade (Chilian waters). Her principal dimensions are:—Length between perpendiculars, 510 ft.; breadth moulded, 62 ft.; depth moulded to shelter deck, 40 ft. 6 in., and 65 ft. 6 in. to the boat deck. Accommodation has been provided for 250 first-class, 200 second-class, and a large number of third-class passengers. The machinery consists of two sets of quadruple expansion four-crank engines, balanced on the Yarrow Slick Tweedy system, having cylinders, 26 in., 37½ in., 53½ in., and 76 in. diameter by 54 in. stroke, with three double-ended and three single-ended boilers for a working pressure of 210 lb. per sq. inch.

The electric generating plant consists of four 65 kw. continuous generators direct driven by high-speed engines with forced lubrication. The generating pressure is 100 volts. The whole of the plant was supplied by Messrs. W. H. Allen, Son & Co., of Bedford. The switchboard, from which are controlled the various lighting and power circuits, is of the Edison & Swan Co.'s make. The ship's lighting comprises 1,500 16-c.p. glow lamps, and three arc lamps for cargo purposes; also one Admiralty type Morse Code signalling lamp. One of the large whistles is controlled by an electrical apparatus which admits of its being operated by a small handle on the navigating bridge. It can, in addition, be switched on to a special clock in the wheel house, which blows the whistle automatically at fixed intervals of every sixty seconds, thus providing a great additional safeguard to the security of the ship in foggy weather. The ventilating plant consists of two 8-h.p. Allen enclosed motors, driving powerful Sirocco fans for ventilating the stokeholds; four enclosed motors by the Electric and Ordnance Accessories Co., of Birmingham, driving fans for ventilating the galleys and lavatories; and sixteen 54-in. ceiling motor fans for ventilating the dining saloons. Eighty-six 9½-in. trunnion motor fans are installed in the first-class state-rooms, all of Messrs. Bergtheil & Young's manufacture.

Another application of electric power is the driving of the laundry installation, which is done by a 5-h.p. enclosed Allen motor. A Waygood passenger lift, connecting the four passenger decks, is worked by an 8-h.p. enclosed Siemens' motor; and there is also an electrically-operated hoist for raising provisions from the refrigerating chambers below. In the galleys and sculleries are installed eight motors for such various purposes as spit-turning, knife-cleaning, potato-peeling, bread-kneading, boot-cleaning, and dish-washing. There is even an electrically-driven bacon-cutting contrivance. Electric heating is represented by radiators, ovens, hot-plates, and irons, and in the barber's shop are to be found electrically-driven hair brushes and fans in connection with the hair-drying apparatus. There is also a very complete system of electric bells throughout the ship, and the principal officers are in close touch by means of a telephonic intercommunication system. The wiring of the steamer was carried out by the builders, Messrs. William Beardmore & Co., of Dalmuir.

International Conference on Electrical Units and Standards.—The President of the Board of Trade has appointed Major W. A. J. O'Meara, R.E., C.M.G., to be an additional British Delegate to the International Conference on Electrical Units and Standards, which is to assemble in London on October 12th next. The names of the members of the Committee, and the general objects of the Conference, were given in ELECTRICAL ENGINEERING, Vol. III., page 894.

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THE REVOCATION AND WORKING OF FOREIGN PATENTS

An Analysis of the Revocation Clause of the New Patents Act

Metal Filament Lamp Manufacture

THE revocation clause of the new Patents Act came into force last Friday, August 28th—one year after the Act of 1907 received Royal Assent—and it has been much discussed during the past week. While there is no doubt that the result of the clause will be that several industries in the United Kingdom will be benefited to a considerable extent, and that employment will be found for many thousands of workmen in the development of manufactures and processes that have hitherto been unworked in the United Kingdom, there has been some misconception on many sides as to the actual effect of the clause in question.

In the first instance, it may be pointed out that the new Patents Act came into force at the beginning of this year. It made other alterations in the patent law of this country than those relating to patents not worked in the United Kingdom, principally the creation of "patents of addition" of which advantage has been taken by many patentees during the past eight months, and a revision of the law with regard to compulsory licences, for the application of which, we believe, no occasion has yet arisen. Undoubtedly, however, the part of the Act which is of the greatest importance is that enabling application to be made for the revocation of a patent not adequately worked in the United Kingdom.

In some quarters it has been erroneously assumed that a patent which is not worked in this country will automatically lapse and become void. This is not so. To begin with, four years from the date of the patent have been allowed in which the patentee must put the process or manufacture he describes into effect. But even if the date of the patent is prior to August 28th, 1904, the fact of its not having been worked in the United Kingdom does not in itself invalidate the patent. The exact wording of the clause in question (No. 27) is as follows:—

27.—(1) At any time not less than four years after the date of a patent, and not less than one year after the passing of this Act (*i.e.*, after August 28th, 1908), any person may apply to the Comptroller for the revocation of the patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom.

(2) The Comptroller shall consider the application, and, if after inquiry he is satisfied that the allegations contained therein are correct, then, subject to the provisions of this section, and unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or gives satisfactory reasons why the article or process is not so manufactured or carried on, the Comptroller may make an order revoking the patent either—(*a*) forthwith; or (*b*) after such reasonable interval as may be specified in the order, unless in the meantime it is shown to his satisfaction that the patented article or process is manufactured or carried on within the United Kingdom to an adequate extent.

Provided that no such order shall be made which is at variance with any treaty, convention, arrangement, or engagement with any foreign country or British possession.

(3) If within the time limited in the order the patented article or process is not manufactured or carried on within the United Kingdom to an adequate extent, but the patentee gives satisfactory reasons why it is not so manufactured or carried on, the Comptroller may extend the period mentioned in the previous order for such period not exceeding twelve months as may be specified in the subsequent order.

(4) Any decision of the Comptroller under this section shall be subject to appeal to the Court, and on any such appeal the Law Officer, or such other Counsel as he may appoint, shall be entitled to appear and be heard.

It is seen that the patent will continue valid unless application for its revocation is made by some interested party. If the business of only one particular British firm or individual is adversely affected by the monopoly granted by the patent, it is—to use an Americanism—"up to him" to take the necessary action; but, if a whole industry is concerned, it may be some time before an agreement is arrived at for joint action being taken by several firms. The procedure appears fairly simple and straightforward, but it is more than probable that it will prove an expensive one in the case of an important patent, and a single firm will not be inclined to bear the whole cost if its competitors in this country will benefit simultaneously.

The first step is to obtain from the Patent Office "Patent Form No. 24," and pay for a £2 stamp upon it. This is simply a formal application for the revocation "on the ground that the patented article (or process) is manufactured [or carried on] exclusively or mainly outside the United Kingdom," giving the name and address of the applicant or applicants, and the number and date of the patent. Simultaneously with, or "as soon as may be after," the return of this form to the Patent Office duly filled in, the applicant must deliver to the patentee or his agent a copy of this application, and must furnish the Comptroller with evidence of such delivery.

The next move has to be taken by the patentee, who, within 14 days from the receipt of this copy of the application, or such further time as the Comptroller may allow, must leave at the Patent Office a "statutory declaration," stating whether or not the allegations contained in the application are correct; and, if they are incorrect, to what extent, and in what place the patented article or process is manufactured or carried on in the United Kingdom; and setting out in the event of the article or process not being manufactured or carried on in the United Kingdom to an adequate extent, the reasons why it is not so manufactured or carried on. The patentee must deliver copies of this evidence to the applicant, and furnish the Comptroller with evidence of delivery.

Certain rules are given for the exact form that this "statutory declaration" must take, and it must be made before a justice of the peace or a commissioner of oaths, or, if made outside the United Kingdom, before a British Minister, Consul, Vice-Consul, notary public, judge, or magistrate.

The applicant is now given fourteen days, "or such further time as the Comptroller may allow," to reply to this, in the form of a similar statutory declaration, and he must deliver copies to his adversary as before and furnish proof of delivery to the Comptroller. The Comptroller may ask for further evidence, in which case, presumably, the same process is continued. When the Patent Office has taken full cognisance of the evidence, the Comptroller will appoint a day for hearing the case, and will give the applicant and the patentee ten days' notice; and in the event of the Comptroller deciding to take evidence *viva voce* in lieu of or in addition to the evidence by declaration, or to allow any declarant to be cross-examined on his declaration, he may require the attendance of any declarant or other person, whose evidence he may consider desirable. If, as is probable, the applicant or patentee desires to attend the hearing, he has to signify his intention on "Patent Form 9" within five days, and has to pay a fee of £2. The Comptroller has the power to require that evidence be taken on oath, and he may award to any party such costs as he may consider reasonable, and direct by which party they are to be paid. This, it will be seen, may in itself occasion a heavy expense, far exceeding the comparatively small fees already mentioned, if several

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witnesses are called, and if the hearing lasts a long time; and an additional cost will, of course, be the appeal to the High Court, which is almost bound to follow the Comptroller's decision, and in which both parties would, of course, be represented by counsel.

Those who have read the new Patents Act carelessly may think that they would be entitled to infringe an unrevoked patent that has not yet been worked in this country, and then put in a claim for the revocation of the patent as a counterclaim to any action for infringement that might be instituted. This is not the case, however. It is true that under Clause 32 of the Act, a defendant in an action for infringement, if entitled to present a petition to *the Court* for the revocation of the patent, may apply by way of counterclaim for its revocation, but in the case of revocation for not working in the United Kingdom, the petitioner is only entitled to apply to the *Comptroller* and not to the Court in the first instance, so that the clause does not apply here.

Returning now to Clause 27 in the Act itself, it will be seen that wide discretionary powers rest with the Comptroller with regard to the revocation of unworked patents. In defending his patent, the patentee has either to prove that the patented article is manufactured to an adequate extent in the United Kingdom or must give "satisfactory" reasons why it is not so manufactured. No indication is given in the Act what reasons are to be regarded as "satisfactory." A number of advertisements have appeared in various technical journals recently over the names of well-known patent agents offering patents for sale, or offering licences under them, and in a large number of instances the subject matter of the patent is described by title only without the name of the patentee or the scope of the patent being mentioned. It is certainly doubtful whether such announcements are likely to attract *bonâ fide* offers to buy the patent or take licences under it; and it is still less likely that the fact of the insertion of such a bald advertisement in one or perhaps two trade newspapers not having resulted in useful negotiations would be regarded as a satisfactory reason for the patent not having been worked in this country. Surely some greater effort on the part of the patentee would be required. If he is unable to find the funds to work the patent here himself, or is not himself in a position to find a market for his patented article sufficient to warrant its manufacture here, an honest endeavour to find a purchaser or licensee might conceivably protect the patent from revocation, or at any rate enable him to obtain an extension of time under the discretionary powers of the Comptroller. But unless he can prove that he has persistently advertised for a purchaser or licensee in all the leading papers devoted to the particular trade in question, and has supplemented this personally, by an active endeavour by other methods as well, to place the patent or to find means of manufacturing his patented article here, we cannot think that he would win his case. A perfunctory announcement of his willingness to part with his patent rights by licence or sale, made in an obscure way in the holiday months of the year, would, we think, rather act prejudicially to than assist a subsequent endeavour to answer an action for revocation under the new Act.

Passing from the letter of the law to the actual effect it is having at the present moment, it is satisfactory to note that the result of this clause in the Patents Act has already been the building of a number of works in this country for the manufacture of articles that have hitherto only been imported from abroad. The most important of these to the electrical industry will be the factories that will be devoted to the manufacture of metal filament lamps. The owners of the Auer and Just-Haneman patents (the General Electric Co.) are already manufacturing here at the Robertson lamp works, and we are waiting to hear that the owners of the tantalum lamp (Siemens Bros. Dynamo Works) have taken a similar step. A lamp, called the "Z" lamp, has also been manufactured tentatively at a works in Willesden, but, so far as we have been able to ascertain, no great progress has been made towards bringing a British-made Z lamp generally upon the market; but experiments in the manufacture of these new lamps must necessarily proceed slowly. The lamp made under the Kuzel colloid patents, and at present manufactured in Germany by the Pintsch Company, is to be made here, and we understand that a company or syndicate has been formed which has taken the "Imperial" works at Brimsdown, recently occupied by Messrs. Waters' shellac factory. Power for driving the works will be taken from the North Metropolitan Electric Power Supply Co. It has been announced that the employees will be drawn from the district, and this may account to some extent for the choice of the situation of the works, which is not very distant from the Ediswan works at Ponder's End.

Finally, metal filament lamps under the British Thomson-Houston patents, which have for the most part originated with the firm's parent company in America, are being made at Rugby, and the Sunbeam company at Gateshead are enlarging their works in order to make metal filament lamps under the Westinghouse patents.

Altogether, it will be seen that there is evidence of considerable activity in this direction, and doubtless one of the most interesting and useful features of the electrical exhibition to be held in Manchester next month will be the display of British-made metal filament lamps.

The "G.B." Surface-Contact System in London.—According to *The Morning Leader*, Mr. W. M. Mordey, President of the Institution of Electrical Engineers, has been retained to report upon the working of the "G.B." surface-contact system of traction in the Mile End Road. It is said that the London County Council have asked Mr. Mordey to report, and that he has been to Lincoln to investigate the working of the system there.

Obituary.—We regret to announce the death, at the age of 71, of M. E. Mascart, the eminent French physicist. He had been since 1878 director of the Central Meteorological Office in Paris, and was the author of several scientific treatises. To our readers he may be remembered as being the joint author with M. J. Joubert of the classical work, "Leçons sur l'Electricité et le Magnétisme. He was a member of the Institute, a professor at the Collège de France, and an honorary member of the Institution of Electrical Engineers.

Alleged Death from Electric Shock.—Whilst a smith's striker was working an electric welding machine at the works of Messrs. Dobson & Barlow, Bolton, he suddenly fell, and died soon afterwards. The doctor said there was no possibility of accounting for death except by electric shock. A fellow apprentice stated that when he got hold of an iron bar which the deceased was holding he received a shock. The jury returned a verdict of death from shock.

Next Year's British Association Meeting.—Reuter states that a committee has been formed in Winnipeg to arrange for the entertainment of the British Association there next year. Various Western Governments and cities have been requested to co-operate. The programme includes a trip through the West and one through the mountains to the Pacific coast. Transportation facilities are being arranged, and a number of distinguished guests from Canada and the United States will be invited. Provision will also be made for a limited number of ladies.

Electrically Propelled Ships.—According to the *Elektrotechnischer Anzeiger*, a company in Berlin is fitting a steamship which runs on the Oberhavel with a system of electric propulsion. The equipment consists of a suction gas plant consuming anthracite, a gas engine coupled to a direct-current generator, a battery of accumulators, and electric motors on the propelling shafts. It is estimated that the running costs will be less than those obtained with an ordinary steam engine equipment, on account of the saving in fuel. Two new ships with a similar equipment will also be added to the service next spring.

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A NORWEGIAN SINGLE-PHASE RAILWAY

TRONDHJEM, or Drontheim, the well-known seaport on the east coast of Norway, from which large amounts of copper, timber, and fish are exported, is situated on the Trondjhem Fjord. At the extreme end of the southernmost arm of this fjord is the small town of Thamshavn, and the railway which we are about to describe, and which is the first electric railway in Norway, runs from this town along the bank of the river Orkla to Svorkmo, a point some twelve miles distant from Thamshavn. An extension of the railway to Loekken, where there are copper mines, is now being constructed. Loekken is sixteen miles distant from Thamshavn, and is 540 ft. above the sea level. In the year 1897, the company which owns the railway, the Chr. Salvesen & Chr. Thams's Communications Aktieselskab, of Thamshavn, applied for a concession to construct the railway, but this was not granted until

Fig. 1.—View of the Falls at Skjenaldfossen, with Power Station on the Left.

1904. The railway was opened by King Haakon on July 10th last.

At Thamshavn there is an extensive quay, up to which very large vessels can proceed, and there are special arrangements for delivering the copper ore, which is brought from the mines in Meldalen, direct from the railway trucks into the ships; the trucks are taken out to the end of a pier on an elevated track to where the ore-shoots are. A large depôt for storing the ore, and workshops in connection with the railway, are under construction.

Except in the stations, the line consists of single track of 3.28 ft. gauge, with a maximum gradient of 1.3 per cent., except for a short section close to Thamshavn, which has a gradient of 4 per cent. The sharpest curve is 820 ft. radius. The construction of the track has been carried out under the superintendence of a government engineer, as it is possible that the line may, at some future date, be connected with the government's railway system. The rails weigh 42 lbs. per yard, and are supported on fourteen sleepers per length of rail of 10 yards. The dimensions of the sleepers are 6.25 ft. by 8.7 in. by 4.4 in. All the bridges over which the railway passes are constructed of steel. The stations are connected by telephone, all circuits having metallic returns. There are four level-crossings and one tunnel.

The power supply for the railway is obtained from a

Fig. 2.—View from the Power Station, showing Dam and Pipe Line.

generating station at the Skjenaldfossen waterfalls, some five miles distant from Thamshavn. The dam and the commencement of the pipe line are illustrated in Fig. 2, and the falls themselves are to be seen in Fig. 1. The building on the left of this illustration is the power-station which is situated at the foot of the falls. The station was built and equipped by the company in 1905, and has since supplied light and power to Thamshavn and other towns in the district. The falls have a head of about 185 ft., and the average available power is 3,000 h.p. In the power-stations, the

Fig. 3.—Baardshaug Station with Passenger Train.

interior of which is shown in Fig. 4, there are five turbine generating sets, with a total capacity of 3,080 h.p., and they are all fitted with automatic regulating apparatus. The turbines run at 750 revs. per min., and are direct coupled to 545 K.V.A. three-phase generators. Current is generated at 1,000 volts and transformed up to 15,000 volts by means of oil and water-cooled transformers. The frequency is fifty cycles.

The 15,000-volt transmission-line goes direct to a station on the line called Baardshaug; here it divides,

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one line going straight to the mining district near Loekken, the other alongside of the line to the converter-station at Thamshavn. This sub-station contains an oil transformer, which transforms down from 15,000 volts to 600 volts. Two three-phase motors, fed with current at this pressure, are direct-coupled to twenty-five cycle single-phase generators, which supply current

The rolling-stock consists of three 20-ton 160-h.p. locomotives for hauling goods and passenger trains, and one 80-h.p. motor-car for first-class passengers only. Each locomotive is equipped with four enclosed Westinghouse single-phase compensated-series commutator motors, connected two in series. The maximum speed of the locomotives is thirty-one miles per hour.

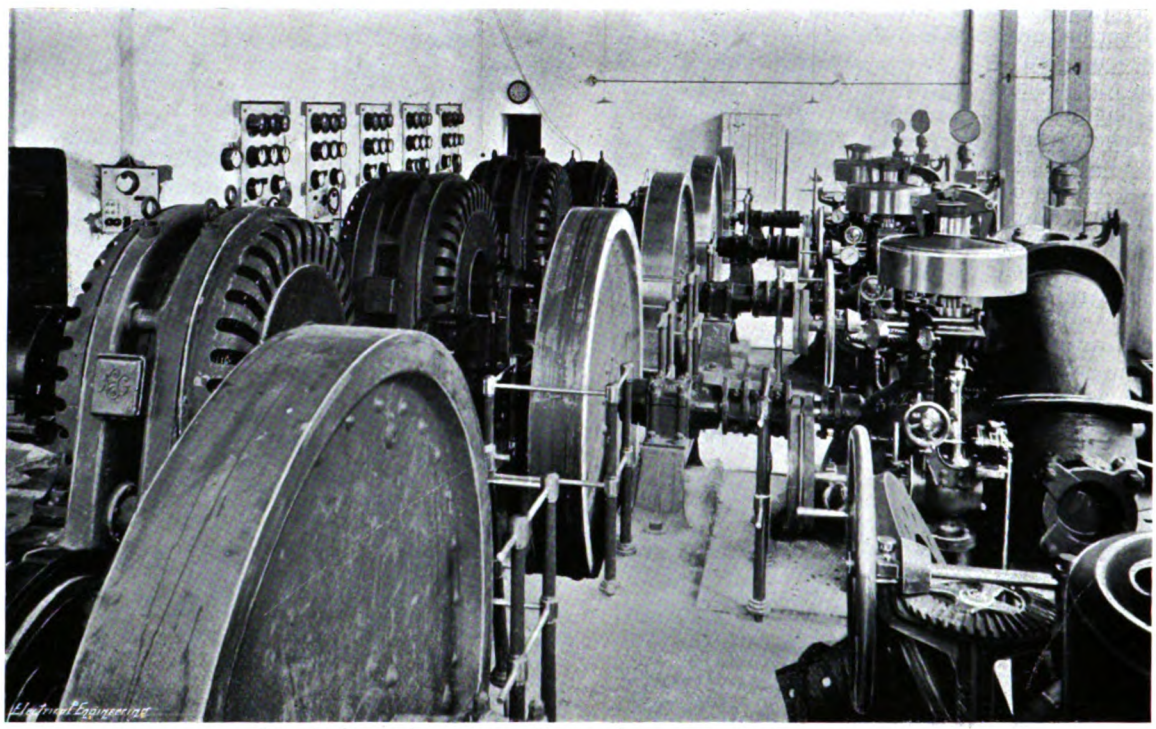

FIG. 4.—INTERIOR OF THE POWER STATION AT SKJENALDFOSSEN.

to the overhead contact line at a pressure of 6,600 volts. These motor-generator sets have a capacity of 250 kw. each at unity power factor, and are controlled by an automatic pressure-regulator. The substation contains, besides the transformers and motor-generators, the usual lightning-protection apparatus, switchgear, etc.

Current is collected from the contact line by means of a pantograph-bow operated by compressed air. One of these bows can be seen attached to the motor-car in Figs. 3 and 5. The equipment of locomotives and car also includes transformers for reducing the pressure from the contact line-pressure of 6,600 volts to the motor terminal-pressure, which is varied from 240 volts

FIG. 5.—TRAIN CONSISTING OF LOCOMOTIVE AND TWO TRAILERS AT BAARDSHAUG STATION.

The method of suspension can be gathered from an inspection of Figs. 3 and 5. A steel wire is supported on high-tension insulators, and from this wire the contact wire is suspended by means of short hangers and clip fastenings, on the single catenary principle. The contact wire has a section of 0.1 sq. in.; the rails form the return and are bonded.

at starting to 540 volts at full speed. Both locomotives and cars are fitted with Westinghouse compressed-air brakes, with the necessary complement of motor-driven air compressors, reservoirs, etc. Hand-operated brakes are also provided.

The electrical equipment of the motor-car consists of two 40-h.p. motors of the some pattern as those in-

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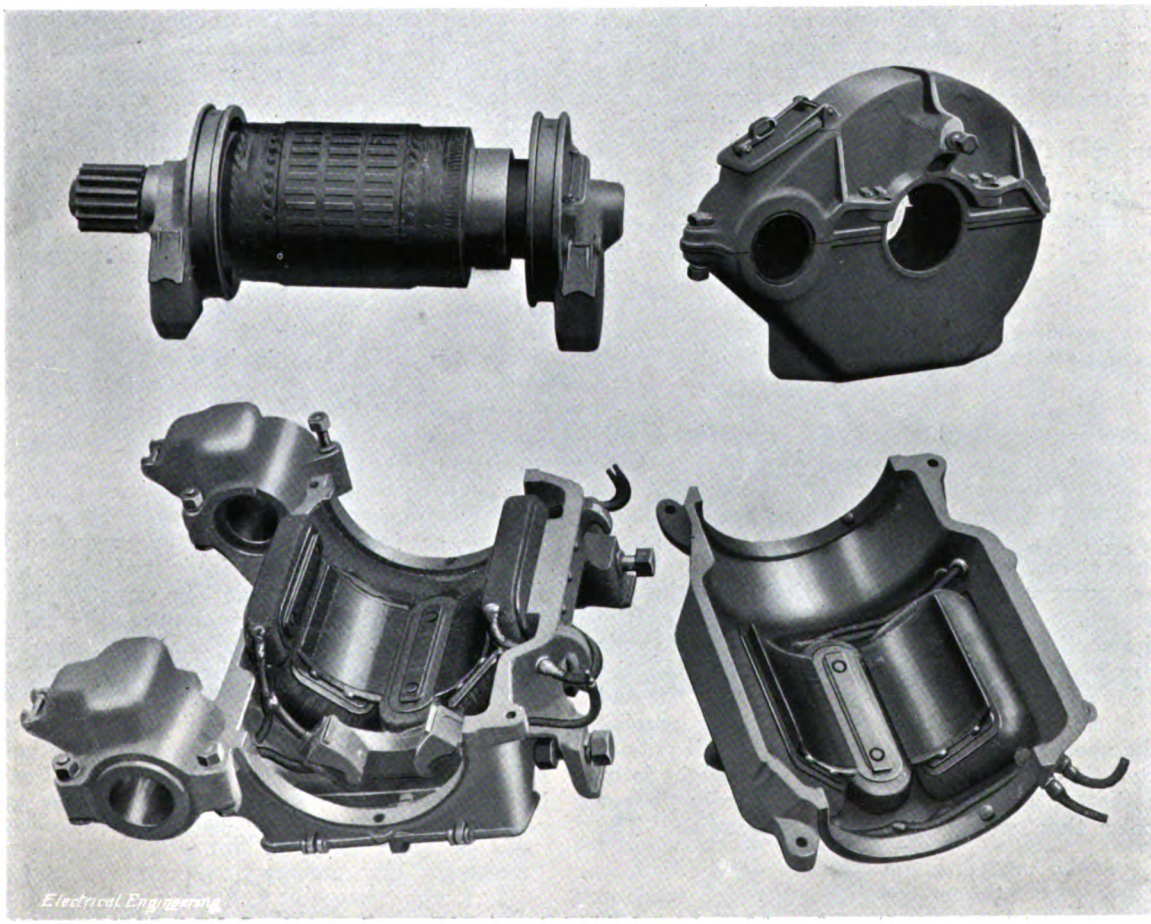
stalled in the locomotives, and the necessary transformer, switch-gear, and brake equipment. The other items of the rolling-stock are four passenger trailers, three goods waggons, and eighteen trucks for ore, ballast, etc. As previously mentioned, a transmission line to Loekken supplies power to the mines in Meldalen, where the air compressors, winding machinery, etc., are electrically driven. From Loekken another line, six miles long, goes to the Hoeidal mines, which are twenty-two miles from the power-station at the Skjenaldfossen falls.

The locomotives and the single motor-car were supplied by the Westinghouse Co., but the rest of the electrical work was carried out by the Elektrisk Bureau of Christiania. We are indebted to Chr. Salvesen and Chr. Thams's Communications Aktieselskab, of Thamshavn, for the particulars in this article, and for the photographs with which it is illustrated.

INTERPOLE TRACTION MOTORS

THE requirements of modern electric tramway practice are much more exacting than those of earlier years, partly on account of the more extended use of electric braking, and also from a general alteration in the conditions of service. With a view to meeting these more onerous conditions, Messrs. Dick, Kerr & Co. have developed a series of interpole motors, embodying a number of new points in design and construction and superior in many ways to the older type.

Such motors are particularly suitable for tramway systems where extensive use is made of electric braking, and in any circumstances where the duty is more than ordinarily heavy. We are informed that they are sparkless under practically all loads, cool in operation, and oil proof. Sparkless commutation, which is ensured by the addition of the interpoles, is particularly important when the motor is running as a generator for braking. Under these conditions, a certain amount of sparking has hitherto been considered unavoidable, and cases are not unknown of motors flashing over at the brushes when the controller is on the brake notches. The employment of interpoles also increases the overload capacity, and the wear of the commutator and brushes is reduced. Messrs. Dick, Kerr & Co. tell us that in some cases the motors will stand as much as 100 per cent. overload without injury. Further, the reduced wear of commutator and brushes, combined with improved methods of ventilation, results in the motor being very clean running, a fact which lessens still further the danger of flashing over, and also avoids other troubles well-known to the tramway manager. In general it may be said that these interpole motors will operate with complete satisfaction under conditions which would seriously embarrass motors of equal power but unprovided with interpoles.



Photograph of Various Parts of Dick, Kerr Interpole Traction Motors.

The motors are rated in the customary way, i.e., on the output, including gear losses, for one hour with a temperature rise in any part as measured by thermometer, not exceeding 75° C. (135° F.) above that of the surrounding atmosphere, the temperature of which does not exceed 25° C. (77° F.).

The field frame is made in the usual form of two bowl-shaped castings of soft steel of high permeability, thereby securing the smallest possible weight. The two halves are fitted together with a carefully machined joint to ensure a good magnetic circuit, and to make

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the frame both watertight and dust-proof. The lower half of the frame is hinged to the upper half, thus permitting the lower field coils to be easily inspected and cleaned.

Each armature bearing box is contained in a separate solid casting independent of the motor frame altogether, being held in position in the main motor frame by means of a tongued and grooved joint, and firmly fixed by studs. The armature can, therefore, be lowered with the bottom half for inspection, or can be retained in position in the top half, as may be desired. It can further be removed from the main shell with its bearing boxes complete, if occasion requires it. Special attention is called to the fact that the bearing boxes for the armature are solid. This is a most valuable feature of the design, as it effectually prevents oil from the bearing creeping into the interior of the shell, thus making the motor practically oil-proof.

The main pole pieces are made up of laminated steel sheet punchings rivetted together, and are bolted to the inner surface of the frame. The pole pieces are interchangeable, and can readily be replaced in case of repair. For supporting the main field coils, two flat steel springs, each capable of exerting a pressure of about 400 lbs. are inserted between the field coil and the shell. The coils are held in place by the pole shoes themselves, and brass washers which cover the surface of the coil. As each coil is thus forced against the brass washer by the springs with a pressure of nearly 800 lbs., any shrinkage of the coil is automatically taken up, and the coils at all times held rigidly in position. Mechanical troubles in this portion of the motor should thus be entirely obviated.

The interpoles are of solid steel, situated symmetrically between the main poles and fixed in position by rivets. The interpole field coils are clamped in position by independent screws which are properly locked to prevent any movement. The ends of all field coils are finished off with strong bronze terminals for interconnection after they are assembled in the motor frame.

The armature core is built up in the usual way, with distance pieces to permit free circulation of air. Ventilation is also assisted by means of the fanning action of the connections between the armature coils and the commutator bars. These connections are made of thin flat copper strips, which, when the armature rotates, act as fan vanes, and draw a current of air right through the motor. The air enters through the opening on the top of the shell at the gear end, and is drawn towards the centre of the armature core passing through the end winding at the gear end, the armature core, the end winding at the commutator end, and finally passing out of the shell at the opposite end to which it enters. It is stated that this artificially-produced draught is so effective that it enables a motor to run fully 25 per cent. cooler than would be possible otherwise. The beneficial action of these fan vanes is independent of the direction of rotation.

The armature leads are carried straight to the commutator risers, so that the removal of the commutator is easy. All that is necessary to do, in order to remove the commutator, is to unsolder each conductor and bend it slightly upwards. The commutator can then be pulled off without any disturbance of the armature winding.

Particular attention has been paid to the bearings and the method of lubrication. As previously indicated, the armature bearing boxes themselves are solid castings, entirely independent of the main motor frame. They are made to gauge, and interchangeable, as are also the bearing brasses. A constant and efficient supply of oil to the armature bearings is secured by employing oil rings which the firm have found by actual practice to be superior to any other method of lubrication. The oil after use in the bearing is drained back to the reservoir by large drain channels, which have sufficient capacity to deal with the maximum amount of oil which can possibly be supplied to the bearings. The continuous flow of oil has a cooling action on the shaft, as well as acting as a lubricant. Special oil throwers are provided to deal with the small amount of oil which is not taken care of by the main drains, the oil from the throwers also being drained back to the oil chamber. After the bearings have been filled with oil they will run with safety for a considerable length of time without attention; it is even said to be quite safe to allow such bearings to run for a fortnight without oiling, although it is, of course, better practice to have a regular system of oiling once a week. Special chambers are provided below the oil reservoir, and any oil which is not returned to the main reservoir drains into these chambers. The bottom of each chamber can be closed by a cover, and when this opening is closed the motor can plough through almost any depth of water without getting flooded.

The axle bearings are also lubricated by means of oil, but in this case a wick arrangement is employed. These bearings will also run for a fortnight before requiring refilling. Arrangements are provided for allowing the wick to be quickly and easily withdrawn. Two helical springs acting on the wick-holder press the wick against the axle, two springs being provided to ensure that the lubrication is not interfered with, should one spring fail from any cause. The armature bearings are made of special anti-friction bronze, the axle bearings being also of bronze or malleable iron lined with best white metal, as may be desired.

The whole of the gearing is contained in a malleable iron case in two halves, which is designed to withstand heavy vibration, and is supported at three points. All bolts are of the same size, and are locked from turning by special lugs cast on the frame and gear case. The nuts are locked by spring washers.

MESSRS. J. H. HOLMES AND CO.'S WORKS

IT is to be hoped that Messrs. J. H. Holmes & Co., of Newcastle-upon-Tyne, will not misunderstand us when we say that their works are distinctly deceptive. As viewed from Portland Road, where their main entrance is situated, a very modest conception of their size is obtained—an impression which is entirely contradicted by a tour through the various shops, employing upwards of 540 men.

In 1883, when the works were established by Mr. W. H. Holmes and three of his sons for the purpose of installing electric light in private houses, factories, workshops, steamships, and the like, the staff consisted of one man and a boy, and such work as the temporary lighting of bazaars, flower shows, and balls, and the illumination after dark of skating ponds and football fields, was very acceptable. In thost days electricity was in the nature of a novelty, as was evidenced in 1884, when their present Majesties, then Prince and Princess of Wales, visited Newcastle. On that occasion Messrs. Holmes provided portable steam engines and dynamos, and fitted various prominent places in the town, such as the steeple of St. Nicholas Cathedral, with powerful arc lights, which were the most attractive items in the whole scheme of public illumination. This firm's pioneer work did not a little to popularise electric light in the North.

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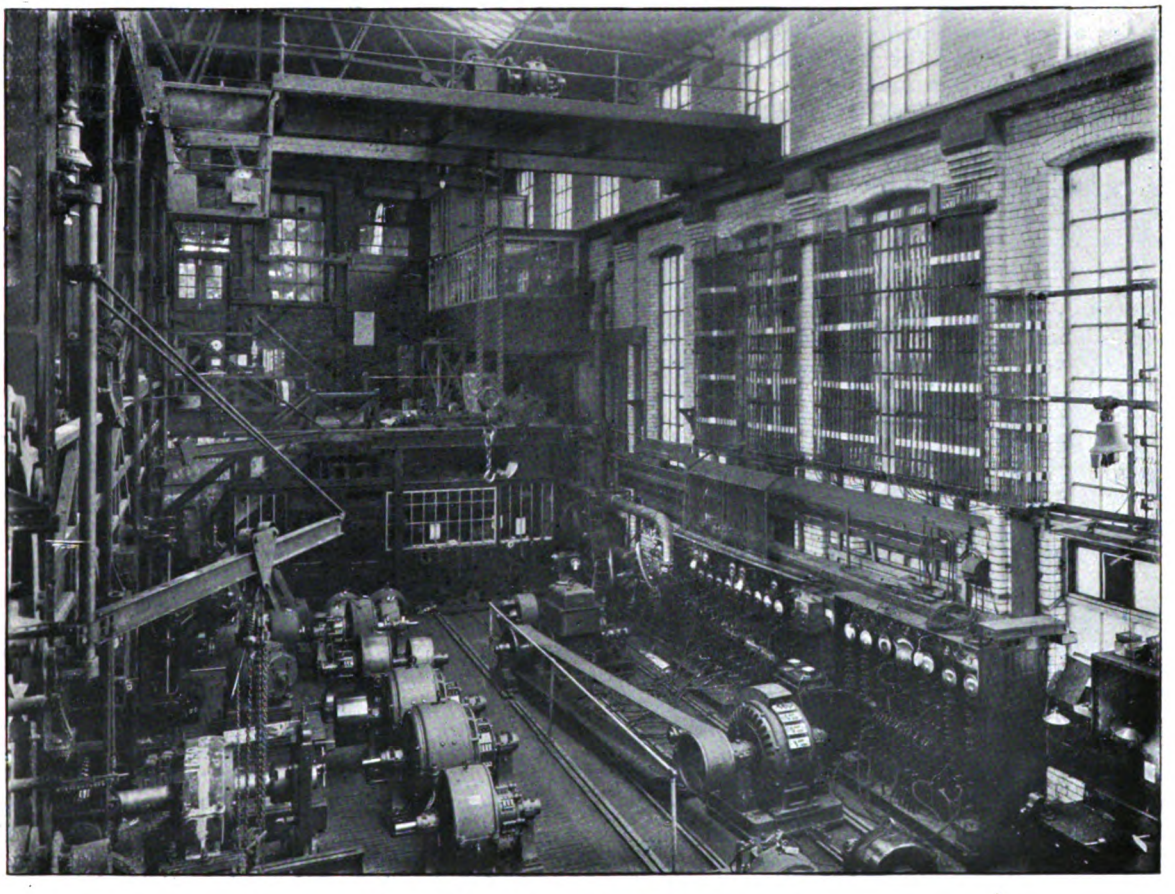
Their first workshop, for the manufacture of electrical supplies, was opened in Stoddart Street, Shieldfield, and was occupied until 1887, when the central portion of their present premises was built. At that time it was hardly possible to obtain items such as switches, fuses, ceiling roses, and lamp holders of good quality in the open market. Early in the year of 1884, Mr. J. H. Holmes invented and patented the loose handle or quick-break switch which, in various modifications, is almost universally used throughout the whole world. At one time no fewer than thirteen firms were under licence to make these switches under the patent, and at the 1885 Inventions Exhibition in London, the firm obtained a bronze medal for their exhibit of these switches. Although the making of dynamos and motors was commenced in 1884, the Number One "Castle" dynamo made at that time is still at work in Ireland, and furnishes a standing—or running—defiance to depreciation and "obsolescence."

Other inventions rapidly followed. In 1889, at the request of the late Mr. W. Langdon, the electrical engineer of the Midland Railway Company, Mr. J. H. Holmes, designed and patented a constant potential dynamo capable of being driven at variable speeds in either direction from one of the axles of the guards' van, and this was applied, not only to the Midland, but also to railways in Germany, France, and Russia. In the same year the Suez Canal Company allowed the passage by night through the canal of any vessel carrying an electric light projector at the bow, having a certain range of projection. Mr. Holmes went to Egypt, spent some time there studying the requirement of the officials, and on his return designed suitable projector apparatus, very many of which, together with their portable generating sets, have been manufactured for canal and river traffic. In 1896 the firm acquired the British rights in the Lundell patent, while in 1898 they introduced the well-known "Holmes-Clatworthy" system for driving web printing presses for the production of newspapers.

With the extension of business involved in these patents, together with the contracting work of the firm in fitting up country houses with electric light and generating plant driven by steam, gas, or oil engines, the manufacture of "Castle," drum, Lundell, and other machines, the fitting up of upwards of 900 steamships ranging from Royal yachts to ocean tramps with electric light, and the electric lighting and power equipment of mills and factories at home and abroad, it is no wonder that the floor area of their works has enlarged from 240 square yards in 1885, to 10,684 square yards in 1908.

The works comprise two main buildings, in which the principal operations of manufacturing, assembling, erecting, testing, packing, and despatching are carried out, while in separate buildings are the foundry, pattern shop, electrical instrument shop, and stores. The main buildings are divided into departments for machining and drilling the castings and forgings, winding armature, and field coils, building commutators and cores, and manufacturing smaller work, such as switchboards, switches, projectors, fuses, gear wheels, and fittings. In the machine shop are found a large number of modern tools, including automatic grinding machines, large turret lathes, a 100-ton hydraulic press, and the usual complement of a large engineering shop. Electric cranes serve the shop, while the whole of the plant is electrically driven, the larger machines and those of smaller size requiring quick speed variation being fitted with individual motors. An interesting example is a Niles vertical boring mill fitted with a motor having a double-wound armature, giving a cutting speed on the tool up to 80 feet per minute. In this shop, steel castings for magnets are regularly turned and bored at cutting speeds of 60 to 80 feet per minute, and hard steel spindles are roughed out at 50 to 100 feet per



Portion of the Erecting and Testing Shop.

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minute with cuts up to ¼ in., afterwards being ground to a fine finish to half a thousandth of an inch accuracy by Browne & Sharp automatic grinders. These speeds and feeds are from 300 to 500 per cent. better than those considered good practice a few years ago, and indicate the advance rendered possible by self-hardening steel and rigid machine tools. There is in this shop a special tool department for grinding and storing tools, where gauges, micrometers, &c., are kept. The whole of the machining is carried out to limit gauges, while jigs and templates are extensively used for drilling and boring.

Erection and testing is carried on in a large building adjoining and at right angles to the machine shop, and divided into six sections for tool making, repetition work, erection of dynamos and motors up to 60 b.h.p., large armature building, erection of machines up to 750 b.h.p., and testing. The tool making shop is equipped with the latest machinery for quickly meeting the requirements of the other departments, while the repetition work section turns out all the brass and iron screws, bolts, nuts, and terminals required in the firm's manufactures. One gallery is set aside for the erection of the smaller machines and the fitting of reduction gears to motors, being served with an overhead travelling crane for rapid handling. The erecting and testing of large machines is, however, carried on in the main bay, where several electrically driven tools, notably a large radial drilling machine, are located. This bay is served by a powerful three-motor travelling crane and several jib cranes. The principal testing bed is made to accommodate direct-coupled steam plants, arrangements being made to conduct tests simultaneously at different steam pressures on the various sets. Large motors are also included in the equipment for testing dynamos without engines, and there is a large testing switchboard, complete with all recording and measuring electrical instruments. At the time of our visit, 700 to 800 dynamos and motors were passing through the shops, and among the interesting machines under erection or on the test bed was a motor-alternator for the Birmingham University, a booster for Brisbane, Western Australia, several reversible booster sets for "floating" batteries, a 30 h.p. vertical motor for shaft sinking, running at the high speed of 2,400 r.p.m., which was doing its work with the greatest facility on the test bed, and several ship lighting plants. The illustration on p. 359 shows a portion of the erecting and testing shop. The testing bed and switchboards are at the right-hand side with the offices of the testing staff in the background. In this illustration, the machine under test is a three-phase generator.

Reference should here be made to the generating station which supplies the current for lighting the works, driving the machines, and conducting the tests. At the present time steam is supplied by two Lancashire boilers at 180 lbs. pressure to four high-speed direct-coupled sets aggregating 330 b.h.p., but the steam plant is being replaced by three-phase motors which will drive the existing continuous current generators. Energy for this purpose is obtained from the Newcastle-upon-Tyne Electric Supply Co., Ltd., a static sub-station having been built on the works to transform from 6,000 to 440 volts. All the motors driving the line shafting in the shops are now three-phase, but for machines where a wide speed range is desirable and are individually driven, and in the case of some of the cranes operated by series motors, continuous current has been retained. The generating station board is arranged so that two, three, or four dynamos can be connected in parallel or series for the purpose of obtaining any desired pressure for testing; motor generators with a range of 115 to 600 volts provide the current for testing medium-sized motors, while high pressure testing up to 2,000 volts is dealt with by an alternator.

The starting switches for controlling the shafting motors are also placed in the generating station so that the engineer in charge can simultaneously start all the shaft-driven machinery in the works. There are over 130 motors installed in the whole works for electric driving, &c., ranging in size from 1/6 h.p. to 100 h.p. The total aggregate horse-power amounts to 780, and the average daily load for power purposes, excluding testing, equals about 80 h.p. The power station deals with approximately 250,000 b.o.t. units per annum.

Above the heavy machine shop, which we have already described, are three floors, devoted respectively to switchboard erecting, brass finishing, and commutator building, the manufacture of switches, and the storage of raw and finished material. On the first floor the manufacture of ships' fittings, brush holders, and projectors is also carried on, together with the assembling of large motor starting switches, and the controllers, and the erection of switchboards. Some of these range up to 50 ft. in length, and a very fine example was passing through at the time of our visit. One of the features on this board was a switch with an internal toggle joint, and an abutment release, while on another section was a two-way throw-over main switch, whose "off" position was secured by the engagement of an ordinary cycle "ball" into a recess in the hinge of the switch blade.

On the second floor, switches of all sizes from 25 amperes and upwards were being made, many of them being the firm's "Holmes-Page" type, which, either open or fitted in gas and watertight cast-iron boxes, together with similarly-protected fuses or with asbestos-tube fuses, are too well known to need further description. Motor-starting switches, reverse-current circuit breakers, mining panels, &c., were also under manufacture, and we saw a demonstration of quick-acting circuit-breaking, which operated down to 3 per cent. reverse current—considerably below practical requirements. Lift control switches were also on view, and an electrically-controlled steering gear for the Italian Navy was also interesting. A rather curious device for mine motor starters was an arrangement of a double ratchet, engaging on the handle of an iron-clad starter, so that the handle could not be swept directly forward, but had to be "joggled" along its path, giving the motor time to start up.

The store on the top floor is served by two electric lifts, one being open to all departments below, the other communicating direct with the goods receipt and despatch department, situated in an extension of the main building. The foundry contains little of exceptional interest beyond a motor-driven magnetic separator to extract iron and steel particles from scrap brass and copper before the latter is run into ingots. The wood-working department is also most efficiently equipped.

Special mention must be made of the new five-storied building which is now devoted to small motor manufacture. The top floor, owing to the steep gradient of the works site, is approximately on a level with the bottom floor of the older building, and is connected by a bridge carrying a narrow-gauge railway. The erecting floor on the top storey is so arranged as to allow the work to "follow on" in sequence, rails running the whole length of the shop past long rows of low erecting benches, and into the testing shop beyond. In the erecting shop overhead runways above the benches give quick handling of motor parts, while machinery for turning and grinding up commutators on the finished armatures is also fitted in the erecting shop.

The testing department is equipped with four testing tables and switchboards, each table having its own complete motor generator set for giving any desired voltage. By this means, four motors can be tested simultaneously, each at a different voltage. Power de-

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veloped by any motor under test is used for driving a dynamo, the current generated by the latter being used to assist in driving the motor generator which is supplying the motor under test. This utilisation of the Hopkinson method of testing necessitates only a small proportion of the load being taken from the power station, sufficient only, in fact, to compensate for the frictional and electrical losses in the testing plant.

All motors finished off for stock are kept above the testing and painting shops, an electric lift being provided between the two floors. Armature cores are stacked up near the central hoist, and overhead runways are provided for conveying them to the winding benches, and subsequently to the binding lathes. The magnet coil-winding machines, which are electrically driven, are arranged along one side of the shop, and include several automatic and semi-automatic machines for laying the wire on evenly. On the other side are the machines for taping the armature coils, special tools to shape them for core slots, and an air pressure blower, with a complete installation of pipes for supplying air blast to gas stoves for brazing, soldering, &c. There is also a special transformer for testing the finished armature coils before assembling them on the cores.

A large fireproof room at one end of this floor is devoted to drying, dipping, and impregnating all armature and magnet coils with insulating varnish by the vacuum process. A large horizontal iron cylinder is employed, fitted with a number of shelves and trays to accommodate coils, armatures, &c., the large armatures being placed on the bottom. When the removable door at one end has been securely fastened, the inside of the cylinder is heated to a temperature of about 150° F. by means of a coil of steam pipes. The air is then exhausted by an electrically-driven air pump, and a vacuum of 29 in. to 30 in. obtained, dependent upon atmospheric conditions. It will thus be seen that every particle of moisture is drawn out or evaporated, and the armatures and coils rendered perfectly dry. After remaining in this vacuum chamber for some hours, the articles are taken out and plunged into a tank of insulating varnish, subsequently going into the vacuum chamber again to dry, after which treatment they are practically waterproof.

Further protective measures are taken with field magnet coils and small wire-wound armatures, having a great many closely-wound layers of wire. These are also passed through smaller vacuum chambers, which are connected with the varnish tank. After the air has been exhausted a tap is opened, and as the top of the varnish tank is exposed to air, the atmospheric pressure forces the varnish into the vacuum, filling it up under a pressure of about 10 lb. per square inch. It will be readily understood that this process causes the varnish to enter every space, however small, and covers the inside wires as thoroughly as the outer layers. The surplus varnish is allowed to return to the tank below the floor by gravity, the armatures or coils being subsequently dried in the bigger chamber, after which they are finished off and allotted to their respective jobs.

The resistance frame and sheet metal working department and core building shop are on the floor below. A speciality is made of cast-iron grid resistances, stiffened by Holmes patent asbestos and metal strips, and in connection with the grinding of the contact surfaces of the grids an interesting attachment to the grinder is used, consisting of a magnet surface plate or holder, formed of interlaced fingers having opposite polarity when energised by a small magnetising current. By this means the grids are held in position during the process of grinding, being easily removed from the holder when the current is switched off. The core shop is equipped with powerful blanking presses, automatic notching machines, circle cutting machines, and hydraulic presses for assembling cores. In this shop all pole-piece stampings are made and built up together with the three-phase stators and rotors.

It will be evident from the above description that a very great amount of care and experience has been directed towards the equipment of these works, and while we must congratulate Messrs. J. H. Holmes & Co. on the result, we must put on record our appreciation of their courtesy in giving us facilities for the preparation of this article.

A NEW FIELD TELEPHONE SET

THE International Electric Co. have sent us an interesting little pamphlet, which is well illustrated, dealing with the subject of field telephony in general, and the "Medhurst" field telephone in particular. This instrument, which weighs only a little over four pounds, consists of a transmitter, receiver, Morse telegraph key, switch, buzzer, dry cells, and a condenser, which are all contained in a leather case.

The transmitter is of the interchangeable sealed capsule pattern, in which damage to the carbon of the microphone is

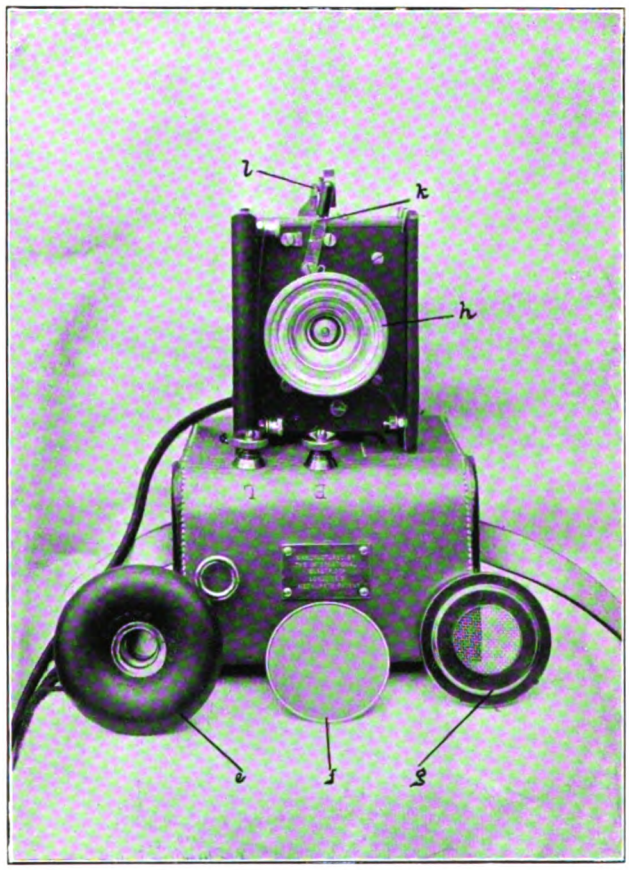

Fig. 1.—Field Telephone with Transmitter Capsule Detached.

simply repaired by inserting a new capsule. In Fig. 1 the capsule is shown at *f*; it is clamped into the carrier, *h*, by the ring, *g*. No loose wire connections are required, as the contact points meet one another as soon as the capsule is placed in position, and the ring is screwed home. We are informed that the capsule is absolutely watertight, and that it can be immersed in water for 24 hours without impairing the action of the transmitter.

The receiver is of the double-pole watch pattern, and there is a screw to adjust the diaphragm to synchronise with the note of the buzzer, so that it can be used as a receiver for Morse signals when the telephone cannot be employed. The key, *l* (Figs. 1 and 2), is employed for transmitting the signals. A switch, *k* connects up the receiver for this purpose, and a pad, *e* (Fig. 2), can be provided for fitting over the receiver in order to keep out extraneous noises from the ear.

The buzzer serves equally for ringing-up, for these signals, and as the induction coil for the microphone circuit; it has a primary and secondary winding with resistances of one ohm and 250 ohms respectively. Battery power is supplied by two

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Obach cells, *q*. The condenser is made on the Mansbridge principle.

Fig. 3 shows a field exchange for six lines. The large receiver at the top is made use of for calling up the exchange by means of a buzzer call, and a pre-arranged code of signals indicates from which station the call emanates. The operator

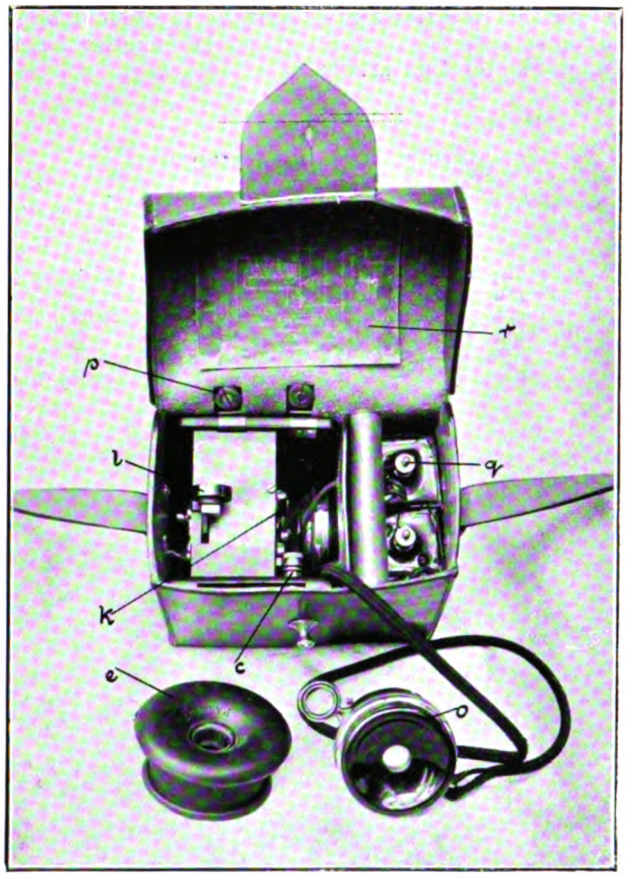


FIG. 2.—INSTRUMENT READY FOR USE FOR MORSE SIGNALS.

withdraws the corresponding plug from the bottom row of holes and inserts it in the hole corresponding to this station. Having ascertained the number of the wanted station, he

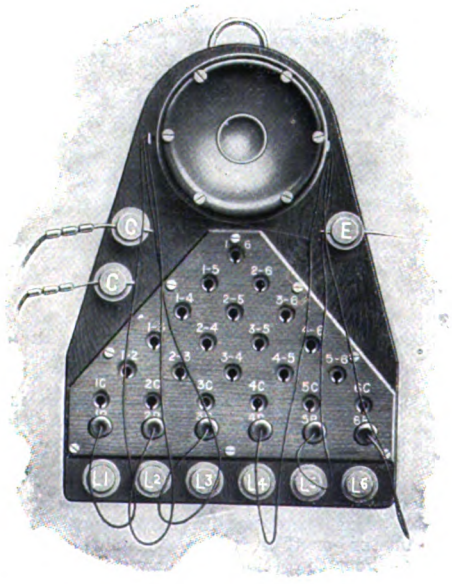


FIG. 3.—SIX-LINE FIELD EXCHANGE BOARD.

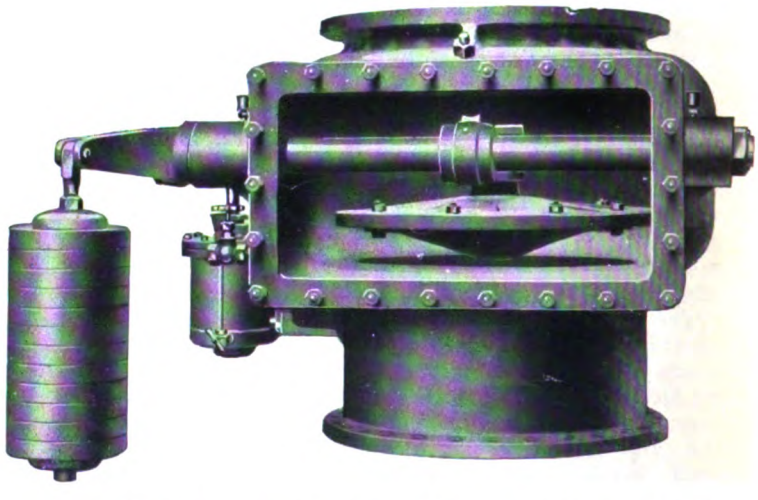
removes the plug and inserts it in the hole marked with the two numbers that are to be connected, the board being arranged on the "pyramid" principle.

CATALOGUES AND PAMPHLETS RECEIVED

ARC LAMPS.—A new price list from the Brockie-Pell Arc Lamp Co. contains full particulars of the well-known Brockie-Pell open, enclosed, miniature, and flame arc lamps. The direct-current miniature enclosed lamp takes only from 2½ to 3½ amperes, and burns for over 50 hours; the alternating-current lamp burns for about 40 hours. Both types have an overall length of only 16 in. The flame arc lamps are made on the same principle as the firm's open type arc lamps, and can be used with white or yellow flame carbons. These lamps burn for from 8 to 32 hours, according to the type, without recarboning. Globes, spare parts, and carbons are also included in this list.

TECHNICAL EDUCATION.—We have received from the Hackney Institute a syllabus of the classes to be held during the session 1908-9. These include classes in engineering and general science which are held at the Hackney Technical Institute, and practical trade classes which are held at the Sir John Cass' Hackney Institute. Time-tables and full details of the lectures and laboratory work are included in the syllabus, as well as particulars of the fees. The syllabus is illustrated with excellent photographs of the various laboratories and workshops.

AUTOMATIC EXHAUST RELIEF VALVES.—We have received from Messrs. Babcock & Wilcox, Ltd., a leaflet describing their automatic exhaust relief valves, which are designed for use with condensing engines, and act as safety devices in automatically relieving pressure in the condenser by by-passing the exhaust steam to the atmosphere. The relief valve is held hard down on its seating as long as a vacuum is maintained in the condenser, but any rise of pressure, due to the failure of the air or circulating pumps, lifts the valve and allows the steam to escape freely, thereby preventing the serious damage that might result from the sudden slowing down of an engine due to an accumulation of back pressure. The valve recloses automatically as soon as the condenser has regained its vacuum. If one condenser is used for several engines, only one automatic relief valve is required; but if each engine has its own independent condensing plant separate valves are needed. It is usually more convenient to place the valve within reach of the ground, and near the bottom of the uptake pipe to the atmosphere, and in this case the vertical pattern, shown in the illustration below, would be used. To suit varying piping arrangements, it is, however, sometimes convenient to use a valve of either the horizontal, inverted, or angle pattern, all of which work on the same principle as the vertical type. The body is of cast iron fitted with a renewable seating. The valve, also of cast iron, has a white metal seating which is cast into a dovetailed groove. This arrangement provides an air-tight joint, and prevents the valve adhering to its seat. The wear is all taken on the soft metal facing, which can be easily trued up or entirely replaced if necessary. The valve is balanced by an adjustable weight on a lever keyed to a spindle, which is carried in bearings bushed with gun-metal. To prevent hammering, due to the intermittent action of the exhaust steam, and to ensure the smooth action of the valve, a small piston, working in a dashpot of oil, is attached to the other end of the counter-balance lever. In the valve body an opening is



provided large enough to permit the removal of the valve for examination without disturbing any of the connecting pipes. A filling and a drain cock are furnished where a water seal is required, but this is not necessary except under special circumstances. A locking device is also fitted for holding the valve permanently off its seating when the exhaust steam has to be passed to the atmosphere for lengthened periods. These valves can be obtained in all sizes from 6-in. to 30-in. bore.

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ELECTRIC SIGNS.—We have received from Simplex Conduits, Ltd., a leaflet describing their new patterns of fixed and moving signs. The signs can be obtained either for night work only, or by the addition of a special glass, for day work also. One single 16-c.p. lamp is said to be ample for most sizes, but to obtain a particularly brilliant effect a 25-c.p. lamp is used in the case of the largest size of 24-in. diameter. Lamps with a special shape bulb must be used with these signs. The signs with varying colour effects are operated by small electric motors.

IRONCLAD SWITCHES.—An artistically got up catalogue is to hand from Messrs. Parmiter, Hope & Sugden, of Manchester. This gives full information with regard to the firm's standard switchgear, which includes the well-known Ajax motor-starting switches, knife switches, ironclad switches, fuses, &c. To comply with the latest regulations, the handles of the latest types of the ironclad switches are interlocked with the cover, so that the latter cannot be opened until the switch is in the full off position, and, further, the switch cannot be put on until the cover is entirely closed. The electrical contacts are of phosphor bronze, and the cases are watertight, rubber packing being fitted round the lids. A new tandem switch is described; the special feature is the employment of adjustable coupling pieces, by means of which the two poles can be fixed to break together, and any extra lengths due to wear and tear or warping of the coupling bars taken up. Distribution fuse boards with spring clip fuses, in teak and cast-iron cases, are described, as well as the Ajax open, semi-enclosed, and totally enclosed motor switches. Particulars are also given of a new pattern of three-pole ironclad switch and fuse box, which will shortly be put on the market. A separate lid is provided for both the switch and the fuse box, and these are, if required, so interlocked that they cannot be opened at the same time, and neither of them opened until the switch is in the off position. It may be mentioned that in this pattern, as in most of the latest patterns, the switch handle is at the side. The cover need hus have no slit, and the hand of the operator cannot be burnt by any arc which may be formed. This arrangement with the handle at the side is one which has been strongly recommended by Mr. G. S. Ram, H.M. Electrical Inspector of Factories.

LAMPS AND FITTINGS.—We have received from the Linolite Company two or three leaflets relating to their "Tubolite" lamps and fittings. One of these gives particulars of the standard sizes of these fittings, which are constructed to take from one to ten lamps. The standard "Tubolite" lamp is 12 c.p., and can be obtained for pressures varying from 100 to 125 volts. For pressures above 200 volts, two lamps are connected in series. Another leaflet describes the chain-sling method of suspension, which is recommended for most cases where the fitting has to be horizontal. It can be instantly set to any angle, and is easily removed for dusting. Two patterns of desk or table stands for "Tubolite" lamps are illustrated in the same leaflet. The firm announces a reduction in price of the standard fittings, and states further that they hope soon to be able to put on the market a metal filament "Tubolite" lamp of standard dimension and 1·5 watts per candle efficiency.

METAL FILAMENT LAMPS.—A leaflet is to hand from the International Electric Co., in which is described their "Orieco" metal filament lamp; this is now made for voltages up to 250. The various sizes of lamps are listed as follows:—200 to 250 volts, 50 c.p.; 70 to 125 volts, 32 to 50 c.p.; 40 to 50 volts, 25 c.p.; and 25 to 30 volts, 8, 16, or 20 c.p. A pattern with spherical bulb is listed at 200 to 250 volts, 50 or 100 c.p.; and 70 to 130 volts, 25, 32, 50, or 100 c.p. The consumption of these lamps is given as 1·25 watts per British candle-power. Particulars of the "Orieco" accumulator lamps and other low voltage, low candle-power lamps are also given. These lamps can be used on continuous- or alternating-current circuits, and are now made to burn safely in any position. It is further stated that the high efficiency is maintained throughout the whole life of the lamp.

PEAR SWITCHES.—We have referred in recent issues to leaflets issued by Messrs. A. P. Lundberg & Sons, relating to wall-plugs and ceiling roses. A new leaflet describing their various patterns of "See-saw" and tumbler pear switches, has been sent us. The former can be obtained as a two-way switch for two-way and intermediate wiring purposes, or as a single-way switch. The bases of these switches are made of porcelain, and the brass sliding bar actuating the contact arm in both types is insulated from current-carrying parts. Several patterns of tumbler switches in pendant form are listed, as well as an improved pattern of the well-known "Bowspring" pear switch. "See-saw" switches for surface fitting and lever switches for use in the bases of portable lamp stands are also included in the list. Two patterns of door switches for laboratory lighting are described and illustrated, and a contact switch so constructed that the circuit is broken when the plunger is pushed home is mentioned. This type is employed for the lighting of strong rooms and cupboards, *i.e.*, where light is only required when the door is open.

RESISTANCE ELEMENTS FOR ELECTRIC HEATING APPARATUS.—A leaflet from G. Schniewindt, of Neuenrade, Westphalia, Germany, gives dimensions, costs, and other particulars of resistance elements which consist of fine resistance wire woven together with asbestos string. The nets are woven non-inductively. These compact and light heating nets are particularly suitable for light semi-portable electric heating apparatus of all classes. They can be obtained alone or fitted in iron frames insulated with vulcanite tubing. The standard unit measures six inches square, and consumes 250 watts. The diameter of the wire is varied according to the pressure. The large heating frames consume from 500 to 3,000 watts.

ELECTRICALLY-DRIVEN ROLLING MILLS AT SANDVIKEN, SWEDEN

THE methods which have been used hitherto for equalising the demand on the generating plant and dealing with the serious peaks which exist in the load curve of such installations as electrically-driven rolling mills, in cases where the supply is alternating and batteries are employed, have usually depended on one of two principles. The voltage of the continuous-current side of the motor-generator set is sometimes controlled by the current in the alternating supply circuit, either by a relay controlling the field rheostat of the continuous-current machine of the set, or by the employment of a small rotary converter fed by a series transformer in the main supply circuit to supply the excitation. These methods are open to objection where there is much variation in the power factor of the circuit, as the regulation is not then sufficiently close. In order to obviate this disadvantage, the Oerlikon Company have developed a modified system of control, in which the regulation is effected not only by the strength of the current in the alternating circuit, but by the actual power absorbed.

An installation of this kind has been carried out by the company at the rolling mills at Sandviken, in Sweden, for a maximum power of about 600 kw. This mill is supplied from a generating station at Näs, about 35 miles distant, over a three-phase 18,000-volt transmission line. Step-down transformers are used to reduce the voltage at the works to 520 volts. The various motors are arranged on two separate circuits. On one of these are placed those on which the load is very variable, including about 50 small machines varying from 5 to 30 h.p., and the following rolling-mill motors: one of 600 h.p., one of 500 h.p., one of 300 h.p., two of 225 h.p., and one of 140 h.p. On the other circuit are placed about 60 motors, varying from 50 to 100 h.p., the load of which is nearly constant. All these motors are three-phase. The sudden variations of power in the first circuit amount sometimes to 500 or 600 kw., and a maximum load of 1,570 kw. is occasionally required for short periods.

The equalising plant to be described is for the purpose of dealing with these peaks. By its use not only is it possible to connect more three-phase motors to the circuit than could be done otherwise, but also to maintain a supply to a certain number of continuous-current motors employed for cranes, &c., and a part of the lighting from the continuous-current side of the set. In the event, too, of an interruption in the three-phase supply, the motor-generator set can continue to supply either continuous current at 440 or 220 volts, or alternating current at 520 volts or 220 volts three-phase by drawing on the battery.

The main motor-generator set consists of three machines coupled in line and mounted on one bedplate. The machine in the centre is a synchronous three-phase alternator wound for 520 volts 50 cycles,

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which can act either as a motor giving from 750 to 900 h.p., or as a generator with a normal output of 550 k.v.a. at a power factor of 0·8. The larger of the continuous-current machines can be used as a generator giving 1,100 to 1,400 amperes at 460 volts or a 600 h.p. motor. The third machine is a continuous-current booster, and has a maximum output of 1,400 amperes at 120 volts. The larger continuous-current machine is provided with three slip-rings connected to a 40 kw. three-phase transformer for supplying the existing three-wire 220-volt lighting system. Both continuous-current machines have commutating poles.

Another motor-generator is provided for supplying the excitation to the main set and at the same time regulating the voltage. This set consists of three machines. The driving motor is rated at 25 to 30 b.h.p. on a 520-volt three-phase circuit at 970 r.p.m., and is of the slip-ring induction type, with brush lifting arrangement. The exciter itself is a shunt-wound dynamo for 18 kw. at 110 volts, and the third machine is a 2 kw. regulating dynamo which supplies the excitation of the booster. The 18 kw. machine supplies the excitation both of the continuous-current generator and of the synchronous machine of the main set, as well as of the regulating machine. This last is provided with two opposed field windings, which are arranged to predominate according as the booster voltage is to be added to or subtracted from that of the battery.

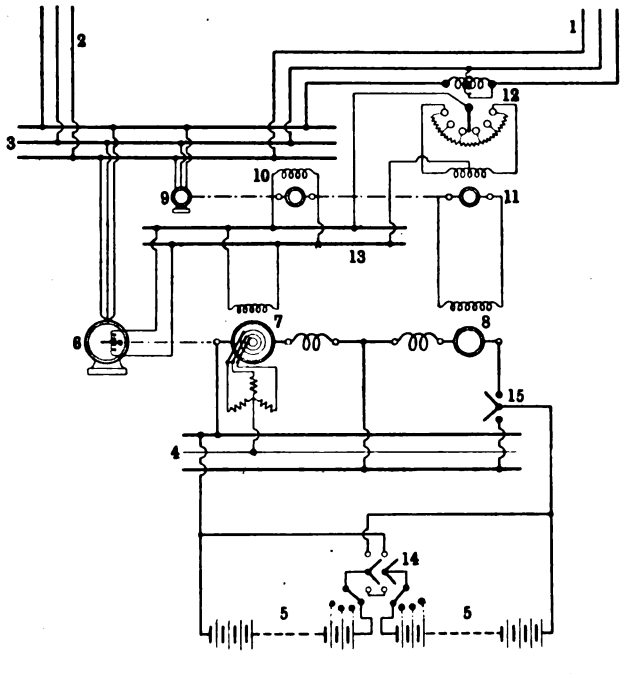

DIAGRAM OF CONNECTIONS FOR THE LOAD EQUALISING SYSTEM INSTALLED AT SANDVIKEN.

1. Cables from sub-station.
2. Motor Circuits.
3. Main Bus Bars.
4. D.C. Bus Bars.
5. Battery.
6. Synchronous Motor.
7. D.C. Generator.
8. Booster.
9. Three-phase Motor driving Exciters.
10. Exciter.
11. 2 k.w. Exciter for Booster.
12. Wattmeter Relay.
13. Exciter Bus Bars.
14. Paralleling Switch for Battery.
15. Booster cutting-in Switch.

The battery has a capacity of 1,406 ampere hours, and a maximum discharge rate of 850 amperes. It consists of 228 cells, and is divided into two parts, each provided with cell switch for the last eight cells, so that it can be used when required on the 220-volt circuit with the two halves in parallel. The system has been guaranteed to limit the fluctuations of load on the central station to 75 kw. in either direction, with variations of load up to 600 kw. and an average load of 1,570 kw.

A diagram of connections is given above. The regulation of the voltage of the small machine which excites the booster is effected by a wattmeter relay in the main three-phase feeding circuit. This relay actuates the regulating rheostat. The arrangement of the connections to the three-phase continuous and excitation is clearly shown. The continuous current generator of the large motor-generator set is provided with slip rings for connection to a three-phase static balancer or compensator.

When the power which is being absorbed is exactly equivalent to that for which the wattmeter relay is set, the position of the rheostat-arm is such that the voltage of the generator and the booster is exactly equal to that of the battery. If the load increases, the booster adds its voltage to the battery and allows it to discharge, and, on the contrary, if the load is below the mean the battery is charged. The regulator itself is of the well-known Thury pattern, driven by a small continuous-current 110-volt motor. A special arrangement is adopted to ensure that abnormal conditions of load shall not produce charge or discharge currents higher than a certain value. This consists of two solenoids which come into action when the current reaches the predetermined maximum, and oppose the action of the relay, so that further movement of the regulating switch is prevented. These solenoids are put in action by a separate relay (not shown in the diagram of connections) connected in shunt to the commutating pole-windings of the continuous current-generator through which the current to or from the battery passes. Another special device is provided to prevent the possibility of long continued overloads causing the battery to discharge to a greater extent than is desirable. This consists of a relay which inserts a resistance in the field circuit of the regulating machine as soon as the battery voltage falls to a certain limit, and thus prevents further discharge. As soon as the battery has received a certain amount of charge, and its voltage is thereby raised, this resistance is cut out of circuit again. A signal lamp is provided to show when this device comes into action. There is also a certain amount of hand regulation possible for giving the battery extra charging if required and avoiding overcharging, which might occur in special circumstances.

The fact that the power factor of the load has been found to vary from about 0·57 to 0·86 shows the desirability of a system in which the regulation is effected in accordance with the true watts passing and not merely the current. The efficiency of the converting sets when charging the battery at full current is 86·4 per cent., and the efficiency of the system when the battery is discharging at full current works out at 85·8 per cent, so that assuming a battery efficiency of 85 per cent. the overall full-load efficiency of the whole process of storage and subsequently drawing out energy is 63·15 per cent. The average overall efficiency of the whole system is, of course, much higher than this, as a large part of the energy does not pass through the battery at all. Actual records of the loads taken by the motors and drawn from the generating station show a remarkable degree of regularity in the latter, and even better results are anticipated when the generators are more fully loaded, as the governors of the water turbines will then be able to work within finer limits than at the present time, when the sets are only working at about two-thirds of their full rated load.

The switchboard consists of eleven panels, upon which are mounted the various starters, regulators, main switches, instruments, &c., which are required for the machines described above, each machine having its own panel. Three panels relate to the battery, and on these are mounted the overload circuit-breakers in the circuit from the motor-generator and the battery and various instruments, including charge and discharge meters. The synchronous machine is provided with an overload circuit-breaker actuated by a time-limit relay. The connections have already been indicated in the diagram. It will be seen that the voltage

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of the continuous-current bars is independent of that of the booster, and corresponds only to the voltage of the generator, which can be kept very constant, so that lighting can be satisfactorily run from these bars, notwithstanding the great variations of the power load. The connections are the same when the synchronous machine is acting as a generator to feed the three-phase network, except that the wattmeter relay is inoperative and hand regulation is used. The installation has been at work since April, 1907, and is in use day and night, excepting Sundays.

THE TELEPHONE EXCHANGE AT MESSRS. DEBENHAM AND FREEBODY'S

THE private branch exchange is now such a recognised necessity or all large business firms that a few words about the telephone exchange fitted at Messrs. Debenham & Freebody's establishment may not be without interest. A complete account of the electric light and power equipment appeared in our last issue.

Departments are kept in close touch with each other by means of this telephone system, some eighty telephones having been fitted throughout the building in the different departments and offices. The switchboard is built to accommodate two operators, and the different lines are distributed to equalise the traffic. The system

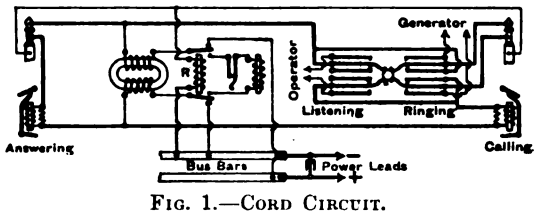

Fig. 1.—Cord Circuit.

R = Relay to cut off Local Battery on Exchange Connections.

is in touch with the outer world by means of eight junction lines connected to the Gerrard Exchange. At this latter exchange the lines are all consecutive and marked in conjunction, so that the operator can readily ascertain which lines are engaged when a number is required. By this means it is only on rare occasions that "line engaged" is given. Two lines are reserved for outgoing calls from this subscriber. The circuits are of the standard C.B. type, and are given above (fig. 1).

The calling apparatus consists of indicators of the "doll's eye" type, which, normally invisible, come into sight when an extension calls.

The ringing is done by a local plant consisting of a small motor generator; the ringing current is taken through a 660-ohm. lamp to prevent the possibility of current on the line that could heat up the apparatus.

There are twenty-four cord circuits, thirteen on the first position and eleven on the other, a number neces-

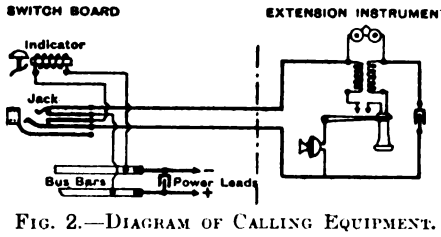

Fig. 2.—Diagram of Calling Equipment.

sary to cope with heavy traffic at certain periods of the day. The supervisory indicators are fitted immediately in front of their corresponding cords.

At night-time the exchange line is left plugged through for the use of the night-watchman and fireman. By this means calls incoming to the firm may be dealt with at any hour of the night.

THE MANCHESTER ELECTRICAL EXHIBITION: SUPPLEMENTARY LIST OF EXHIBITORS

THE Exhibition organisers have sent us the following list of exhibitors, supplementary to that published in our issue of August 20th. The total number of exhibitors is now about 230, which the organisers believe is greater than that in any previous trade exhibition ever held.

Abbey Electric Co., 17 Victoria Street, London, S.W.
Automatic Machine Co., Collier Street Works, Salford.

Bate, C. D., & Co., 40 Brazennose Street, Manchester.
Bateman Machine Tool Co., Balm Road, Hunslet, Leeds.
Bell Rock Belting Co., 24 Gravel Lane, Salford.
Birch, G. & Co., Ltd., Engineers, Manchester.
Birch, J. & Co., Ltd., 3 London Wall Buildings, London.
Brayshaw, Ltd., Engineers, Manchester.
British Thomson-Houston Co., Ltd., Rugby.

Combination Metallic Packing Co., Ltd., Hillgate, Gateshead-on-Tyne.

Dowsing Radiant Heat Co., Ltd., 24 Budge Row, London.

Electrelle, Ltd., Spring Gardens, Manchester.
Electric Rifle Co., Shaftesbury Avenue, London.
Elkington & Co., Ltd., 22 Regent Street, London.

Fittings, Ltd., 112 Victoria Street, London.

Griffin, J. J., & Sons, Ltd., Kingsway, London.

Harper Electric Piano Co., 238–262 Holloway Road, London.
Hughes & Stirling, Liverpool.

Kearney High Speed Railway Co., Ltd., 17 Old Queen Street, London, S.W.
Keith (James), & Blackman Co., Ltd., 27 Farringdon Avenue, London, E.C.

Luke, H., Ltd., Brazennose Street, Manchester.

Marples, Leach & Co., 24–30 Artillery Lane, London, E.C.
Mawdesley, Ltd., 25 Victoria Street, London.
Mealy, T. H., 87 Stovel Avenue, Manchester.
McPhail & Simpson, Ltd., Engineers, Wakefield.

Noyes, C. J., Pendleton, Manchester.

Phillips, J. W., & C. J., 23 College Hill, London.
Phillipson & Co., Holland Street, Astley Bridge, Bolton.

Small & Parkes, Ltd., Hendham Vale Works, Manchester.

Thornton, A. G., Ltd., 44 King Street, W. Manchester.
Triumph Stoker, Ltd., 85 Kirkstall Road, Leeds.

Vincit Co., 117B Queen Victoria Street, London, E.C.
Vulcan Boiler & Central Insurance Co., Ltd., King Street, Manchester.

Wellman-Seaver & Head, Ltd., 4–7 Victoria Street, London, S.W.
Wright, A., & Co., Ltd., 1 Westminster Palace Gardens, London.

ELECTRICAL ENGINEERING IN MEXICO

THE annual report of the British Consul-General in Mexico shows a considerable increase in the value of the imports from the United Kingdom. The large amount of mining work carried on in the country affords an excellent opportunity for the introduction of electrical machinery, although, of course, owing to the proximity of the United States, most of the imported machinery is of American manufacture. In his report, Consul-General Stringer states that British manufacturers and merchants could doubtless extend their trade with Mexico by sending out capable and energetic representatives, with a working knowledge of the Spanish language, to beat up trade on the spot. Catalogues, of course, help a great deal, but he emphasises the fact that it is of little or no use to send out catalogues and price lists in English; and that in giving weights and measures, the metric system should be used. The value of the imports under the heading of machinery and implements, which includes industrial, agricultural, and mining machinery, and also electrical appliances, was £2,780,000 for the year 1906-7.

In the report of the Vice-Consul for the State of Colima, it is mentioned that there are several factories using electric power, including two large ice plants. The electric light and power company's generating station in this district has been working for one year, but the plant installed is not of sufficient capacity to supply the power needed for local necessities. It is pointed out that during next year the State of Colima will be brought

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within 12 days' journey (*via* New York) of London and within 20 days (*via* Southampton and Vera Cruz) of London, Paris and Berlin. The principal importers in Colima of foreign goods are German, and naturally they import principally German goods. The city of Colima is the largest and most important city on the Pacific coast of Mexico, and with the opening of the railroad from the interior will forge rapidly ahead. In this report also it is emphasised that to secure their share of the foreign trade British merchants should either send commercial travellers to solicit orders personally and display goods, or should send fully illustrated catalogues in Spanish to the principal importing houses. The present custom of sending English catalogues is, according to the report, worse than useless.

The Vice-Consul for Guadalajara gives the following information with regard to the currency and weights in vogue in Mexico :—The standard unit of currency is the Mexican peso, which, for purposes of ready calculation, is generally assumed to be the equivalent of 2s. The metric system is the legal system of weights and measures adopted by the Mexican Government, but the old-time units of weight are still much used in parts of the country, and it is, therefore, as well to state their names and equivalents :—

1 adarme	=	1·1500 dram
1 onza		1·0151 oz.
1 libra		1·0150 lb.
1 arroba		25·3776 lbs.
1 quintal		0·9063 cwt.
1 carga		2·7189 cwts.
1 toneladа		0·9063 ton

Writing of foreign competition, the Vice-Consul complains that few British commercial travellers make a speciality of Mexico, and the great majority simply take in the whole Republic as part of their general beat through Spanish America. It is very seldom that a British commercial traveller is seen in Guadalajara, and it is doubtful whether more than six visit this city in the course of a year. German travellers are, on the other hand, ubiquitous, and at least one hotel in Guadalajara is largely dependent on their visits for its revenue. The United States manufacturer floods Guadalajara and the whole country with handsome catalogues printed in the Spanish language, and in no case is any charge made for catalogues. With regard to the power supply in Guadalajara, the report states that the Guadalajara Tramway, Light & Power Co., which was organised in 1907 to effect the amalgamation of a French and Spanish company, at present generates 10,000 horse-power, derived from hydraulic power, but can raise that amount to 100,000 horse-power. A rival electric power company will shortly be organised, and an additional 75,000 horse-power can be furnished from the resources at its command.

That there is room for improvement in the methods of generating and distributing electrical energy is evidenced by the statement in the report of the Consul in Mazatlan that the town is well lighted by electricity, but that for the householder electric light is an expensive luxury in Mazatlan, since he must pay 4s. per month for a single 16 candle-power and £1 16s. per month for ten 16 candle-power lights. The writer of this report is of the opinion that exhibitions of British manufactures in Mexican towns would tend towards increasing British trade with Mexico.

ELECTRICITY IN AGRICULTURE

IN an American consular report, Consul R. J. Thompson, of Hanover, quotes some interesting passages from an address read before the Prussian Agricultural Society by Herr von Podbielski, former Minister of Agriculture. The address refers to farming on a large scale as being the only finally profitable system of agriculture, as it is impossible to make use of the improvements effected by modern science, and especially by the application of electricity, on small farms. The advantages of distribution at a high pressure over a large area from a central generating station are pointed out, and the system, in which a transformer in the farm building supplies a low-tension circuit consisting partly of several waterproof junction boxes distributed in the yards and fields, is described. To connect up any piece of apparatus to one of these junction boxes, a strong pliable cable from 50 to 100 yards long, and wound on a portable drum, is employed.

A motor of sufficient capacity for driving chaff-cutters, oil-cake breakers, pumps, and other agricultural machines can be easily carried about on a litter by two persons. The farm work proper lasts for only a few months of the year, and for this reason the motors are not permanently connected, and may be used throughout the year for all kinds of work, thus deriving the largest possible returns for the money invested. For instance, the motor that is used to drive the oil-cake breaking machine may also be used to drive a pump for draining water from swampy ground. Large motors must be put on wheels. By using belts, such motors can be used for all possible work, and especially with threshing machines.

There are electrical threshing machines in use where the motor is permanently connected with the machine. A number of such machines are in successful operation. Barns are equipped with electrical cranes lifting an entire load of hay at once and placing it in the loft in any desired position. Such an installation means the saving of numbers of farm hands. Some large farms use electric cars. The electric railroad of the great Dahlwitz farm, which for ten years has forwarded large quantities of farm products to the markets of Berlin and vicinity, may be cited. If even a very small profit is to be derived from agricultural work, the farmer is bound to use machinery instead of manual labour, because the wages for the latter are steadily increasing. Electricity is the power best adapted to the work. Until very lately, however, it could not be used extensively on account of the high price per kilowatt-hour, charges of from 40 to 60 pfennigs (5d. to 7d.) per kilowatt-hour, excluding its use for agricultural purposes. According to Herr Podbielski's calculations, the price per kilowatt-hour in Germany, in order to leave a reasonable profit, should be no more than 20 pfennigs (2·4d.), and if modern machinery is employed, it is possible to furnish electricity at such a price. At our coal centres the kilowatt-hour is already furnished at from 6 to 7 pfennigs (0·7Zd. to 0·84d.).

The use of electricity in agricultural work may be classified as follows : (1) About the barnyard, as working the chaff cutter, corn cleaner, bruising mill, hauling crane, &c., unloading of hay, and, on large farms, smithy and cartwright work, and, further, for lighting the stables and the houses; and (2) in the fields, pulling the plough, running the machines, reapers, &c., and threshing. There is no difficulty in installing the machines referred to in the farmyard, but the expense for the use of electricity in the fields is much too high as yet. The cables are too expensive, and the plough run by electricity does not as yet work satisfactorily.

THE MANUFACTURE OF METAL FILAMENT LAMPS

ALTHOUGH there are now metal filament lamps of various types on the market for running at pressures over 200 volts, these have necessarily long filaments, and give out correspondingly large amounts of light. The problem of increasing the specific resistance of the tungsten, tungsten alloy, or other metal from which the filaments are manufactured still engages the attentions of the lamp manufacturers, and the patent specifications which are published from time to time give an idea of what is being done in this direction. Our Patent Record for last week contained, in the list of specifications published last Thursday, two patents relating to this subject.

The first was taken out by the Elektrische Glühlampenfabrik "Watt" of Vienna, and described a process for obtaining filaments consisting of an alloy of tungsten and one or more of the other refractory metals, such as titanium, thorium, or vanadium. The process consists in intimately mixing powdered tungsten with powdered oxides of the above metals and a binding agent containing carbon. The proportion of pure metal in the filament should be only just sufficient to render the cold raw filament a conductor. The paste formed is shaped into filaments, and these are heated in a chamber from which air is excluded. After the above treatment the filaments are raised to a white heat in an atmosphere of hydrogen. The oxides are reduced with the aid of the carbon in the binding agent and the hydrogen, and an alloy of the tungsten and the metals from the oxides is produced. The value of such alloys as, for instance, tungsten with thorium or titanium resides in the fact that they have high melting points and a much higher specific resistance than pure tungsten. This last property would enable the length of the filament

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for a given pressure to be considerably reduced, and would render the manufacture of high voltage low candle-power lamps a possibility.

The second of the two specifications is one by the Glühlampenfabrik "Union" of Berlin. The process of manufacture in this case is entirely different, and the final filament consists of tungsten or molybdenum or an alloy of these two metals, and silver. The incorporation of silver into the filament is said to increase the specific resistance and to render the filament less brittle. The process consists in heating carbon filaments to a temperature of 600° C. by passing a current through them, and at the same time exposing them to the action of the vapours of salts of tungsten or molybdenum, such as the chlorides, which readily evaporate in a vacuum. Hydrogen is introduced at the same time, and the metals are deposited on the carbon filaments, the chlorine combining with the hydrogen. The silver is incorporated into the filaments either beforehand by treating the carbon filaments with a solution of a silver salt, or at the same time by introducing silver chloride along with the tungsten and molybdenum chlorides. If desired, the carbon can then be completely burnt out of the finished filament by raising the whole to a high temperature in an atmosphere of hydrogen.

CORRESPONDENCE

To the Editor of "ELECTRICAL ENGINEERING."

SIR,—I have to thank your reviewer of my little work on "The Slide Rule" for several compliments, not all, perhaps, intended. When he states that it is likely to "produce slaves to the slide rule," surely there is an implied tribute to my descriptions of the appliance and its uses. One's description of a thing must "live" if it captivates the reader so that he becomes an actual slave to the thing so glowingly described. In regard to the "surprising dearth of the definite article," it is a curious fact that in the first 100 words of the review itself the definite article occurs eleven times (some are mere quotations), whereas in a passage of similar length selected at random from my book it occurs ten times. In sentences like the following, "Set *the* cursor to 264 on *the* C scale and bring 345 on *the* D scale to *the* cursor," which constitute a large portion of the work, it is evidently only a tribute to the writer's commonsense to call attention to the fact that he in later chapters omits the definite article. The word "delogarise," to which your reviewer objects, is not mine—I wish I could invent anything so good. Like most of the terms due to Prof. Perry, it "gets there" better than another author's sentence. Suppose, for instance, one is working out a calculation by logs., and one finds that the logarithm of the answer is, say, 2·351, the English of the operation to be performed is "*find the number of which* 2·351 *is the logarithm*"; another version is, "*find the antilogarithm of* 2·351," but the term "anti-logarithm" has no real relation to the operation indicated. Perry's nomenclature is "*delogarise* 2·351," which indicates in the shortest and most concise way the actual operation involved.

I think there are few mathematicians who would not be proud to father such an apposite and expressive term. I am glad to copy it.

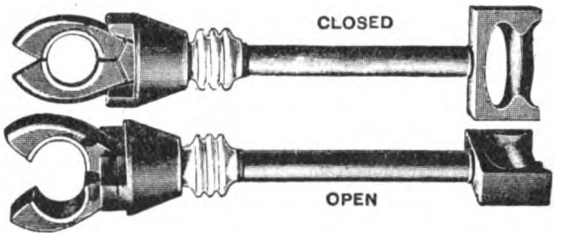
Yours, &c.,
R. G. BLAINE.

International Exhibition in Turin.—An international industrial exhibition is to be held in Turin in 1911. The sections will include electricity, measuring instruments, and transportation (tramways and railways). The programme and regulations (in English) may be seen at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

"The Electron."—The first two numbers of this monthly magazine, the official organ of the Siemens Stafford Institute, were reviewed at some length in ELECTRICAL ENGINEERING, August 13th, page 241. The third number, which has just been published, contains as a frontispiece a plan of the Stafford works. The biography of Ernst Werner von Siemens, which is given at some length, is the second of a series of biographies of prominent "Siemens" men, the first of which was an historical sketch of some of the earlier members of the Siemens family. A Paper on "Sparking: its Causes and Cure," read by Mr. S. P. Smith before the Engineering Society, and the concluding instalment of the discussion to Mr. M. Schenkel's Paper on the "Siemens-Schuckert-Werke Single-phase Series Motor" are included in this number. There are three short articles and several notes relating to the athletic, literary, and other social sections of the institute.

FUSE TONGS

MR. FRITZ LÜLING, of Küsnacht, near Zürich, has sent us particulars of a new patent tongs for removing and replacing fuses. He states that it can be used with safety for fuses up to 40,000 volts, or even higher, and that it can be manipulated with one hand. The illustration below indicates clearly the mechanism used. The handle is of wood, and is insulated from the tongs themselves by a corrugated insulator which has been tested up to 40,000 volts. As soon as the tongs



are placed against the fuse they open automatically, embrace the fuse tube, and close again. The handle is then turned slightly, and this locks the tongs, so that the fuse can be withdrawn. In inserting the fuse, the reverse action, of course, takes place. The tongs are made in three sizes: those for diameters of $1\frac{3}{16}$ inches are $13\frac{3}{4}$ inches long, and those for diameters of $2\frac{1}{4}$ inches and $3\frac{1}{16}$ inches are $27\frac{1}{2}$ inches long. It is stated that the tube is gripped uniformly all round, so that there is no risk of its breaking.

THE "OVERSHOOTING" OF TUNGSTEN LAMPS

IN an article by J. Stuart Freeman in a recent issue of the *Electrical World* some experiments are described which give conclusive evidence of the "overshooting" of tungsten filaments. Among the rapidly increasing number of users of the tungsten incandescent lamp, doubtless many have noticed what appeared to be a sudden rise in candle-power, upon turning on the current, to far above normal, then a gradual decrease to the operating brilliancy. The first investigation that was made settled the fact that the phenomenon is a reality and not a mere illusion. Apparatus was constructed for making a continuous photograph of the intensity of the rays emitted from the lamp after turning on the current, first when the lamp had been cold, and again after the lamp had been hot for some little time. This was done by revolving a cylindrical film holder in a lathe at a known speed and feeding before the exposing slot a card with a small hole in it, through which the rays of the light could shine. By this means it was demonstrated that there is certainly an "overshooting" of light intensity at the moment of turning on the current, and that it lasts for about one-tenth of a second. This, however, occurred only after the lamp had been turned out for some time, or, in other words, when it was cold. After being lit, then extinguished, and again lit, after the elapse of a second or so, the phenomenon was not visible.

This experiment suggested to certain engineers the use of the oscillograph in the investigation of the subject. In these investigations a 22-volt tungsten lamp was placed in an enclosed tube inside the oscillograph box so that the light could shine, through a small aperture, on to the revolving film. The current wave was obtained by connecting the vibrator across a shunt in series with the lamp. By means of a contact-making device and a small relay, operated by the same current that controlled the oscillograph shutter, the lamp circuit was automatically closed, thus obtaining on the same film both the current wave and the actual intensity of light emitted from the lamp. All the records were taken from a direct-current source. The current went directly to the lamp and instrument, with neither reactance nor resistance in the circuit.

These experiments showed that the total excess of brilliancy on switching on lasted for about one-fifth of a second, and the greater excess for one-tenth of a second only. The difference between the time when the current was turned on and when the filament reached incandescence was very short, being only one-sixtieth of a second, but the filament held its high temperature for fully one-thirtieth of a second after the current was turned off.

From readings taken, it was shown that the lamp was running on a steady direct E.M.F. of 22 volts, and that the initial current was 5·7 amp., while the final current was 0·68 amp. The total exposure to the lighted lamp was one-quarter of a second and the duration of the greatest "overshoot" in the current was about one-fiftieth of a second. A photograph taken when the filament was still warm, owing to a previous lighting, showed that there was no "overshooting" as regards excess of light,

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but that the same ratio existed between the initial current and the final current.

It was found that an entirely different state of affairs exists in the case of a carbon incandescent lamp of the same candle-power, namely, 16. This was also run on a direct current with no resistance in the circuit. The voltage was 120, and the initial current was but 0·15 amp., while the final current was 0·3 amp. It took approximately one-fifth of a second for the current to become normal. This easily illustrates the comparative susceptibility of filaments made from each of the two elements. By comparing these two records we find that while the current of the tungsten lamp "overshoots" its normal point of operation when turned on, and then decreases to it, the current of the carbon lamp starts low and increases to normal, at no time exceeding that point. This is, of course, due to the fact that whereas the resistance of the metal filament increases with increasing temperature, the resistance of the carbon filament decreases. Further, the difference in the number of watts necessary to produce 16 c.p. in each of the two lamps is quite noticeable, for while the tungsten lamp, running on 22 volts, started at 5·7 amp., and ran on 0·68 amp., the carbon lamp, running on 120 volts, started on 0·15 amp., and ran on 0·3 amp.

Lastly, a record was made from a film revolved at 120 revolutions per minute, which showed all of the above characteristics concerning the tungsten lamp, and an additional phenomenon. In making this record, a 25-volt tungsten incandescent lamp was run on a 25-cycle, alternating-current circuit. The current kick was shown at the instant of closing the circuit, and also the alternate heating and cooling of the filament, corresponding to the alternations of the current wave. On closing the circuit there were 3·4 amp. effective, while at normal there was but 0·3 amp. effective. It was noticed, however, that the filament began to brighten at the maximum point of the wave, and itself reached a maximum at one-eighth of a cycle farther along, or a point midway between maximum and zero on the descending part of each wave. Also that the minimum brilliancy was not at zero, as might be expected, but at one-eighth of a cycle farther along.

As a result of these tests there seems to be no question that the suppositions of the first investigator, who made known his experiments in this line, and others thinking the same way, are correct; and there is nothing further that can be done to prove more conclusively the above, since clear records made by the oscillograph are universally accepted as proof.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

THE *Westdeutsche Thomas-Phosphat-Werke*, of Berlin, describe in the German patent 200,876 (1908) a process for manufacturing oxides of nitrogen by electric discharges through air containing some gas or vapour mixed with it which will cause an explosion. For example, oxy-hydrogen gas or ether vapour is mixed with air, and then this explosive mixture is subjected to the action of the electric discharge. By means of the explosion thus brought about, an extremely high temperature is produced which causes oxidation of the nitrogen. The reaction, however, is so extremely rapid that there is no time for a reverse reaction—the decomposition of the oxides of nitrogen already produced—to take place. It will be remembered that in the Birkeland-Edyde and similar processes one of the chief points is the rapid removal of the oxidised nitrogen from the zone of reaction. Dr. M. Platsch (German patent 200,138 of 1908) endeavours to arrive at the same end by blowing finely powdered peroxides directly past the arc to cool the gases the moment they have been oxidised. The peroxides also give up oxygen in *statu nascendi*, and thus increase the oxidation of the nitrogen. The oxides employed are readily regenerated, and the nitrites and nitrates are readily removed from them.

Heinrich Fassbender publishes in the *Zeitschrift für Physikalische Chemie*, 62 (1908), p. 743, notes upon some experiments which he has carried out in connection with the "influence of the silent electric discharge upon explosive gas mixtures." He finds that a mixture of oxygen and carbon monoxide explodes more readily and with greater energy after being subjected to the action of the silent electric discharge, probably owing to the formation of ozone. An interesting point was brought out when a mixture of carbon monoxide and oxygen was exploded without being subjected to the silent discharge, as the residual gases coloured iodised starch paper blue, showing that ozone had been produced. When a mixture of hydrogen and chlorine was subjected to the silent electric discharge and then exploded, no difference in the speed of reaction was noticed. In this case, as no oxygen is present, the formation of ozone is not possible. If the gases are ionised by means of the silent discharge, they immediately become molecular again when the influence is removed. It appeared, however, that, in consequence of the action of the discharge upon a carefully dried mixture of hydrogen and chlorine, larger quantities of hydrochloric acid were produced by the explosion. Likewise, larger quantities of CO_2 were formed when a mixture of CO and O was subjected to the discharge. The action of the discharge at times caused union of the gaseous products with explosion and flame formation.

In the *Gazetta l'Elektrician*, XV. (1908), p. 357, a comparison of the largest electric furnaces is given. There are now several Kjellin furnaces capable of dealing with 20 tons of steel, and requiring 1,000 h.p. to work them. Stassano and Keller furnaces of a like capacity have also been built. In connection with the manufacture of calcium carbide, the Pieonteschen Co., of St. Marcel, have furnaces taking 1,000 h.p., 1,500 h.p., and the largest, 2,500 h.p. A new carbide works at Dargo has in one enormous room 10 1,000-h.p. furnaces. In the manufacture of ferrosilicon, Keller and Leleux have built three furnaces which together take 5,000 h.p.

In the July number of the *Physical Review*, Mr. G. A. Hulett describes a form of cadmium cell which is suitable for supplying a small current of much greater constancy than that which can be obtained from an accumulator. It consists of a wide-mouthed bottle which has a diameter of about 8 cm. The bottom of the bottle is covered with a layer of mercury about 0·5 cm. in thickness, which in turn is covered to a depth of 4 or 5 cm. with a solution of 10 c.c. concentrated sulphuric acid and 0·800 grm. cadmium sulphate per litre of water. A little above the surface of the mercury a shallow glass vessel 4 cm. wide and 4 mm. deep is supported, which contains the 12·5 per cent. of cadmium amalgam. The mercury and the amalgam are joined together by means of wires enclosed in tubes. The mercurous sulphate is prepared in the cell itself by sending a current through it from the mercury to the amalgam, the solution being well stirred in the meanwhile. The internal resistance of the cell is 6 ohms, and it can give a current of 0·00001 ampere for a number of days without the E.M.F. varying appreciably. A larger cell has been prepared which gave a constant current of 0·04 ampere over a long period.

Dr. F. W. Alexander, in his annual report to the Poplar Borough Council, states that the electrolytic apparatus for the preparation of hypochlorite disinfectant is still working in a satisfactory manner. Daily 185 gallons of the fluid are produced in eight hours, which contains, on the average, 4·5 to 5·0 grm. of active chlorine per litre. The cathodes, it will be remembered, are of zinc, and the anodes of platinum wire wound upon slate. The zinc electrodes have not required to be renewed, although the plant has been in operation for over two years. To prevent the action of the salt upon the interior of the supply tank, it has been coated internally with "Rosbonite," a preparation which is stated to answer the purpose admirably. The total cost of the plant to the end of January, 1908, was £606, and the hypochlorite fluid manufactured in the two years was 32,386 gallons at a total cost of £1,009. Dr. Alexander estimates that the initial cost, £583, and a further sum of £398 have been been saved to the borough by the employment of the electrolytic disinfectant in place of the older chemical methods before used.

In the *Zeitschrift fur Elektrochemie* of August 21st, Gilbert N. Lewis contributes an article upon the "Determination of Ionic Hydration by Means of Potential Measurements." He considers that in the theory of concentration cells an important omission is always made. It is considered that the E.M.F. is the actual measurement of the energy liberated when the changing of a salt of higher to lower concentration takes place. This, however, is only correct when the changing over of the salt is the only process which takes place when the current passes through the cell. If in the solution the ions are hydrated, then, when the current passes, water will be transported in both directions, and if the cation or the anion carries more water in the one direction, then the result of the passage of the current will result in more water being carried in one particular direction; and, as the activity of the water is not the same in dilute as in concentrated solutions, the transport of the water will be accompanied by a change in the free energy. Consequently, the electrical work which is obtained from a cell when an equivalent of electricity passes through it is the sum of two quantities, the one being produced by the ionic transportation, and the other from the water transport. The method of measurement employed is to use on one side of the system a thallium electrode and a saturated aqueous solution of thallous chloride, and on the other side a thallium electrode and a solution of thallous choride in a molecular sugar solution. When the current passes through such a combination it is possible for four materials to be transported—(1) metallic thallium, (2) thallous chloride, (3) water, and (4) sugar. It is, however, considered that sugar does not combine with the ions, and, consequently, is not transported with the ions. From the other three processes the two first cause no work, because the activity of the thallium and the thallous chloride is the same on both sides. On the other hand, the activity of the water is 2 per cent. less in the sugar solution. Consequently, the water transportation is the only process in which a change of energy is bound up. Therefore, the E.M.F. of the cell is a direct measurement of the transported water. An experimental confirmation of the method has commenced, and promises to yield valuable results.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Aug. 27th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

1907 Patents

17,660. **Safety Device for Lifts.** M. J. McVITTIE. An automatic electromagnetic brake for preventing the fall of a lift-car on the breakage of the suspension rope. The car runs between steel guide rails, and two electromagnets fixed to the sides of the car have poles shaped to the profile of these rails. The poles of the electromagnets are kept in contact with the rails by means of springs, and thus take the place of the usual guiding shoes. A spring, normally held in compression by the tension in the suspension rope, closes a circuit on being released by the breakage of the rope. This causes the electromagnets to be energised, and the car is thus held firmly to the guide rails. By reducing the current the grip of the magnets may be reduced and the car allowed to slide down. By connecting a small lamp in parallel with the brake circuit, failure of pressure will be indicated. Three claims, four figures.

17,718. **Lifting Magnet for Arc Lamps.** DEUTSCHE BECK-BOGENLAMPEN GES. Arc lamps in which the electrodes are brought into contact through the action of a weight often fail to strike owing to the weight being insufficient to overcome the frictional resistance of the lifting mechanism. The present invention is a design of lifting magnet to overcome this fault. Connected to the feeding mechanism is a rod which has a head held loosely within a recess in the magnet core. The rod is attached to a piston moving in a damping cylinder which may contain air or liquid. On cessation of current the magnet core drops, collides with the rod head, and operates a valve so that the piston falls easily and allows the electrodes to touch. One claim, one figure.

21,904. **Automatic Reverse-current Circuit-breaker.** A. ECKSTEIN, A. C. HEAP, and D. B. MELLIS. A reverse-current circuit-breaker for use on continuous-current circuits, and consisting of two coils wound separately on an iron core. The iron circuit is so shaped and the coils so placed that each coil has nearly a complete iron circuit independent of the other coil, but in each case the circuit is broken by a short air-gap. The two coils have a common magnetic circuit with no air-gap, so that as long as the currents in the two coils are in the same directions the flux traverses the common path. Should the current of the one coil reverse, the fluxes take the independent paths, and as the flux density is considerably reduced owing to the gaps, the armature is released and the circuit-breaker is operated. The chief advantage claimed is that there is very little tendency for the reverse current, even though very great, to reverse the field through the unidirectional current winding, and thus retain the armature, as the reverse current winding has its own magnetic circuit. Two claims, two figures.

1908 Patents

1,773. **Control of Single-phase Traction Motors.** E. F. ALEXANDERSON. Arrangements for enabling commutator traction motors to be run with single-phase or direct current at the highest possible voltages in both cases, thus reducing copper sections in the motors themselves and in the control circuits. The motors are operated as repulsion motors on alternating current, and as series motors on direct-current circuits, and the pressure for alternating-current working is made double that for direct-current working, without increasing the strain on the insulation of the motors, by earthing the middle point of the secondary of the main transformer. Means for short-circuiting the armature for alternating-current operation, without breaking the series connection, is provided. To give the necessary increase in the compensating ampere-turns relative to those of the exciting winding when changing over from series motor to repulsion motor connection, the compensating windings are divided, and are connected in parallel for direct-current operation and in series for alternating-current operation. For direct-current operation the armatures and exciting windings are connected in series. For alternating-current operation the exciting windings are supplied direct. Six claims, four figures.

7,006. **Petrol-Electric Transmission System.** F. PORSCHE (AUSTRIAN DAIMLER MOTOR CO.). A method of transmitting power from a prime mover, such as a petrol engine, to the wheels of a vehicle, and maintaining a constant torque of the engine in spite of the variable load. Two electric systems, each consisting of an armature and field magnets, are mounted concentrically, and are capable of a certain amount of longitudinal movement. Owing to the conical shape of the armatures and the bores of the field magnets, this movement causes the air-gap of one system to be increased while the other gap is reduced. These variations of the gaps are accompanied by corresponding variations of the flux density. The engine is connected to the electrical machine by means of a spring and on an up-gradient, the spring yields, causing the motor gap to be reduced and the dynamo gap to be increased. The speed is reduced, and thus the power kept constant. Five claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

10,855, DELAGE & WOOG. Ignition devices for explosion motors.
11,185, MAVOR, HIRD & MAVOR, & COULSON, Ltd. Speed control of alternating current motors.
15,846, FENNELL & PERRY. Methods of electrical distribution.
17,981, SHEPPARD. Automatic control of the speed of a motor.
18,165, SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*). Automatic telephone exchanges.
18,210, MONGE & ARZANO. Electrolytic processes for covering silvered mirrors with a protective metal layer.
18,348, FENNELL & PERRY. Electrodes for storage batteries.
18,527, NEALE. Railway signalling apparatus.
18,537, PHILLIPS. Electric musical instruments.
18,582, BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitats-Ges.*). Protective devices for electric systems.
18,688, LOWDEN. Incandescent electric lamps.
19,348, FLOHR. Manufacture of iron or steel with the aid of electrical furnaces.
20,508, VANDERVELL. Sparking coils for internal-combustion engines.
20,867, ALLGEMEINE ELEKTRICITÄTS GES. Alternating current machines of the commutator type.
22,405, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Systems of electric motor control.
22,481, ALLGEMEINE ELEKTRICITÄTS GES. Control of electric motors.
23,418, TURNER. Electric transformers.
23,786, GIMINGHAM. Manufacture of electric lamps.
24,589, POOLEY & MACDONALD. Protective devices for electric circuits.
24,808, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Alternating current machines.
25,115, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Systems of generating and distributing electric current.
25,148, ASHTON & ASHTON. Electric ignition in combustion engines.
27,225, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Electrical protective devices.

1908 Patents

2,195, DERAIN. Dynamos.
4,030, TIDNAM. Telegraph poles.
4,261, MARKS (*National Regulator Co.*). Apparatus for automatically controlling the temperature in buildings.
4,568, TAYLOR & BROOM. Electric arc lamps.
5,159, PIEPER. Electro-mechanical transmission systems for automobiles.
6,173, GROSWITH. Electric couplings for fire and other hose containing embedded conductors.
6,181, BOCK. Railway signalling.
6,450, BLIVEN. Trolleys or collectors for electricity.
6,555, MERGUIN. Connection for cables.
7,571, BROOKES (*Cushman Electric Co.*). Field magnets for dynamo electric machines.
10,118, VON GIZINSKY, MCCLURE, & WIESNER. Electric railways and tramways.
10,273, SNYDER. Sanding apparatus for tramcars.
12,876, SIEMENS-SCHUCKERT WERKE GES. Device for starting internal-combustion motors.
14,698, Firm ROBERT BOSCH. Carbon brush holders for magneto electric igniters.
16,538, MONGE & ARZANO. Electrolytic processes for covering silvered mirrors with a protective metal layer.
16,539, MONGE & ARZANO. Electrolytic processes for covering silvered mirrors with a protective metal layer.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

3,388, HOWELL. Incandescent electric lamps.
8,018, MEYERLING. Ampere-hour meters.
14,480, HOLMES & ALLEN. Trolley-heads for electric traction.
15,864, AUVERT & FERRAND. Device for suppressing stray fluxes in rotary transformers.
16,534, COOLIDGE. Manufacture of refractory conductors.
16,542, OTTO. Production of ozone.

Expiring Patents

No patents of electrical interest expire during the current week.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10–10½	−½
Do. 4½% Cum. Pref.	10	4½	4½	9½–10	
Do. 6% Cum. Second Pref.	10	6	6	10½–10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	100–103	
Bromley (Kent) E.L.& Power Co.,Ltd.	5	5½	—	4½–5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94–97	
Brompton & Kensington E. S. Co.,Ld.	5	10	5½*	6¾–7¾	
Do. 7% Cum. Pref.	5	7	7	6⅞–7⅞	
Central E. S. Co., Ltd.. 4% Guar. Db.	Stock	4	4	99–102	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	3½–4	
Do. 4½% Cum. Pref.	5	4½	4½	4–4½	
Do. 4% Deb. Red	Stock	4	4	96–99	+1
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½	3½–4	
Chelsea Electric Supply Co., Ltd.	5	4½	—	3–3½	
Do. 4½% Deb. Red	Stock	4½	4½	100–103	
City of London Elec. Lt. Co., Ltd.	10	6	6	9½–10½	
Do. 6% Cum. Pref.	10	6	6	11⅝–12¾	+½
Do. 5% Deb. Red	Stock	5	5	122–125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101–104	
Cty of Durham E. P. Dis. Co.	5	2	—	2½–3	
Do. 5% Pref.	5	5	5	3¾–4½	
County of London Elect. Sup. Co. Ld.	10	5	—	7½–8½	
Do. 6% Cum. Pref.	10	6	6	10⅝–10⅞	
Do. 4½% Deb. Red	Stock	4½	4½	107–110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99–102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛–⅜	
Do. 6% Cum. Pref.	5	—	—	½–1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59–66	
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾–5½	
Do. 5% Cum. Pref.	5	5	5	5–5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97–100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6–6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	90–93	
Kensington & Knightsbridge E.L.Co.	10	4¾	4¾*	7¾–8¼	
Do. 4% Deb. Red	Stock	4	4	94–97	
Kens. & N'tng Hill E.L. Cos. Db.Rd.	Stock	4	4	97–101	
London Electric Supply Corporation	3	2½	—	½–1⅛	
Do. 6% Pref.	5	5	6	4⅜–4¾ xd	−⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4	89–92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4½–5	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜–4⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	105–109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	84–89	
Midland E.Corp. for P.Dist. 1st Mt. D.	100 & 500	4½	4½	94–97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	94–97	
Newcastle-upon-Tyne Elec. Supply.	5	2½	2½	5–5½	−¼
Do. £2 Paid	5	2½	2½	3¼–3¾	
Do. 5% Pref. (fully paid)	5	5	5	5¼–5¾	−⅛
Do. £2 Paid	5	5	2½	3–3¼	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅝–12⅞	−¼
Oxford Electric Co., Ltd.	5	7	2½*	5⅜–6¼	
Do. 4% Deb. Red	Stock	4	4	95–98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5½*	7–8	
Do. 7% Non-Cum. Pref.	5	7	7	6½–7½	
Do. 3½% Deb. Red.	Stock	3½	3½	86–90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	½–¾	
Do. 4% Deb. Red	Stock	4	4	68–72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜–2¾	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝–⅞	
Do. 7% Cum. Pref.	1	7	7½	1⅛–1⅛ xd	⅛
Do. 4½% 1st Deb. Red	Stock	4½	4½	100–103	
Urban Elec. Supply Co., Ltd.	5	5	—	½–1	
Do. 5% Cum. Pref.	5	5	5½	1⅝–2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	82–85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5½*	7½–8½	
Do. 4½% Cum. Pref.	5	4½	4½	5–5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	92–94	
Central London	Stock	3	3½*	68–70	+1
Do. 4% Preferred	Stock	4	4	85–87	
Do. Deferred	Stock	2	—	50–53	
Do. 4% Debentures	Stock	4	4	101–104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	82–84	
City and South London Cons.	Stock	4½	1½	32–33	
Do. 4% Perp. Deb.	Stock	4	4	100–103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111–114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109–112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107–110	
Great Northern & City Pref. "A"	10	11½d.	—	½–1	
Gt. Northern, Piccadilly & Brompton	10	4	3½*	7–7½	
Do. 4% Perp. Deb.	Stock	4	4	91–93	
Mersey Cons.	Stock	—	—	1–3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3–6	
Metropolitan Cons.	Stock	½	½	36½–37½	+1½
Do. 3½% Preference	Stock	3½	3½	84–87	
Do. 3½% "A" Pref.	Stock	3½	3½	73–76	
Do. 3½% Convertible Pref.	Stock	3½	3½	70–73	
Metropolitan District	Stock	—	—	11½–12½	+½
Do. 6% Perp. Deb.	Stock	6	6	113–118	
Do. 4% Deb.	Stock	4	4	71–76	
Do. Perp. Extension Pref. (5%)	Stock	—	—	19–23	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	47–51	
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	5	38–42 xd	-1
Whitechapel and Bow 4% Deb.	Stock	4	4	101–104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅜–⅝	
Do. 5% Cum. Pref.	1	5	—	⅝–⅞	
Do. 4½% Deb. Red.	Stock	4½	—	86–91	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	91–94	
British Electric Traction Co., Ltd.	10	—	—	1¼–1½	−⅛
Do. 6% Cum. Pref.	10	6	6	3⅞–4⅜	−⅛
Do. 5% Perp. Deb.	Stock	5	5	96–99	+2
Do. 4½% 2nd Deb.	Stock	4½	4½	76–78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼–4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4	97–100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½–12½	−½
Do. 6% Pref.	10	6	3%	12¼–13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3¼–3¾	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	¾–1⅜	
Do. 4% Deb.	Stock	4	4%	56–61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92–94	
London Street Tramways Co.	4	4/6	2½%	⅞–1¼	
London United Trs., Ld., Cm. Pf.	10	5	—	5½–6½	−¾
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	76–81	−3
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛–⅜	
Do. 5% Cum. Pref.	1	5	5%	¾–1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92–95	−1
National Elec. Construction Co. Ltd.	1	2/-	—	⅜–⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼–⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛–⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	89–92	
Potteries Electric Traction Co. Ltd.	1	4	—	½–¾	
Do. 5% Cum. Pref.	1	5	2½%	⅝–¾	
Do. 4½% Deb. Red	Stock	4½	4½%	93–96	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜–5⅛	
Do. 6% Cum. Pref.	10	6	6%	9½–10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾–1	
Do. 4% Deb. Red	Stock	4	4%	76–80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	78–82	
Yorkshire (West Riding) Elec. Trams	5	—	—	½–1⅜	
Do. 6% Cum. Pref.	5	—	—	3½–3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83–86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	58–61	
Do. 6% Pref. Ord.	Stock	6	6%*	104–105	+⅜
Do. Def. Ord.	Stock	1	—	17¼–17¾	+1⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	86–89	+2
Direct Spanish Telegraph Co. Ltd.	5	4	—	3–3¼	
Do. 10% Cum. Pref.	5	10	10%	8–9	
Do. 4½% Debs.	50	4½	4½%	100–103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13⅜–13⅝	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100–102	+1
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½–101½	+⅜
Do. do. (Mauritius Sub.)	25	4	—	101–103	+⅜
Eastern Ext. Australasia & China	10	7	6%	12¾–13¼	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100½–102½	+½
Eastern Telegraph Co.	Stock	7	1¾%*	135½–138½	+½
Do. 3½% Pref.	Stock	3½	3½%	84½–86½	+½
Do. 4% Mort. Deb.	Stock	4	4%	102½–104½	+1
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	27½–29½	−½
Indo-European Telegraph Co. Ltd.	25	13	—	56–59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜–½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108–110	+1
Do. Deferred	Stock	6	6%*	119½–121½	−½
Do. 6% Cum. 1st Pref.	10	6	6%	10–12	
Do. 6% Cum. 2nd Pref.	10	6	6%	10–12	
Do. 5% 3rd Pref.	5	5	2½%	5⅛–5⅜	
Do. 3½% Deb. Red	Stock	3½	3½%	98½–100½	
Do. 4% Deb. Red.	Stock	4	4%	103–105	
Western Telegraph Co., Ltd.	10	7	6%*	13⅜–14½	
Do. 4% Deb.	Stock	4	4%	01½–103½	+1
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞–1⅛	
Do. 6% Cum. Pref.	1	6	7½	1¼–1⅜	
Babcock & Wilcox, Ord.	1	20	—	3½–4⅛	−⅛
Do. 6% Pref.	1	6	—	1½–1⅝	+⅛
British Insulated & Helsby Cables, Ld.	5	10	—	6½–7	+¼
Do. 6% Cum. Pref.	5	6	—	6–6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103–106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91–96 xd	−2
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅞–1⅛	−⅛
Do. 4% Mort. Deb. Red.	Stock	4	4%	43–48	
Brush Electrical Engineering Co.	2	—	—	0–½	
Do. 6% Pref.	2	—	—	½–¾	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68–73 xd	−2
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50–54	
Callender's Cable and Const. Co., Ld.	5	15	—	9½–10¾	
Do. 5% Cum. Pref.	5	5	5%	5½–5¾	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107–109	+1
Consolidated Electrical Co., Ltd.	1	3½	—	¾–⅞	
Crompton & Co., Ltd.	3	5	5%	1⅛–1⅜	−⅛
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	90–93	
Dick, Kerr & Co., Ltd.	1	10	—	1⅝–1⅞	+⅛
Do. 6% Cum. Pref.	1	6	6%	1–1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	99–102	
Edison & Swan United "A," £3 paid	5	2/6	—	½–¾	
Do. do. (fully paid)	5	4/2	—	1½–2½	
Do. 4% Deb. Red.	Stock	4	4%	76–79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85–87	
Electric Construction Co., Ltd.	2	—	—	⅜–⅝	+⅛
Do. 7% Cum. Pref.	2	7	—	1⅜–1⅞	
Do. 4½ 1st Mort. Deb.	Stock	4	4%	66–71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½–8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	86–90	+2
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½–11½ xd	−½
Do. 4½% Cum. Pref.	5	4½	4½%	5–5½ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107–108	+1
I. R. & G. P. Co., Ltd.	10	10	2½%*	15½–16½	
Do. 4% Deb. Red.	100	4	4%	99–101	+½
Tel. Const. & Maintenance Co.	12	17½	10%*	32–34	+½
Do. 4% Deb. Bds. Red	100	4	4%	100½–102½	+½
Willans & Robinson. Ord. Shres	1	5	—	⅞–1¼	
Do. 6% Cum. Pref.	5	6	6%	2½–3	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72–76	

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THE EALING TRAMWAY DISPUTE

ON page 274 of our issue for August 20th, we reported the circumstances of an inspection by Col. Yorke, the chief inspecting officer of railways of the Board of Trade, of the tramways between the Ealing Town Hall and the Hanwell Boundary. It may be recalled that two previous inspections had been complained about by the Council as not being sufficiently thorough, the reason for the inspections being alleged noise from the tramways, due, it was said, to insufficiently heavy track, upon which were run too heavy cars. The amusing incidents connected with the last inspection were recorded in our last issue of August 20th, and we are now able to publish Col. Yorke's report:—

I have the honour to report for the information of the Board of Trade that in compliance with the instructions contained in your minute of the 5th instant, I have this day inspected the tramways in Ealing.

I was met at the borough boundary by the Mayor and Surveyor of Ealing, and I asked them at once to point out to me any places in the tramways concerning which they wished to make complaint. As there appeared to be no bad places near the boundary, I told the Mayor that as a complaint had been made, that on the occasion of my previous visit in August, 1907, I had not inspected the whole route, I proposed on this occasion to walk over the whole tramway line from boundary to boundary, and this I did. The Mayor and Surveyor did not accompany me, but proceeded to the Town Hall, where they awaited my return. I walked over the route along the centre of the road, and examined the whole of the tramway tracks, and I found them to be in fair order, and in a better condition than I anticipated.

There were evidences that numerous repairs had been executed within the last week or two, and in some cases within the last day or so, and the officers of the company made no secret of the fact that many repairs had been recently carried out, and are still in progress. Some of these repairs were rather rough, and showed signs of haste.

After a careful examination of the tracks from end to end, I have to report for the information of the Board of Trade that in my opinion the London United Tramways within the Borough of Ealing are not at the present time in such a condition "as to be a danger or annoyance to the ordinary traffic."

Some facts relating to the laying of the tramways in Ealing make interesting reading. When the agreement between the Council and the company was arrived at some seven years ago, the company, at the special request of the Council, laid their track with blocks of a special Californian wood, a material which was also employed by the Middlesex County Council at the desire of the Ealing Council for the remainder of the roadway. It was soon seen, however, that these blocks wore down very quickly, and the company are gradually executing repairs with hard Jarrah wood blocks. But on either side of the track the original blocks remain, and it is notorious locally that they are in an exceedingly bad condition. In fact, a ratepayer has ventured the opinion that the expedition with which Col. Yorke carried out his inspection is clear proof that, at any rate, he was walking on the tramway tracks, as had he been walking on the sides, he would have been soon tired out with "falling into holes and climbing out again." Further, the Middlesex County Council refuse to renew the roadway yet for reasons well known both to itself and the Ealing Council. Against the imputation that the company is able continually to hoodwink the Board of Trade inspector by hurried repairs just prior to the inspection, comes the suggestion that if the Ealing Council could prevail upon the Board of Trade to order the tramway track to be entirely relaid, they would be in possession of a lever for forcing the Middlesex County Council to deal with the remainder of the roadway at the same time.

LOCAL NOTES

ARGENTINE: *La Plata Electric Supply.*—The *Review of the River Plate* states that the Senate of the Province of Buenos Aires have before them a petition for leave to establish a new electric light and power works in the City of La Plata. The Bill has been approved in general, and the Minister of Public Works spoke in favour of the project. There is considerable discontent at the present time in La Plata in connection with the River Plate Electricity Co., which is principally due to the charge of $2·50 a month made for meters, but our contemporary does not think that there is room for two companies in La Plata, seeing the hold that the existing company already has in that city.

AUSTRALIA: *Footscray (Victoria).*—According to the *Australian Mining Standard*, the Lighting Committee of the Footscray Council propose recommending to the Council that steps be taken to bring the electric light into existence. A poll of the ratepayers is to be taken to obtain their sanction to the floating of a loan for the purpose.

Brunswick (Victoria).—The proposal made some time ago by a syndicate to supply the town of Brunswick and the adjoining borough of Coburg (V.) with electric light and an electric tramway service, was considered last week by the Brunswick Electric Lighting Committee, and was rejected, although the Borough Council of Coburg had decided in favour of it. However, the Lighting Committee had no actual power to veto, and the matter will not be finally disposed of until dealt with by the City Council at its forthcoming meeting, and it is not at all certain that the committee's recommendation will be adopted. To reject this offer, as a previous one was rejected, would necessitate the borrowing of a large sum for the purpose of installing a municipal plant, and to this there is strong objection in the Council.

BARGOED: *Telephone Service.*—At the last meeting of the local Chamber of Trade, a letter from the Postmaster-General was read, stating that he had given instructions for the extension of the telephone and telegraphic system to Bargoed. Efforts are now to be made to obtain a trunk line between Bargoed and Cardiff.

BARNSTAPLE: *Electric Light Tariffs.*—The Lighting Committee have made a report recommending a system of two rate meters for large consumers. The Council has confirmed the arrangement, which is that all consumers for lighting of over 2,000 units per annum be offered a two-rate meter method of charging, namely, 4½d. per unit between 6 p.m. and 11 p.m., and 2¾d. per unit between 11 p.m. and 6 p.m. No discount will be allowed to consumers taking advantage of this system. This will not apply to public lighting.

BECKENHAM: *Metal Filament Lamp Tests.*—The Electrical Department is carrying out some exhaustive life tests on metal filament lamps used for street lighting. The lamps are being run night and day.

BELFAST: *Tramway Matters.*—At the weekly meeting of the Tramways and Electrical Committee on the 31st ult. the Town Clerk was instructed to have a draft agreement prepared *re* the running powers of the Cavehill and Whitewell Tramway Co. over the Corporation's lines.

BIRMINGHAM: *Tramway Extension.*—The proposal that the Birmingham Corporation should extend its tramway system into Stechford continues to receive support. A meeting of the local Ratepayers' Association was held last week-end, when a resolution was passed urging the City of Birmingham to negotiate with the Yardley Rural District Council to promote a Bill in Parliament authorising the proposed extension.

BRAZIL.—*Advertising Methods.*—H.M. Consul at Pernambuco, Mr. P. Staniforth, writing with reference to the methods of foreign competitors with which a British exporter has to contend, mentions that a representative of a German electrical firm fitted an installation of electric lamps and accumulators to a carriage of one of the Pernambuco suburban railways, free of charge, to show the advantages of his firm's special system with a view to orders.

BRIDLINGTON: *Condition of Electric Plant.*—A report has been received from the National Boiler & General Insurance Co. to the effect that the boilers, engines, and economisers at the Electricity Works are in good order.

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BRIGHOUSE: *Electric Lighting Loan Refused.*—The Local Government Board has refused to sanction a loan of £3,624 for the purpose of replacing old generating plant which has been disposed of in consequence of the decision of the Council to abandon generating electricity itself in favour of taking a supply in bulk from the Yorkshire Electric Power Co. The Council has also applied for a loan of £3,940 for a sub-station in connection with the bulk supply, but a communication from the Local Government Board asks for further particulars with regard to this before a decision is given.

BURY: *New Generating Station.*—Plans are now being prepared for the new Corporation electricity works, which are to cost about £80,000.

CAERGWRLE: *Electric Lighting.*—A scheme of electric lighting has been reported upon favourably.

CARDIFF: *Visit of Associated Chambers of Commerce.*—Arrangements have been made for those attending the meeting of the Associated Chambers of Commerce in Cardiff to inspect the electricity and tramway undertakings.

CHICHESTER: *Electric Lighting.*—Negotiations are being carried on between the Board of Guardians and the Chichester Electric Lighting Co., with regard to the installation of electric light in the workhouse, but the Guardians refuse to pay the expense of wiring, holding the opinion that the cost should be borne by the company.

CHINA: *Telegraphs.*—A new telegraph line is being built along the river at Shantung, with the combined object of improving the present service, and of giving flood warnings.

COLWYN BAY: *Tramways.*—The extension of the Llandudno and Colwyn Bay tramways on to Old Colwyn is contemplated, but the County Council and the Urban District Council have to carry out considerable road widenings before the actual work upon the lines can be commenced.

EDINBURGH: *Exhibition Lighting.*—The formal inauguration of the scheme of decorative electric lighting of the buildings at the Scottish National Exhibition took place last week, Sir Robert Cranston, ex-provost, presiding. At present only the buildings have been dealt with, but the grounds will also be included in the scheme, which, when completed, will comprise some 20,000 lamps.

GLASGOW: *Tramway Accounts.*—From June 1st to date the Corporation tramways have carried 49,567,109 passengers, compared with 50,030,993 passengers during the corresponding period of 1907. The total revenue from June 1st amounts to £204,091, against £203,382 for the corresponding period of the previous year.

GREYSTONES: *Electric Lighting.*—The Greystones Electric Lighting Co. has again made an application to the Council for permission to their application for an electric lighting provisional order, but the consideration of the matter has once more been deferred.

GUATEMALA.—*Electrical Imports.*—The total value of the imports under the heading of electrical appliances and material, from the United Kingdom, Germany, and the United States amounted to £8,110 during the year 1907. The individual amounts were £240, £5,660, and £2,210 respectively. The figures for 1906 were £101, £3,140, and £5,600 respectively. Thus the British and German imports have increased; those of the United States decreased.

HALIFAX: *Runaway Tramcar.*—Whilst ascending Gibbett Hill, Halifax, on Thursday, a tramcar began to run back, and, on the curve near the bottom it left the rails and came to a standstill at the kerbstone opposite a jeweller's shop. No damage was done to the car, but sixty workmen jumped off the vehicle, and one sustained a sprained ankle.

HASLINGDEN: *New Tramways.*—The Board of Trade will make an inspection of the reconstructed tramways this week. The Accrington Council are providing the cars and current, for which Haslingden pay 7d. per car mile. The arrangement is for nine months, to give Haslingden time to erect their own generating station.

HYTHE: *Tramways.*—One of the conditions imposed by the Council when the National Electric Construction Co. secured their Bill for the construction of tramways in the district was that the surface-contact system should be used. Now, however, the company, owing to the extra cost, are seeking to substitute the overhead trolley system, and as there is considerable difference of opinion amongst the inhabitants on the matter a poll of the ratepayers is being taken.

INDIA (CALCUTTA).—*Electric Power.*—In an American Consular Report, Consul-General W. H. Michael, of Calcutta, states that electric power for domestic and mechanical purposes has become almost a necessity in Calcutta, and a reduction in the cost would have the effect of largely increasing the consumption of electric energy.

ITALY.—*Electric Lighting.*—It is reported from Castellammare di Stabia that a small generating station with steam turbo-alternators for supplying light and power in the district will shortly be opened.

LONDON: *London County Council: Tramways.*—It is stated that all difficulties in the way of the conversion of the remaining horse tramways in Battersea and Wandsworth have been removed as the result of prolonged negotiations between the Battersea Borough Council and the Highways Committee of the London County Council. Work will be proceeded with at once on the Queen's Road and Chelsea Bridge Road route, whilst a tentative agreement has been arrived at with regard to the line from St. John's Hill to Vauxhall, which awaits confirmation by both Councils. Both the lines will be reconstructed upon the conduit system, but owing to the very low railway bridges in Queen's Road only single-deck cars will be used on this route.

MALVERN: *Assistant Engineer's Salary.*—The Urban District Council on Tuesday unanimously confirmed the Electric Lighting Committee's recommendation to advance the salary of Mr. C. E. D. Greenhalgh, the Assistant Electrical Engineer, by £20 per annum.

MANCHESTER: *Telephones in Public Libraries.*—The Libraries Committee have arranged with the National Telephone Co. for placing telephone facilities at fourteen branch libraries.

Tramwaymen's Flower Show.—The employers of the Manchester Corporation tramway department held their annual flower show at Fallowfield last week. The Horticultural Society, when started three years ago, had a membership of 25, but there are now over 200 members. Mr. J. M. McElroy, the Corporation tramway manager, opened the show, which included vegetables.

MEXICO: *Telegraphs and Telephones.*—Federal telegraphs in the State of Jalisco reach a total length of over 1,870 miles, and telephone lines in the hands of private companies cover 625 miles.

MONTREAL: *Public Lighting Contract.*—The Montreal Light, Heat, & Power Co. refuse to continue the public electric lighting at the prices of the old contract, which has just expired. The old schedule of charges was $60 per lamp in the city and $90 in certain of the outside districts. Mr. Lea Walbank, the manager of the company, has stated that the present bargain with the Council is an unfair one to the company, but he is willing for both sides to appoint experts to determine the price. He will, however, not negotiate except upon the basis of a ten year's agreement.

NAAS: *Central Ireland Electric Power Bill.*—At the weekly meeting of the Naas Board of Guardians last week Mr. John O'Connor, M.P., was publicly thanked for having secured the recommittal of the Central Ireland Electric Power Bill to the Committee of the House of Commons, which had previously rejected the measure. The Bill, it will be remembered, was passed and became law after Dublin and some other portions of the area originally scheduled had been struck out.

NEW ZEALAND: *Tramway Troubles.*—The special Court of Conciliation, appointed some weeks ago to deal with the dispute between the Auckland Tramway Co. and its employees, has made its award, says the *Australian Mining Standard.* All points claimed by the men are conceded, with one exception, viz., the stipulation that employees should not be required to work alongside "blacklegs," that term signifying two former employees who had refused to come out. On this point the Chairman said that these two men were entitled to their opinion, and it would be unfair to punish them for having the courage to act independently. The award was come to only on the casting vote of the Chairman. The Board direct that the recommendations shall take effect from September 1st, 1908, and shall continue in force until August 31st, 1910.

NORTHFLEET: *Electric Lighting.*—Supply is now given in Northfleet from the Gravesend municipal electricity works. The Gravesend Corporation was granted a provisional order for the district in 1905, but after a scheme was prepared, and an agreement entered into between the two parties, a resolution was passed abandoning the proposed supply. After much correspondence the Northfleet Council threatened a legal action to compel the fulfilment of the agreement, but this was not found necessary, and public lighting was inaugurated last week.

PERTH (Australia): *Electric Tramways.*—The aggregate gross receipts from January 1st to August 21st of the Perth Electric Tramways, Ltd., were £46,953, against £47,855 for the corresponding period of 1907.

SHANGHAI.—*Electric Tramways.*—Mr. A. Rose, Consul at Shanghai, reports that although the installation of 26 miles of electric tramway was expected to raise a storm of indignation among the natives of the coolie class, the innovation has passed almost without comment, and the cars are thronged with Chinese passengers.

SOUTH STONEHAM: *Electric Supply.*—The Rural District Council has agreed to allow the Southampton Corporation to lay mains in this district.

SOUTHEND: *Broken Trolley Wire.*—On Thursday one of the trolley wires of the Corporation tramways in the High Street broke and fell on a visitor, who was not, however, injured.

SOUTHPORT: *Bowling by Electric Light.*—In order to permit of bowling after dusk in the autumn and winter the Corporation have erected arc lamps at the Crowlands Bowling Green.

SUNDERLAND: *Electricity Supply.*—It is stated that the demand for electric power from the Corporation Works has shown no increase during the past six weeks, and that in consequence the reduced estimates prepared a short time ago are to be allowed to stand.

WEDNESBURY: *Strike.*—The strike at the works of the Patent Shaft and Axletree Co. has been ended on the men

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agreeing to resume work, and the company to consider the alleged grievances. The company has all along refused to consider the matter until the men returned to work.

WIMBLEDON: *Street Lighting.*—The Electric Lighting Committee have decided upon the installation of a 220-volt 50-c.p. metal-filament lamp in each of the 1,045 lamp-posts in the borough, and the purchase of 155 metal-filament lamps for the purpose of stock, at an estimated cost of £286, while the estimated cost of the necessary alteration of wiring and fittings is £130 12s. 6d. A sub-committee has been appointed in the matter of a dispute between Jas. Howden & Co., Ltd., the contractors for the supply of a Zoelly turbine, &c., and the Electrical Engineer, respecting the amount of pipework included in their tender.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ASTLEY.—We understand that the Pilkington Colliery Co. (a new concern) intend putting down a considerable amount of electrical plant at the new pits they are now sinking at Astley Green, in southern Lancashire. The development of this new coalfield is expected to cost about a quarter of a million sterling.

BANBRIDGE (Co. Down).—The Council is to nominate a committee for the purpose of conducting negotiations in connection with an electric lighting scheme. The place has a very convenient source of power in the Upper Bann, which flows through the town.

BAVARIA.—In connection with the development of the water-power resources of Bavaria, the Bavarian Government offers prizes of £1,000, £750, and £500 for the three best sets of designs, including estimates of cost, for the works for the utilisation of the water-power of the "Walchensee." A general outline of the scheme, and the conditions of the competition, which is open to engineers of all nationalities, are to be obtained from the Bavarian State authorities on payment of a deposit of £1. The designs must be submitted on or before January 20th, 1909.

DENMARK.—The Town Council of Reykjavik (Iceland) has given to a Danish company a concession for supplying the town with electric light and gas. The concession is for a period of 25 years, and the plant is to be in working order by October 1st, 1909.

EAST INDIAN RAILWAY CO.—Tenders are invited for the supply and delivery of a 600-kw. three-phase alternator and of gas engine alternators and equipment, in accordance with specifications to be seen at the company's offices, Nicholas Lane, London, E.C. Tenders by September 16th. For each specification a fee of 21s. is charged (not returnable).

HASLINGDEN.—The Board of Guardians have been unable to come to terms with Rawtenstall for the supply of electricity for lighting the workhouse, and have decided to seek the sanction of the Local Government Board to generate their own electricity for lighting and power purposes.

INDIA.—In connection with the conversion of the Nilgiri Mountain Railway, the electric lighting of several towns will be undertaken.

ITALY (BARI).—The capital of the Società Elettrica Barese has been increased from £40,000 to £160,000 with a view to establishing a tramway service not only in Bari, but also to Carbonara, a town of about 12,000 inhabitants, some two miles distant.

LONDON: *London County Council.*—Tenders are invited for low-tension cables, &c., also high and low tension switchgear and motor generators. Tenders by September 8th.

SALFORD.—The Electricity Committee invite tenders for the supply and delivery of lighting and power feeder and distributor pillars. Specification and form of tender may be obtained on application at the office of Mr. Victor A. H. M'Cowen, Borough Electrical Engineer, Frederick Road, Pendleton. Tenders to be sent to the Chairman of the Electricity Committee by noon, Monday, September 14th, 1908.

STOKE-UPON-TRENT.—Tenders are invited for the supply, delivery, and erection of a water-cooling apparatus. Particulars from Mr. P. J. S. Tiddeman, the Electrical Engineer (fee, £1, returnable), and tenders to the Chairman of the Electricity Committee by September 8th.

WREXHAM.—An application is to be made to the Local Government Board for sanction to borrow £3,000 for extensions by the electricity department.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations, and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Buildings, Byward Street. Builders, John Green, Ltd., 12–14 Arthur Street, West, London Bridge.

S.E.—Business premises, Dockhead. Builders, Todd & Newman, 1A Stannard Road, Dalston, N.E.

Repairs, &c. (£1,500), to Christ Church, Blackfriars. Rev. E. J. Baker.

S.W.—New bank, King's Road, Chelsea, for London & County Banking Co., Lombard Street, E.C.

W.—Buildings, Devonshire Street. Builders, J. Jarvis & Sons, 253–255 Hackney Road, N.E.

Re-building 50 Welbeck Street, for Dr. Jefferson Faulder, 58 New Cavendish Street, W.

PROVINCES.

ABERDEEN.—Residence. Architects, Sutherland & George, 40 Union Terrace, Aberdeen.

ALDERSHOT.—Offices for Ind. Coope & Co., brewers, &c., Aldersgate, E.C.

BANGOR.—The Cathedral is to be fitted for electric lighting.

BIRMINGHAM.—Additions, The Crown, Snow Hill, and alterations, Britannia Inn, Sherbourne Road, and Stag's Head, Brearley Street, for Mitchells & Butlers, Ltd., brewers, Birmingham.

New factory in Hill Street for Birmingham Printers, Ltd.

Business premises, Aston Broak Street, for the Pitman Health Food Co.

BECKENHAM.—Additions, &c., to private residence (£1,400). Architect, G. St. Pierre Harris, 8 Laurence Pountney Hill, E.C.

BRIDGWATER.—Alterations (£8,500) to Municipal Buildings. W. T. Baker, Town Clerk.

BRISTOL.—Addition to Mission Hall. Surveyor, H. C. H. Tarr, Oxford Chambers, St. Stephen's Street, Bristol.

Chapel at Stapleton Workhouse.

BURNLEY.—Roman Catholic Church (£4,000) in Ivy Street.

BURTON LATIMER.—Factory for Standard Boot Co.

COWES (Isle of Wight).—Two houses. Builders: G. Ball & Son, Victoria Road, Cowes (Isle of Wight).

CREWE.—Wesleyan Sunday School (£1,800). Architect, F. P. Halsall, Victoria Chambers, Chapel Street, Southport.

DARTFORD.—Municipal buildings (sites under consideration). W. Kay, Clerk, District Council.

DUBLIN.—The Sligo Leitrim Asylum is to be fitted for electric lighting. Particulars from Messrs. A. Scott & Son, 49 Upper Sackville Street, Dublin, and tenders by September 15th.

DUNDEE.—Houses. Surveyor, T. M. Cappon, 32 Bank Street, Dundee.

FELIXSTOWE.—Additions and alterations to Post Office. Builders, T. Ward & Sons, Cliff Works, Felixstowe.

GELLIGAER.—Hospital (£7,800). Builders, Vodden & Lee, Gilfach-Bargoed (South Wales).

GLASGOW.—Masonic Temple, Vulcan Street. Alexander Grant, 631 Alexandra Parade

HERNE BAY.—Residence, Oxenden Park. Achitect, J. Huxtable, Highgate House, Station Road, Herne Bay.

HUDDERSFIELD.—Additions to Watergate Brewery.

Thirty houses. Surveyor, J. H. Hanson, Market Green, Cottingham, Hull.

LLANDUDNO.—Carnegie Library. Architect, G. A. Humphreys, Mostyn Estate Office, Llandudno.

MANCHESTER.—Extension of Cheetham Baths. City Architect, Henry Price.

Diocesan Church House, &c. (£50,000). Architect, John Brooke, 18 Exchange Street, Manchester.

MOTHERWELL.—Council Chamber in Brandon Street for Dalziel Parish Council.

NOTTINGHAM.—Offices for Sun Fire Office.

Re-building at Northgate for Shipstone & Sons, Ltd.

SALFORD.—Addition to Town Hall. Architect, J. B. Broadbent, 15 Cooper Street, Manchester.

SKIPTON (Yorks.).—Extensions, &c., Moor View Baths. Council Surveyor, John Mallinson.

SOUTHEND.—Additions to laundry, Eastwood Road, for Albany Laundry Co.

STOCKTON BROOK.—Wesleyan Church. Architect, Wm. Campbell, 2 Bagnall Street, Hanley.

UXBRIDGE.—Offices and factory. Surveyors, Thomas & Thomas, 191 Edgware Road, Paddington.

New Post Office (£4,000). Builder, George Jaggard, New Bushey, Watford.

WELLS (Somerset).—Laundry buildings for Somerset and Bath Asylum (£5,500). Builders, H. W. Pollard & Son, Monmouth Street, Bridgwater.

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WEST HAM.—The Guardians invite tenders for supplies, including electrical fittings. Particulars from the Clerk, Union Road, Leytonstone, and tenders by September 17th.

WHITLEY BAY (Northumberland).—Pier, with pavilion, tea-rooms, &c. (£35,000). Architect, T. Brewer-Mather, Wallsend-on-Tyne.

WIGAN.—Four houses. Builder, A. Sharples, Essex Street, Wigan.

Additions to St. John's Parish Church, Dicconson Street. Rev. G. L. Carolan.

Additions, St. Catherine's Vicarage, Catherine Street. Rev. E. C. Poulter.

WIMBLEDON.—Six houses, Richmond Road. Surveyors, Daw, Seville & Co., 27 Chancery Lane, W.C.

Shops and flats, High Street, and residence, Clifton Road. Architects, Thomson & Pomeroy, 49 Hill Road, Wimbledon.

Residence and motor-house, Calonne Road. Surveyors, Boyton, Sons & Trevor, Wimbledon Park Station.

Eight Houses, Stuart Road, C. Barwell, The Elms, Morden.

Residence, Alan Road. Engineer, W. Allan Tanner, 16 Belvedere Gardens, Wimbledon.

Factory, Ashcombe Road. Estate Agent, L. S. Rogers, 86 Lancaster Road, West Norwood.

Residence, Murray Road. Architects, Niven & Wigglesworth, 104 High Holborn, W.C.

Extensions, Queen's Road Schools. Surveyor, Education Committe, Town Hall.

Miscellaneous

BEXLEY.—Tenders are invited for advertising on 12 double-deck cars. Particulars from Tramway Manager, Car Sheds, Bexley Heath.

BLACKPOOL.—The Tramway Committee invite tenders for 100 tons of steel rails, No. 4, B.S. section, 30 cwts. of fish-plates, 20 cwts. of tie-bars, and 300,000 hardwood paving blocks. Particulars from the Borough Engineer, and tenders by September 19th.

LEEDS.—The Tramways Committee is prepared to receive tenders for the disposal of 800 to 1,000 tons of old tramway rails. The rails are 7 in. by 7 in., and 95 lb. to 98 lb. per yard. Particulars from the General Manager.

MERTHYR TYDFIL.—Hills' Plymouth Co., Merthyr Tydfil, invite tenders for stores, including electrical appliances for the twelve months ending September 30th, 1909. Forms of tender may be obtained upon application in writing, enclosing stamped addressed foolscap envelope, and must be sent in not later than September 21st.

SOUTH AUSTRALIA.—Tenders are required by October 21st for power plant for charging accumulators for telegraph purposes at the General P.O., Adelaide.

SOUTHEND.—The Corporation contemplate the extension of the tramways from Leigh on to Hadleigh.

TASMANIA.—Tenders are required by the Postmaster-General's Department by November 2nd for material for accumulator equipment for telegraph purposes.

TURKEY.—H.M. Consul-General at Constantinople (Mr. H. C. A. Eyres) reports a call for tenders by the Turkish Ministry of Posts and Telegraphs for the supply of 1,360 insulators, and 15,000 Leclanché insulators. The date for the receipt of tenders is not given. Applicants should be ready to make a deposit of 10 per cent. or to produce an adequate guarantee legalised by the Constantinople Chamber of Commerce. British firms cannot hope to do business except through a local agent.

WESTERN AUSTRALIA.—Tenders are required by October 6th for the supply of telegraph and telephone material. Tenderers must state the country in which the articles tendered for have been made or produced, and in the case of manufactured articles where the material has been made or produced. Tenders must include Customs duty, if any. Copies of specifications, general conditions, and schedules of tender may be obtained at the General Post Office, Perth (where sealed patterns can be seen), and at the General Post Offices, Adelaide, Melbourne, Sydney, Brisbane, Hobart, and the Commonwealth Office, London.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Municipal Tramways Trust, Adelaide, has accepted the tender of Messrs. Noyes Bros., Prop., Ltd., on behalf of the British Westinghouse Co., for the supply, delivery, and erection of motor equipments and car wiring, the total amount of their contract being £12,242 14s. 2d.; also the tender of Messrs. Geo. Wills & Co., on behalf of the Australian General Electric Co., for the supply of certain spares, the total amount of this contract being £425.

BOLTON.—For the supply of cylinder oils, the tender of Messrs. Waring & Co., has been accepted.

BRIDLINGTON.—The Council has decided to insure two superheaters with the National Boiler & General Insurance Co., at an annual premium of £1 each.

COVENTRY.—A tender for the electric lighting of St. Michael's Church, has been accepted.

DENNY.—The following tenders have been received for cables in connection with the electric lighting scheme:—Lowdon Bros., £923; British Insulated & Helsby Cables Co. (accepted), £764; Johnson & Phillips, £851; Callenders' Cable & Construction Co., £835.

DUBLIN.—Thirty-four Tierney & Malone automatic point controllers are to be introduced in the Corporation's lines. Three of these automatic controllers have been in use for the past four months, with such good results that the Corporation has placed an order with Messrs. Brecknell, Munro & Rogers for the equipment of the system.

ECCLES.—The Electricity Committee have accepted the tender of Messrs. Ferranti, Ltd., for the supply and erection of a switch panel, and that of Messrs. John Spencer, Ltd. (Wednesbury), for circulating water piping at the electricity works.

GLASGOW.—Messrs. Johnson & Phillips, Ltd., have received an order (extension) from the Clyde Navigation, for Rothesay Dock for insulators.

HANLEY.—The tenders of the British Insulated & Helsby Cables, Ltd., for three-core low-tension distributing cable and high-tension feeder cable have been accepted at £257 and £18 respectively.

HULL.—The Electric Light Committee has accepted the tender of Messrs. Korting Bros., Ltd., for pipe-work, at £573.

LOCHGELLY.—The Lochgelly Iron & Coal Co., have placed an order with Messrs. Johnson & Phillips, for the supply and erection of shaft and in-bye cables for their Lochgelly pits.

LONDON.—The following tenders were received for the electric wiring of Messrs. Selfridge's new store in Oxford Street:—Malcolm & Allan, Glasgow (accepted), £5,261; G. Harland Bowden & Co., £5,620; Foote & Milne, £5,923; Lund Bros. & Co., £5,990; Tyler & Freeman, £6,466; Higgins & Griffiths, £6,478; Duncan, Watson, & Co., £6,874; Waring & Withers, £7,173; Electrical Co., £7,200; Edmundson's Electricity Corporation, £7,733; Blackburn, Starling, & Co., £8,074; Rawlings Bros., £8,681; Drake & Gorham, £8,706; Donnison, Sillem & Co., £8,800; Rashleigh Phipps & Co., £9,157; Belshaw & Co., £9,634.

MAIDSTONE.—A demi-car for working upon the Tovil route is to be purchased for £600.

MANCHESTER.—The Electricity Committee have placed with Veritys, Ltd., the order for ½, 2, 7, and 10-h.p. motors of the "Aston" interpole type, and for ½, 1, 2, 3, and 7-h.p. improved "Aston" starters, both contracts being for two years.

TADCASTER.—A tender by the Tadcaster Electricity Supply Co., to light the streets with 13 lamps, from September 1st, 1908, until April 30th, 1909, for £40, has been accepted.

TIVERTON.—The Bradninch Electric Light Co. have offered to light the village of Bradninch, in the Tiverton rural district, at £25 per annum.

WIGAN.—The Electricity Committee has accepted the tender of the Pemberton Colliery Co., Ltd., for the supply of 6,000 tons of Wigan slack at 7s. 6d. per ton.

WIMBLEDON.—The Electric Lighting Committee has accepted the following tenders:—For the supply of bricks required in connection with the foundations for the 1,000-kw. turbo-alternator now being constructed, Sussex Brick & Tile Co., Ltd, 9in. square, 32s. per 1,000, and 9-in. radiated bricks, at 48s. 6d. per 1,000; for the supply of steel girder work in connection with foundations, Dorman, Long & Co., £41 16s. 6d.

COMPANIES' MEETINGS AND REPORTS

BLACKPOOL & FLEETWOOD TRAMROAD CO.—The half-yearly meeting was held at Fleetwood on Thursday, when the report and accounts given in our issue for August 15th were adopted. The Chairman, Mr. G. Richardson, said that the present trade depression was showing itself in the current half-year's accounts, the receipts for the first six weeks being slightly lower than those for the corresponding period of last year.

DUMBARTON BURGH & COUNTY TRAMWAYS CO.—The report states that the accounts show a profit of £3,870. A dividend of 6 per cent. per annum is recommended upon the preference shares, carrying forward £1,730.

LAWES CHEMICAL MANURE CO.—At the annual meeting on Thursday, it was stated that electric motors have been installed at the works, power being obtained from the Barking Council on fairly advantageous terms. The motors were working well, and a saving had thus been effected. The cost had been charged to revenue since the motors took the place of machinery already in existence, and it was the policy of the company to replace and maintain machinery and plant out of revenue.

SALINAS OF MEXICO.—Speaking at the annual meeting of this company on Thursday, Col. G. E. Church, the chairman, said that their neighbours, the Benito Juarez Mining Co., are about to erect an electric power plant near the Salinas Railway station on ground which was rented to them for the purpose for a nominal consideration, but on condition that they furnish the company with electric power at cost price. This should be of much benefit, as their wood fuel was giving out, and the electric power will enable them to produce table salt cheaper.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wirebars, net. c.i.f. port of arrival, quoted on Tuesday night was £63 to £63 10s. per ton (last week £62 10s. to £63 per ton).

ARMORDUCT MANUFACTURING CO.—The annual Staff Outing of the company took place on Saturday, August 22nd. The London Staff, together with the Branch Managers, Agents, and friends, went up the river in the launch *Royal Thames*, from Molesey Lock to Windsor. The party returned after spending an hour in Windsor. The evening was spent at Tagg's Island Hotel.

BOILER AND STEAM PIPE COVERINGS.—Messrs. Conrad Lauer & Co. have started business as boiler and steam pipe coverers at 65 Euston Road, London, N.W. Mr. Conrad Lauer has been associated with Messrs. A. Haacke & Co., of Homerton, for the last 25 years. Mr. George Cross has also left the employment of Messrs. A. Haacke & Co., Ltd., Homerton, to join Messrs. Conrad Lauer & Co.

BROCKIE PELL ARC LAMP CO.—We are informed that the Brockie Pell Arc Lamp Co., who have recently moved their works to Wimbledon, S.W., have just executed a large order for workshop lighting in Lancashire, and are now engaged on an order for three hundred open type double carbon arc lamps for one of the leading railway companies.

ECCO BATTERY & ELECTRICAL CO.—Owing to the continual growth of this business, and to the necessity for being within easy reach of the City, a factory has been built and equipped at Invicta Works, Bow Common Lane, Bow, London, E.

ELECTRICAL APPARATUS IN TURKEY.—H.M. Consul at Smyrna states that electrical appliances which have hitherto been strictly excluded from Turkey, are now being gradually introduced.

ELECTRICAL MACHINERY MARKET IN SPAIN.—A consular report states that North of Spain buyers are so accustomed to deal with German and Swiss firms only in the electrical machinery trade that it is difficult to make them believe that similar goods are manufactured in the United Kingdom, and the only practical way for British firms to secure any share of this trade is to combine to open branches in Spain carrying representative stocks and with a staff of technical experts who can speak Spanish. The electrical machinery and motor trades in Spain possess considerable potentialities, but British industry must adopt aggressive tactics to derive advantage from them.

PLANT FOR SALE.—At the Victoria Pit, Heckmondwike, on Friday, September 18th, will be sold an electric winding plant specially designed and erected by Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne. The plant includes a four-pole 80-kw. dynamo, a 30-h.p. motor, together with switchboard, starting and reversing switches, &c. The auctioneers are Messrs. Hollis & Webb, 3 Park Place, Leeds.

SIMPLEX CONDUITS.—A new department has been opened at the Birmingham manufactory of Simplex Conduits, Ltd., for the exploitation of that firm's electrical signs. This part of their business has hitherto been carried out by sign-writers and sign-makers, whereas, strictly speaking, it comes within the scope of the electrical contractor. The company therefore propose to place the latter in a much more advantageous position in the future.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A general meeting of the Mevagissy Electric Lighting Co. will be held at the Town Hall, Mevagissy, Cornwall, on Friday October 2nd, at 3.30 p.m., to receive the liquidator's account of the winding-up.

At the Edinburgh Sheriff's Court last week the examination of J. A. Wilson, Electrical Engineer, of Kilmarnock, took place. The statement of affairs showed liabilities amounting to £2,450, and assets to £310. The debtor attributed a considerable portion of his losses to the fact that he had neglected his mill furnishing business in order to develop the electric lighting business, which had been a failure. The examination was concluded.

Creditors of the Commercial Electro-Chemical Analysis Co. are requested to send particulars of their claims to the liquidator, Mr. A. C. Roberts, 9 and 10 Pancras Lane, London, E.C., not later than September 30th.

Mr. Edgar Musgrave, of Craven Bank Chambers, Bradford, has been appointed trustee in the bankruptcy of W. T. Garnett, trading as W. T. Garnett's Cable Co., Barkerend Mills, Bradford.

DISSOLUTION OF PARTNERSHIP.—The partnership between William Rodger and Joseph Harris, carrying on business as consulting and electrical engineers, 10 Gardner Street, Glasgow, has been dissolved. Joseph Harris continues.

NEW PUBLICATION

"The Principles of Alternating Currents." By Edgar T. Larner. (London: Crosby Lockwood & Son.) 3s. 6d.

MISCELLANEOUS CITY NOTES

BRITISH INSULATED & HELSBY CABLES.—The transfer books will be closed from the 5th to the 12th inst., both days inclusive, for the preparation of warrants for dividend on the ordinary shares of this company. The warrants will be paid on the 16th inst.

CROSSLEY BROS.—Owing to depression in trade, and the unsettled outlook, the directors consider it undesirable to pay a higher dividend than 5 per cent. per annum for the half-year to June 30th.

DUMBARTON BURGH & COUNTY TRAMWAYS CO.—The result of the working of this company from February this year, when the lines were first put in operation, until July 31st, is that it has earned sufficient to pay its preference dividend and to carry forward £1,780.

GENERAL ELECTRIC CO. (RUSSIA).—The accounts for the past year show a net profit of 511,470 roubles, against 439,050 roubles for the previous year. A dividend of 4 per cent. is recommended, against 3 per cent. for the previous twelve months.

METROPOLITAN ELECTRIC TRAMWAYS.—The receipts from January 1st, 1908, to date amount to £194,500, an increase of £37,167 over those for the corresponding period of 1907.

MEXICAN LIGHT & POWER CO.—Some attention is being drawn to the merits of this company's stock, mainly by reason of a little squabble between a morning and a financial paper as to who first "discovered" this stock. It appears that since April 29th the company's common stock has risen 34½ points, and since August 8th the seven per cent. convertible cumulative preference stock has risen 4½ points.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—Warrants for interim dividend on the company's 7 per cent. cumulative preference shares for the half-year ended June 30th, 1908 (payable on August 31st), have been posted.

TYNESIDE TRAMWAYS CO.—The total receipts to date from the commencement of the current half-year amount to £3,615, against £3,937 for the corresponding period of last year.

NEW COMPANIES

G. DAVENPORT & CO.—This company was registered on August 19th, with a capital of £7,000 in £1 shares, to adopt an agreement with G. Davenport for the acquisition of the business carried on by him at 95 Clerkenwell Road, E.C., as "G. Davenport & Co.," and to carry on the business of manufacturers and importers of and agents for goods in connection with motors, motor-cars and carriages, and horological, mechanical, and electrical novelties, &c. The subscribers are G. Davenport and J. Davie. Private company. G. Davenport is governor director for life. Remuneration, £400 per annum when profits available for dividend are less than 10 per cent., and £500 per annum when more than 10 per cent. of such profits are available. Registered office: 95 Clerkenwell Road, E.C.

DYNAMO ELECTRIC CAR TRANSMISSION SYNDICATE.—This company has been registered with a capital of £2,000 in £1 shares, to adopt an agreement between F. Plutte and A. P. Wright on the one hand, and W. O. Clark on the other, for the purchase of certain patents, and to carry on the business indicated by the title. The first directors are A. P. Wright and A. F. H. Hotopf. Registered offices, 47 New Broad Street, London, E.C.

ELECTRIC LAUNDRY, DYEING & CLEANING WORKS.—This company was registered on August 20th, with a capital of £5,000 in £1 shares (3,500 6 per cent. cumulative preference), to acquire the business of a launderer, &c., carried on by C. J. Robbins at the Electric Laundry, Sydenham Road, West Hartlepool. The subscribers are C. J. Robbins and Miss L. J. Robbins. Private company. Table "A" mainly applies. Registered office: Sydenham Road, West Hartlepool.

LIND & CO.—This company was registered on August 21st with a capital of £5,000 in £1 shares, to acquire the business of an electrical manufacturers' agent, general electrician, and contractor carried on by A. L. Lind & G. St. J. Wood, at 37 Moorfields, Liverpool, as "Lind & Co." The subscribers include A. L. Lind, 5 Cecil Road, Prenton, Cheshire, electrical engineer, and G. St. J. Wood, 4 Buckingham Avenue, Claughton, Birkenhead, electrical engineer. Private company. The first directors are A. L. Lind, G. St. J. Wood, and J. G. Wilson. Registered office:—37 Moorfields, Liverpool.

COMPANY MORTGAGES

ACKROYD & BEST.—Particulars of £15,000 debentures created by resolution of March 3rd, 1904, and secured by a trust deed dated July 2nd, 1904 (supplemental to deeds of 1900 and 1903), have been filed pursuant to Section 10 (3) of the Companies Act, 1907, the amount of the present issue being £500. Property charged—the company's undertaking and property, present and future, including uncalled capital. Trustees—C. T. Naylor, of Alresford, Hants, and J. P. Humble, of Wortley, Leeds.

ALUMINIUM CORPORATION.—Memorandum of equitable charge, dated July 21st, 1908, to secure an unspecified amount

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(stamped to cover £10,000), has been registered. Property charged—Property at Dolgarrog, Carnarvon and Wallsend-on-Tyne, Northumberland. Holders—Lloyds Bank, Ltd., 72 Lombard Street, E.C.

BRITISH ALUMINIUM CO.—Trust deed, dated July 28th, 1908, to secure £1,000,000 debenture stock, has been registered. Property charged :—Certain freehold, leasehold, and other property, present or future, except uncalled capital. Trustees :—Trustees' Executors and Securities Insurance Corporation, Ltd., Winchester House, E.C.

CITY OF LONDON ELECTRIC LIGHTING CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—Trust deed dated February 26th, securing £400,000.

DURHAM COLLIERIES ELECTRIC POWER CO.—Amended return, filed August 10th, of a charge dated July 15th, 1908, states that the holders thereof are the Trustees Executors & Securities Insurance Corporation, Ltd., of Winchester House, E.C. The word "Securities" was omitted from the previous return, which read "Trustees and Executors Insurance Corporation, Ltd."

HORSFALL DESTRUCTOR CO.—A memorandum of satisfaction in full of debenture, dated April 22nd, 1908, securing £2,000 (by way of indemnity), has been filed.

P. & W. MacLELLAN.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—mortgage, dated February 22nd, 1900, securing £150,000 debentures.

OXFORD ELECTRIC CO.—A statement of the total amount outstanding on July 1st, in respect of mortgages and charges created prior to that date, and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—Trust deed, dated July 21st, 1897, securing £50,000.

PACIFIC & EUROPEAN TELEGRAPH CO.—A statement of the total amount outstanding on July 1st, in respect of mortgages and charges created prior to that date, and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars—Debentures, dated November 17th, 1892, securing £99,400 (£100,000 authorised).

SOUTH LONDON ELECTRIC SUPPLY CORPORATION.—Mortgage, dated February 5th, 1907, stamped to cover £80,000, was registered on August 1st, 1908, pursuant to order of Court. Property charged—Certain freehold hereditaments near Denmark Hill, and all purchase-money payable to mortgagors in the event of any sale or transfer of undertaking or part thereof. Holders—National Provincial Bank of England, Ltd., 112 Bishopsgate Street Within, E.C.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—The *Financial Times* contains the following particulars of a trust deed, dated July 30th, 1908, which has been registered by the Underground Electric Railways Co. of London. The deed is to secure (1) prior lien bonds not exceeding £1,000,000 (unless same be increased as provided in conditions endorsed thereon to £1,250,000); (2) 4½ per cent. bonds of 1933, securing not more than £3,000,000; and (3) 6 per cent. income bonds, securing not more than £5,200,000 (all created by resolution of July 30th, 1908). The property charged is (*a*) stocks and shares of various electric railway and tramway companies, amounting in all to £11,079,990 (known as the "appropriated assets"); (*b*) shares in three tube railways, amounting in all to £3,500,000; (*c*) freehold power-house and other buildings at Chelsea, with plant, &c., thereon, cable subway therefrom to near Earl's Court Station, &c.; and (*d*) rights under various contracts. The trustees are the London and Westminster Bank, Ltd., Lothbury, E.C. Commissions, discounts, &c. :—(*a*) For underwriting £1,000,000 prior lien bonds, £25,000, with ½ per cent. brokerage on nominal value; (*b*) for procuring or agreeing to procure subscriptions for said issue of £1,000,000 prior lien bonds, brokerage of ¼ per cent. on amounts allotted in response to such applications from shareholders and holders of profit-sharing secured notes as are handed in by brokers; (*c*) under the scheme of arrangement holders of the £7,000,000 profit-sharing secured notes exchange their notes as to 40 per cent. of their nominal value into 4½ per cent. bonds of 1933 at par, and as to 70 per cent. of their nominal value into 6 per cent. income bonds at par, the exchange taking place as from December 1st, 1907; (*d*) the company has agreed to sell 4½ per cent. bonds of 1933 and 6 per cent. income bonds at the rate of £300, and accrued interest on the 4½ per cent. bonds for £200 (nominal) of the 4½ per cent. bonds and £300 (nominal) of the income bonds (taken together); the total amount which may thus be sold is limited to £200,000 (nominal) of 4½ per cent. bonds of 1933 and £300,000 (nominal) of income bonds.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—A trust deed, August 4th, for securing a series of prior lien bonds not to exceed £1,000,000, together with the power to increase under certain conditions to £1,250,000; also to secure a series of four-and-a-half per cent. bonds (1933) not to exceed £3,000,000; and also to secure a series of six per cent. income bonds not to exceed £5,200,000, has been registered; trustee: London & Westminster Bank, Limited, Lothbury, E.C. (shares and stock, freehold land, buildings, and power-house situate at Lots Road, Chelsea, together with rights and interest of the company in specified contracts).

VENEZUELA TELEPHONE & ELECTRICAL APPLIANCES CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars :—Mortgages or charges, dated July 28th, 1890, and April 7th, 1893, securing £88,500.

WEST COAST OF AMERICA TELEGRAPH CO.—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under section 14 of the Companies Act, 1900, has been filed pursuant to section 12 of the Companies Act, 1907. Particulars :—£150,000 four per cent. debentures and £20,000 four per cent. income bonds, dated April 28th, 1897.

Telegraph Traffic and Movements of Cable Ships.—The Kwandang-Menado cable will no doubt soon be restored now that the cable-repairing steamer has got off the sandbank without suffering damage. The re-establishment of telegraphic communication with Venezuela may either be as far off as ever or nearer consummation, for the Venezuelan Courts have condemned the French Cable Co. owning the cables to pay a fine of $5,000,000, or £1,000,000, and possibly more, for having taken part in or assisted the Matos revolution. This may bring matters to a head, and, as the Dutch Government are preparing to take a stand against President Castro by reason of the prohibition of shipping between Curaçao and Venezuela, they will no doubt receive the moral support of other European nations. A new cable is being laid between Chafarinas, North Morocco, and Nemours, in Algeria, which will be employed for traffic passing between Spain and her African possessions. The German Government are making determined and successful efforts to free themselves from dependence on the telegraph lines of other countries, and are about to subsidise a cable direct from Emden to the island of Teneriffe, and thence to the German colonies in West Africa and South America. The company laying the cable is called the Deutsch Süd-amerikanische Telegraphengesellschaft, and was founded in Cologne by the same syndicate which founded the German Atlantic and other German submarine telegraph companies. It is an entirely independent company from the German Atlantic Co. The cable is being manufactured by the Norddeutsche Seekabelwerk in Nordenham a. d. Weser. The capital of the company is fixed for the present at £1,350,000. The cable between Cadiz and Teneriffe still remains down, as well as the cable between Las Palmas and Arecife. The Port Arthur-Chefoo cable still remains closed to service, and has been in this condition since March 9th, 1904. The cable between Kotonow and Lagos, which was only recently repaired, is again in trouble, having ceased working on 29th ulto. Communication between Bagdad and Bassorah was down on 29th ult., while the cable between Paramaribo and Cayenne, French Guiana, stopped service on August 31st.

Wireless Telegraphy.—It is stated in a British Consular Report that the Marconi station at San Cataldo is still doing service, but is little used for commercial purposes, trade with Montenegro not being important. In a report from the Consul-General in Mexico, it is mentioned that the new wireless telegraphic station between San José del Cabo and Mazatlan will be working very shortly, thus connecting La Paz with the rest of the world, and greatly facilitating all business operations.

According to the daily papers, passengers by the Dover-Ostend mail steamer may now send wireless telegrams at the rate of three half-pence a word for the first ten words, and a penny for each subsequent word.

A correspondent of *The Times*, quoting from an article in the *Dresdener Nachrichten*, with reference to the recent experiments with wireless telegraphy and army balloons, writes that experiments carried out in Germany have shown that an insulating appliance can be fitted, by which means the danger of explosion is, if not entirely excluded, at least reduced to a minimum. The fact has been established, moreover, that messages can be transmitted from balloons even though earth connection is absent. The experiments made in conjunction with the wireless station at Nauen were eminently satisfactory, and they are being continued. On the whole, the results achieved may be described as exceptionally favourable.

A note in a recent issue of the *Yorkshire Post* states that Dr. Polis, Director of the Meteorological Observatory at Aix-la-Chapelle, is continuing his experiments in transmitting meteorological observations at sea between New York and England by means of wireless telegraphy. Dr. Polis, it is said, has succeeded in receiving weather reports from America at a distance of eight hundred nautical miles from the American coast, while reports from Europe were actually picked up at a distance of twelve hundred nautical miles from the English coast.

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ELECTRICAL ENGINEERING

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SUMMARY

THE coroner's inquest concerning the airship explosion at the Franco-British Exhibition was concluded on Monday. From the evidence it appears that the explosion was due to a mixture of hydrogen and air, near the mouth of the gas bag, being ignited from a spark on the switch of a fan which was being used to drive some air into the balloon, in order to make up for some of the hydrogen which had escaped. (Page 381.)

THE first section of the Haslingden Corporation tramway system, which consists of about a mile and a half of single track extending from Haslingden to Accrington, was opened on Saturday last. The overhead work has been carried out on the Pringle "tangential" system. Both cars and current are being supplied at 7d. per car mile by the Accrington Corporation pending the installation of the steam generating set at the Haslingden refuse destructor station. The rails are welded by the Thermit process. An innovation in the way of provision for ventilation of the tramway poles has been introduced. (Page 381.)

A NEW type of single-phase motor, the invention of Mr. H. C. E. JACOBY, has just been put on the market. A special winding is employed to reduce commutation difficulties to a minimum. Although the motor has normally a series characteristic, it is claimed that the effect of a shunt characteristic can be obtained by shifting the brushes automatically by means of a centrifugal governor. For variable speed driving it is arranged that the brush-gear can be rotated by hand. We are informed that the motor develops a starting torque of over twice the normal full load value, and runs sparklessly at all speeds. In the construction of the automatic governing arrangement, use is made of the fact that the brushes tend to rotate with the commutator, and at normal speed the governor just balances this tendency. (Page 383.)

WE have received some further information from Dr. LEE DE FOREST with regard to the wireless telephone station which will be erected shortly in New York. It is hoped that the new station will be in operation by November 1st, and that before two years have elapsed, a wireless telegraph service between New York and Paris will have been established. Dr. DE FOREST does not expect to realise wireless telephonic communication between New York and Paris for five years or more. (Page 384.)

ON Thursday Mr. DUGALD CLERK delivered the Presidential Address to the Engineering Section of the British Association for the Advancement of Science, in Dublin, and dealt with the history and evolution of the study of thermo-dynamics, showing how, although large numbers of economical engines were certainly

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constructed fifty years ago, the appreciation of the true theory of thermo-dynamics was much more recent.

Mr. GERALD STONEY contributed a Paper on Recent Advances in Steam Turbines, dealing also with the electrical generators coupled to them. He had found that compensating winding gave better commutation either than auxiliary poles or commutating poles and compensating winding combined. This winding is generally concentrated on the pole-pieces, and, he said, is given 2 to 2½ times the ampere-turns of the armature. In the case of alternators, the staying of the end windings had been receiving much atention during late years, to prevent breakdowns in the event of short circuits. For the design of the rotor he preferred salient poles to the barrel type. Referring to the importance of a high vacuum, Mr. Stoney said that 1 in. of vacuum is equivalent to 4 to 5 per cent. of the steam consumption. Reference was also made to the Parsons and Law method of compounding alternators.

A report by the Electrical Standards Committee was submitted, giving particulars of tests made to ascertain the secular changes in mercury and wire standards at the National Physical Laboratory, and containing also specifications for the international ohm and ampere, and the preparation of the Weston cadmium cell to serve as a basis for discussion at the International Congress to be held next month. In the Physical Section on Friday, the subject of absorbing interest was the radio-active elements, particularly a discussion on SIR WILLIAM RAMSAY'S question, "Do the radio-active gases (emanations) belong to the Argon series?" and a Paper by SIR JAMES DEWAR, to which we shall refer in our next issue, on measurements of the amount of helium evolved from radium.

On Monday three Papers were discussed simultaneously in the Engineering Section. Capt. H. R. SANKEY described the scheme for the utilisation of peat in Ireland, not only for making charcoal and recovering sulphate of ammonia and other bye-products, but also for making gas. Mr. CROSSLEY and Mr. RIGBY, of Crossley Bros., who have the contract for the gas engine plant in connection with this scheme, contributed to the discussion, commenting also on certain points in the other two Papers. These Papers were on producer gas, by Mr. J. E. DOWSON, and on suction gas plant by Mr. P. W. ROBSON. Mr. Dowson compared the relative advantages and applications of pressure gas plant and suction plant. The suction plant costs less and occupies less ground-space, but the gas is not so strong as in the older form of pressure plant. The fuel and water consumption and the labour are, according to Mr. Dowson, the same in both cases. Mr. Robson's Paper put forward figures and arguments with a view to proving the superiority of suction gas plants to electric power. He outlined the principal upon which these plants work, referred to the difficulty experienced owing to the formation of tar in the pipes and passages when bituminous fuels are used, and suggested a method of eliminating this evil upon which experiments are now being made. Mr. Crossley and Mr. Rigby both said that their firm's fan separator was quite sufficient to eliminate this trouble without seeking for other methods.—Prof. ERNEST WILSON described some observations he had made with light aluminium alloys which showed in some cases a considerable falling off in conductivity with age. (Pages 385-397.)

THE Manufacturers' Association of Great Britain has been successful in securing several important reductions in the import tariffs upon electrical machinery into Australia. A 25 per cent. duty upon dynamo electric machines up to the capacity of 200 h.p., static transformers and induction coils, and electric fans, has been reduced to 20 per cent.; whilst electric fittings are to be admitted free, instead of under a duty of 20 per cent. (Page 397.)

A SINGLE-PHASE lift motor with some interesting features has been brought out recently by an American firm. The motor is a commutator motor working on the repulsion principle, and provided with a device, operated by centrifugal action, to short-circuit the armature when the latter has attained the synchronous speed. The starting torque of the motor is about 400 per cent. of the normal full load torque, and is obtained with about 200 per cent. of full load current. (Page 398.)

UNDER ELECTROMETALLURGY AND ELECTROCHEMISTRY we describe a new type of primary cell. The negative element consists of a number of carbon rods surrounded with an acid solution of lead tetrachloride; the positive element is an amalgamated zinc cylinder which is contained in a porous cell filled with dilute hydrochloric acid or ammonium chloride. The cell resembles the Daniell cell, in that depolarisation is rapid; but it has an E.M.F. of about the same as the Leclanché, and a lower resistance. (Page 399.)

THE output of the Aberdeen electricity undertaking for the year ended July 21st showed an increase of 309,529 units over the preceding year. Owing to the increase in the cost of coal an extra sum of £2,270 is shown in the fuel item.—For the year ended March 31st, 1908, the accounts of the Barrow-in-Furness electricity undertaking show a deficit of £791, after meeting capital charges.—A surcharge has been made in connection with the expenses of the Belfast representatives to the annual convention of the Incorporated Municipal Electrical Association.—Successful experiments have been carried out by the Birmingham Corporation with the Maley electromagnetic track brake; in one of the experiments a car was allowed to run backwards down a hill, and was pulled up without difficulty by the brake.—The accounts of the Bradford tramways department show a balance of £17,238 after meeting capital charges. The whole of this has been carried to the reserve and renewals accounts.—The jolting of the tramcars in Burslem was said, at a Council meeting, to cause pictures to fall from the walls of houses along the route; no information was given as to the nature of the walls or how they were plugged.—An agreement has been drawn up between the Felixstowe Council and the Suffolk Electricity Supply Co. for the purchase of the company's undertaking at £8,000.—A suggestion that trolley omnibuses should be used in Hastings is to receive consideration.—For the 35 weeks from January 1st to August 29th, the receipts of the Liverpool tramways show a falling off of several thousand pounds, and the passengers carried by nearly two millions.—It is understood that the deputation of the Manchester Tramways Committee which recently visited the Continent, will recommend the adoption of trolley omnibuses in certain suburbs. (Page 403.)

THE Accrington Council has received sanction to a loan of £7,500. A suction gas plant is to be installed at Clacton, and a 1,000-kw. steam turbo-generating set at Johannesburg. Extensions of plant are also to be carried out at Cheltenham and Colchester. (Page 406.)

THE accounts of the Yorkshire Electric Power Co. for the June half-year show a net profit of £363 after payment of mortgage interest. There was a loss of £139 in the corresponding period of last year. At the meeting of the Sheffield Gas Co. some comparisons were made between the amount of rates paid by the municipal trading departments and the company in relation to the capital and profits. It was urged that either the gas company was paying too much, or the municipal departments far too little. A dividend of 8 per cent. per annum, for the June half-year is announced upon the ordinary shares of the British Insulated & Helsby Cables Co. An amalgamation is announced between the Mexican Light & Power Co. and the Mexican Tramways Co. (Page 408.)

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A NEW arrangement of boosters and balancers is suggested by Messrs. W. FENNELL and W. P. PERRY for improving the pressure regulation on continuous-current three-wire systems. (Page 411.)

FROM among the Patent Specifications published on Thursday last, the following have been selected and are abstracted in this issue: A system of speed control for marine propulsion with alternating current motors, by H. A. MAVOR and W. B. HIRD; improvements in an automatic telephone exchange, by SIEMENS BROS. & Co.; a method of manufacturing the active plates of alkaline accumulators, by W. FENNELL and W. P. PERRY; an arrangement for automatically isolating a section of an alternating-current distribution system, when a fault develops in that section, by the BRITISH THOMSON-HOUSTON Co.; a resilient glass support for metal filaments, by T. W. LOWDEN; an improvement in the design of single-phase commutator motors whereby certain of the interpoles or auxiliary windings are omitted, by the ALLGEMEINE ELEKTRICITÄTS GES.; a method of preventing the operation of the contactors in a multiple unit control system from being influenced by variations of the line pressure, by the BRITISH THOMSON-HOUSTON Co.; an electromagnetic device for limiting the speed of series motors, by the ALLGEMEINE ELEKTRICITÄTS GES.; the design of small transformers for metal filament lamps, by H. W. TURNER; lead fuses containing an arc-extinguishing composition, by F. POOLEY and W. R. MACDONALD; and a multiple-circuit wave winding for single-phase commutator motors, enabling more than two sets of brushes to be employed, by the BRITISH THOMSON-HOUSTON Co. The only patent of electrical interest which expires during the current week is one by F. H. W. HIGGINS for a non-resonant telephone receiver, a special construction of the diaphragm, and a means of ventilating call-boxes. (Pages 411 and 412.)

RIGID rules are enforced with regard to the use of electricity in mines, and these are supplemented by regular inspections by officials of the Home Office, who possess very definite technical knowledge. In positions where gas might be expected, motors must have their current-carrying parts, starters, and terminals completely enclosed in flame-tight cases, and the same applies to fuses and switches. It is interesting to contrast this with the state of affairs which obtained in the tent at the Franco-British Exhibition, where a gas-bag containing nearly 10,000 cubic feet of hydrogen was stored. In this tent no exceptional precautions seem to have been taken with regard to the wiring, except the insertion of some so-called "safety" plugs, which in all probability rather add to the risk than diminish it. But a graver offence still against the interests of public safety was one which caused the unfortunate disaster resulting in the deaths of three people, and injuries to others, and might very well have resulted in a regular catastrophe involving the fate of a large portion of the Exhibition and the public who were visiting it. An ordinary fan motor was used to force air into the gas bag of the balloon to take the place of some of the hydrogen which had escaped by leakage. Although it appears that this fan was an alternating-current one, and that, therefore, there was no commutator at which sparking could occur, at the base of the fan was a lever switch of the usual type, the handle of which passed through an open slot. Those who have used these fans know well the bright spark which occurs on switching off, which is quite visible through the opening in the base. There can be little doubt that the explosion was occasioned by the attendant who was using this fan switching off when the pressure in the balloon equalised the upward pressure caused by the fan, and the gas started diffusing into the tent. We trust that some vigorous action will be taken by the authorities to fix the blame for this occurrence on those who are really responsible for allowing such dangerous proceedings to be carried out in the centre of an Exhibition in London. It is no excuse to say that the owner of the balloon or his assistants were ignorant of the danger, as was evidently the case. It should have been somebody's duty to have ascertained that these men were ignorant before permission was given to them to handle a large balloon in such a position. We trust that the matter will not rest as it stands with the mild verdict of the coroner's jury, but that definite action will be taken in the interests of public safety.

IN an article on page 367 of last week's issue we described some experiments connected with the so-called overshooting of tungsten filament lamps. The difference between the behaviour of the metal and the carbon filament lamp was there attributed by the experimenters to the fact that, whereas the resistance of the metal filament increases with increasing temperature, the resistance of the carbon filament decreases. In an editorial note the *Electrical World* points out, however, that this fact by itself is not sufficient to explain all the phenomena noticed. The overshooting of current is only what might be expected, and exists in all metal filament lamps; but the overshooting in candle-power is more difficult to explain. There are two theories, our contemporary says, that naturally suggest themselves, and it is rightly pointed out that one of these is hardly tenable. The more probable explanation of the two that are advanced is that the cold tungsten filament absorbs and occludes certain gaseous substances from the low-pressure space within the chamber; that by virtue of the presence of these gases the filament shines more brightly when first brought suddenly to incandescence, but that after the gases have been driven off by heat, the extra luminescence is lost, and can only be regained after prolonged cooling and rest. The other theory is that the increase of resistance accompanying rise of temperature takes a certain small interval of time to be established, so that when the temperature is rising at the rate of tens of thousands of degrees per second, the resistance lags appreciably. The resistance does not shut off the current as promptly as it should, and an extra rush of current and heat energy gets through the filament, bringing the temperature higher than normal, with a corresponding increase in brilliancy. According to the experiments which were described in the article, the overshooting of current took place without any increase in candle-power when the filament was warm, and if this was the case, the second of the two theories cannot be the correct one. The matter is of more than purely scientific interest. We believe that it is already recognised that practically all makes of metal filament lamp have a shorter life if they are frequently switched on and off than if they are continuously burning. This is probably due, at any rate in part, to this "overshooting," and any researches that help to explain the cause of this phenomenon and to bring us nearer to a remedy are welcome.

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IT appears that at any rate the commercial element of the electrical engineering industry is not strongly represented in Dublin at the British Association meeting. In this there is no great departure from the general rule, but the gas engineers have put in a strong appearance, attracted by the fact that Mr. Dugald Clerk, who has made the study of gas engines particularly his own, is president of the Engineering Section. Mr. P. W. Robson's Paper on suction gas plant is conceived in a truly commercial spirit, and his case for suction gas as against electric power is exceedingly ably put. Electrical engineers have frequently presented an equally strong case against it, and it is to be regretted that their side was not represented in any way in Dublin. There is little need to prompt our readers with the proper answers to Mr. Robson—a few instances of suction plants being replaced by electric motors after a short trial will probably go as far as sheets of figures, and although this line of argument may not be so strictly logical, it will carry conviction as easily as Mr. Robson's bald extract from the report of Mr. MICHAEL LONGRIDGE, Chief Engineer to the British Engine, Boiler & Electrical Insurance Co. To quote simply the percentage of gas engine breakdowns as compared with the motor breakdowns without giving particulars of the numbers incurred, the conditions of the two policies, or the cost of the repairs should not carry conviction to many. Similarly the figures in Mr. Robson's table apparently take no account of works load factor, losses in shafting and belting, and other matters which are of considerable importance in considering the problem. Moreover, two of the three cases for which he gives figures are quite possibly instances, from their nature particularly adapted to independent plant. In the third case the charge of £12 10s. per annum for "attendance, &c.," on any gas plant, however small, is exceptionally low, and an increase of a few pounds in this would clearly give the benefit to the electric motor. We have, however, already been tempted to depart too far from our intention not to discuss these details, and will leave our readers to pick further holes in Mr. Robson's argument. At the same time, they will be grateful to him for a particularly clear and well-written Paper on suction gas plant, which will be read with no little benefit to those connected with a kindred industry.

ALTHOUGH there are now several large ocean-going liners and warships fitted with steam turbines in place of the highly-developed marine reciprocating engines, it is well recognised that two of the chief advantages which are gained under other conditions by the substitution of steam turbines for reciprocating engines, namely, low steam consumption, and low weight per horse-power developed, are not so apparent in marine work, owing to the necessity of using slow speed turbines. As was mentioned at the British Association meeting last week, for large powers, and to obtain a high propeller efficiency, it is essential that the propellers should be large in diameter, and should rotate at a comparatively slow speed. On the other hand, as is well known, the lowest steam consumption and weight per horse-power developed are obtained with very high-speed turbines. It has thus been necessary to make a compromise between these two extremes and thus sacrifice economy in both generation and propulsion. It was realised at an early date that one solution of the problem would be to run both turbines and propellers at their most economical speeds, and connect them electrically. Various methods of carrying this out have been proposed, and for descriptions of some of these we refer our readers to the paper read by Mr. H. A. MAVOR before the Institution of Engineers and Shipbuilders in Scotland, of which we gave an abstract in our issue of March 12th last, and also to the Paper by Mr. W. P. DURTNALL, which was given in an abbreviated form in our issue of July 23rd. In both of these Papers it was pointed out that continuous current motors of such large powers as would be required for marine propulsion were hardly practicable machines, and that therefore polyphase motors would have to be used. The same can be said as regards the generators, as it is well known that high-speed turbo-alternators are more satisfactory in every way than high-speed continuous-current turbo-generators. With ordinary polyphase motors, the difficulty of reversing which is one of the most important in direct driving with turbines, is at once eliminated; but the other difficulty, that of running efficiently at speeds lower than the normal, remains. When going in and out of harbour, running in foggy weather, and in the case of warships when manœuvring, it is essential, moreover, that the ship should be capable of running efficiently at one or more speeds considerably below the normal; and as the ordinary polyphase synchronous motor can only run efficiently at one speed, some method of varying the speed must be devised. The motors with double stator windings for producing two different numbers of effective poles are expensive, and only give two speeds. In a patent specification abstracted in our issue of August 20th, Mr. H. A. Mavor described his type of polyphase induction motor with rotating "stator" which has proved of considerable use in other directions than marine work; and again in our issue of August 27th another patent specification by Mr. Mavor for a system of marine propulsion with variable-frequency constant-speed turbo-generators was abstracted. In this system special generators, with means for revolving the armature winding concentrically round the rotor field winding, were proposed. A still further method for producing variable propeller speed with constant speed generators is described by Mr. Mavor and Mr. W. B. Hird in a patent specification published last Thursday and abstracted in our Patent Record on page 411 of this issue. This method consists in having three or four turbo-alternators generating at different frequencies and a corresponding number of motors on the same shaft, with different numbers of poles. By suitable grouping the motors can be rotated at the same speed, or two can be supplied at such a frequency that they run at a higher or at a lower speed than the normal. It is contended that the saving in weight of boilers, coal, and other items of the steam equipment owing to the lower steam consumption to be obtained with high speed turbines, and the elimination of the reversing turbine, will more than compensate for the extra weight of the electrical equipment and the inevitable losses in the generators and motors; but of course in the case of a radical departure such as this, each inventor is an ardent enthusiast, and, needless to say, much more work will be necessary before an entire revolution in marine propulsion is imminent. The problem is, however, a fascinating one, and does not lack elements of considerable promise.

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THE AIRSHIP EXPLOSION AT THE FRANCO-BRITISH EXHIBITION

THE evidence and verdict at the adjourned Coroner's inquest on Monday into the deplorable airship accident at the Franco-British Exhibition on August 14th has elicited the fact that the gas was ignited by a spark from the switch at the base of an electric fan which was being used to pump air into the balloon to replace some of the hydrogen which had been lost through leakage. It will be remembered that the explosion and fire took place in a tent containing an airship, belonging to a Mr. Lovelace, by which three persons lost their lives, and a number of others were very seriously injured.

The following account of the facts of the case and the conditions obtaining on the day of the accident has been compiled from the evidence at the inquiry and interviews with one or two of those prominently identified with the case.

It appears that Mr. Lovelace rented a space from the Franco-British Exhibition authorities which he termed somewhat euphemistically an "aeronautical concourse." Upon this were built a number of tents, one containing an airship, capable of holding 10,000 cubic feet of gas. In another tent, some distance away, was the hydrogen gas generating plant, whilst upon the ground were also a number of captive balloons. The airship tent was 120 ft. long, 45 ft. wide, and 37 ft. high, and the gas bag of the airship was 75 ft. long by 16 ft. diameter. The tent was open at both ends, and, in addition, there were two openings on each side. The envelope of the airship was constructed of silk, covered with varnish, over which a coating of aluminium composition had been spread.

The tent was lighted with electricity by means of "Fairyland" strip, and 75 to 100 lamps were in use. The system is that used for the decorative scheme of lighting all the buildings of the exhibition. In this a form of metal-backed strip is made use of; the lamp-holders are of the central pin and screw terminal type, and there is a packing ring by which an absolutely water-tight joint is maintained. We described and illustrated the system in connection with our articles upon the Franco-British Exhibition (ELECTRICAL ENGINEERING, July 2nd, p. 27). The lighting strip in the present instance was suspended every nine inches from No. 12 gauge galvanized wire, and was taped at the points of suspension to prevent the wire from cutting it. Another feature in the electric lighting was the provision, at the request of Mr. Lovelace, of "safety" plugs, in addition to the ordinary fuses. These are ordinary plugs, so arranged between the wiring that any extension of the distance between the vertical poles of the tent pulls them out and cuts off the current. This device, which is used extensively in America for circuses, has the double virtue for such cases that in the event, for instance, of a tent being blown down, it prevents persons receiving shocks and also obviates fire. In a tent containing a bag of hydrogen gas, on the other hand, its employment is a questionable advantage, for on the tent blowing down, some gas would in all probability escape, and a spark due to the plugs pulling out might conceivably occur simultaneously and ignite the gas.

It may be stated, however, at the outset, that this device was not the cause of the present fire, for which, in fact, the lighting arrangements were in no way responsible. The installation had been inspected and passed on behalf of the electrical and mechanical engineer to the London County Council Fire Brigade.

Later there was introduced an electric fan, mainly for ventilating purposes, but, as has been mentioned, it was used for another and most unusual purpose subsequently. This fan was an alternating current fan of the pedestal type, commonly seen in offices, and was worked by plugging into a lamp socket; the usual switch was situated in the base of the fan, and, of course, sparking would occur at this switch when it was switched off.

These, then, were the conditions on the morning of August 14th. It seems to be accepted by aeronauts, according to Mr. Lovelace, that the envelopes of their airships are never absolutely gas-tight, and so it was that various rents and "pin holes" were being mended, although, generally speaking, the condition of the bag was regarded as satisfactory. Whilst these holes were being mended with stitches and patches stuck on with rubber solution, instructions were given to blow the bag tight by pumping in air. This was accomplished by holding the neck of the envelope over the wire frame of the electric fan, a man holding the two in position between his legs, whilst sitting on the floor. It is well known that hydrogen and air in the proportions of 6 to 1 form a highly explosive mixture, but Mr. Lovelace contended that, whereas only about 500 to 800 cub. ft. of air would be put into the envelope, the 9,000 to 9,500 cub. ft. of hydrogen which the bag contained would remain at the top, and in proof of his argument mentioned that he had actually worked with his head inside the lower portion of an airship envelope in which the air was at the bottom and the hydrogen at the top, and thus there was no diffusion of the gas into the air.

There was some conflict of evidence as to the exact length of time the fan was actually working, and the man who carried out this operation has subsequently died in hospital as a result of his injuries. Mr. Lovelace said that he himself found the motor not working, and tied up the neck of the envelope. His chief assistant asserted that he had taken the motor away from the man who was working, with instructions that sufficient air had been pumped in, a view which was not shared by the man in question, and who was subsequently heard to say that he would put a little more air in. The man also stated in hospital that the motor was working right up to the time of the accident. A theory held by several, therefore, is that after the motor was actually seen not working by Mr. Lovelace and his chief assistant, some ten minutes before the accident, the man in charge of it did commence pumping more air in, and that this accounted for several other witnesses swearing that the motor was heard humming within a minute or so of the explosion. Accepting this possibility, the Coroner suggested that what had happened was that, as the air continued to be pumped in, the pressure of the incoming air began to be neutralised by the pressure of the gas inside, and that a point of equilibrium was reached which resulted in the mixture of gas and air finding its way back and entering the partially enclosed motor, a small spark from which caused a circumscribed explosion, followed by the fire. This theory was, more or less guardedly, supported by Mr. Eustace Ridley, the electrical and mechanical engineer to the London County Council Fire Brigade, and Mr. Frank Converse, the electrical engineer to the Franco-British Exhibition. Of course, the alternating current induction motor used for the purpose would have had no commutator, and what probably occurred is that the man, finding the balloon full and the gas coming out, switched off the motor, and that the spark at the switch ignited the gas. It was stated that the man who had charge of the motor and who had been seen sitting on the ground, was badly burned about the legs, and had said in the infirmary, before he died, that burning gas seemed to come down the neck of the envelope, which he was holding.

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Whilst putting forward no direct theory as to the cause of the fire, Mr. Lovelace's legal representative made several suggestions as to a possible cause. He tried hard to demonstrate that a celluloid or xylonite comb, which Miss Hill—Mr. Lovelace's secretary, who was burned to death—had in her hair, had been set on fire by sun rays coming through holes in the tent where the poles entered, and also that static electricity had been generated at some point in the envelope where there was a pin-hole leakage; on the latter point, Mr. Ridley and Mr. Converse quickly mentioned that the metallic nature of the covering of the envelope would dissipate it at once. An attempt was also made by the lawyer representing the widow of the deceased, to fasten upon the electric lighting installation as the cause of the accident, but in this case an inspection had shown that, although the wires were burned by the fire, none of the fuses had blown, and the collapse of the tent, which will have withdrawn the "safety" plugs naturally occurred after and not before the explosion. Any question of smoking in the tent or smouldering cotton waste was quickly negatived by every witness. Nothing, moreover, can be traced to the gas plant, as this was out of commission at the time of the accident.

Two other facts with regard to the motor came out at the inquiry. One was that none of the witnesses could remember seeing it spark at any time, and the other that Mr. Lovelace's chief assistant had never seen an electric motor used for pumping air into an airship before, and that it was a responsibility which he himself would not have undertaken. Some suggestion of blame attaching to the London County Council was made by a juror of having passed an installation of such a dangerous character as this, and in reply it was stated that the L.C.C. merely inspected the arrangements from the point of view of the safety of the public, and at a time when the airship was fully inflated and floating close to the roof of the tent. No pumping with the electric fan was then taking place, nor did it ever take place whilst the public were viewing the airship. What Mr. Lovelace chose to do at a time when the public were excluded from the show ground, said the L.C.C. representative, did not come within the purview of the County Council.

In the end, the jury's verdict was that the deceased met their deaths from burns by the explosion of the airship, caused by using an electric fan for forcing air into the ship, and the use of which, in the circumstances, they considered dangerous. With the characteristic indulgence of a coroner's jury they attached no blame to anyone.

HASLINGDEN CORPORATION TRAMWAYS

ON Thursday last Major Druett, for the Board of Trade, made an official inspection of the first portion of the reconstructed Haslingden tramway system, accompanied by the Mayor and Corporation, the Town Clerk, the Surveyor, and the Consulting Engineers; the line was opened for traffic on Saturday. As mentioned in our issue of last week, the Accrington Corporation has agreed to supply cars and also current for this section of the line for a period of nine months, for which the Haslingden Corporation pays 7d. per car mile. The section of the line already completed is that connecting Haslingden with Accrington, and is about half the length of the whole line, which connects Accrington, Haslingden, and Rawtenstall, and is nearly three miles long.

It will be remembered that the original scheme for the supply of electric light and power to the three towns, Bacup, Haslingden, and Rawtenstall, from the Lancashire Power Co.'s mains fell through, and that Rawtenstall then erected its own generating station for its own lighting supply and for that of Bacup.

On account of the distance between Rawtenstall and Haslingden, and the small demand for electric light in the latter town, the Corporation was recommended by its consulting engineers, Messrs. Handcock & Dykes, neither to buy electrical energy in bulk from Rawtenstall, nor to erect their own station for the present. A large refuse destructor is now under construction in Haslingden, however, and as a boiler is a necessary item of such a plant, it has been decided to instal a 60-kw. steam generating set in the destructor station, and supply power for the tramways from that.

Another 60-kw. gas- or oil-engine set will be used as a standby, and the usual battery and booster equipment will be installed. An application has been made to the B.O.T. for sanction to raise a loan of £7,200 for this purpose.

The destructor is very favourably situated in the centre of the tramway system, and there are no return feeders. The single main feeder pillar is only a few yards from the station, and is connected with the latter by a 0·2 sq. in. Callender bitumen cable. The rails are connected to the station also at this point only. There are seven Callender section pillars, and telephonic communication between any pillar and either the generating station or the car depôt is provided.

The whole of the line is single-track with turn-outs at frequent intervals. The overhead equipment has been carried out by Messrs. Dick, Kerr & Co., Ltd., to the specifications of Messrs. Handcock & Dykes, and is on the Pringle tangential system (*see* ELECTRICAL ENGINEERING, Vol. III., page 46).

There are only one or two span wires on the system, side brackets with 15-ft. arms being mostly used. The trolley wire is No. 0,000 round wire, and is soldered to the ears. The two trolley wires are spaced two feet apart. Section insulators of the Pringle type are used. Except for a short length between the main feeder pillar and the station, the pilot wires are carried overhead.

The construction of the track was carried out by Mr. J. Singleton Green, the Borough Surveyor, to Messrs. Handcock & Dykes' specification. This consists of 95-lb. rails laid on a cement concrete bed, with granite setts between the rails, and extending to 18 in. on either side of the rails. Anchor rails were fitted every 14 feet, and also on either side of every joint at a distance of 2 ft. 6 in. These were constructed out of the old rails used for the original steam trams. The joints are all welded by the Thermit process. The rails are cross connected every 60 yards. The tie bars are spaced a little over six feet apart.

The cars for the system will be double-deck cars, but they will not be ordered until it is quite certain how many will be required. If the Rawtenstall and Accrington Corporation cars run through in both directions there will be only the local service for the Haslingden cars to do. Until arrangements have been made with regard to this matter, the number of cars required cannot be estimated.

An innovation in the construction of the tramway poles is the provision of ventilating holes in both the pole itself and the base. Four ¾-in. holes are provided at the top of the pole, and four at the bottom, while the base has six holes at top and bottom. By this means a thorough ventilation of the interior of the pole is ensured, and "sweating" is avoided. The concrete at the base of the pole is also carried up a few inches above the ground level, inside the base, to keep the pole from contact with any water that may accumulate in the base below the ventilating holes.

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A NEW VARIABLE SPEED SINGLE-PHASE MOTOR WITH HIGH STARTING TORQUE

IN connection with the electric driving of lifts, cranes, paper-making machinery, and various other types of machinery, it is essential that the motor employed should be capable of developing a large starting torque, while for other machinery a wide range of speeds at high efficiencies is important. The ordinary continuous-current motors have served well in these respects, but there is a considerable demand for a single-phase motor having these characteristics, and many attempts have been made to produce one. A new modification of the repulsion type of single-phase commutator motor has lately been developed by Mr. H. C. E. Jacoby, in order to fulfil these requirements. In this motor commutation difficulties are reduced to a minimum by eliminating in a very simple manner the chief source of commutator troubles inherent to these types of motors. It is common knowledge that when an ordinary continuous-current winding connected to a commutator is employed in alternating current work, the coil undergoing commutation is in such a position that it encloses the whole magnetic flux, as is shown in Fig. 1. This flux being alternating induces a considerable E.M.F. in the short-circuited coil. This E.M.F. is out of phase with the main rotor current, and causes large surging currents to flow in the coil. Attempts have been made to reduce this short-circuit current by inserting resistances between the windings and commutator bars, but there are many disadvantages to this method. Now in order to obtain sparkless commutation it is necessary that an E.M.F. should be provided in the short-circuited coil of just sufficient value to reverse the current. This, as is well known, is generally done in continuous-current motors by the use of carbon brushes which, by introducing a gradually increasing contact resistance at the leaving bar, thereby produces a drop of potential across the contact; and this, by a suitable choice of carbons and constants, produces excellent results. It will readily be seen that in the case of an alternating current motor with an alternating E.M.F. of consider-

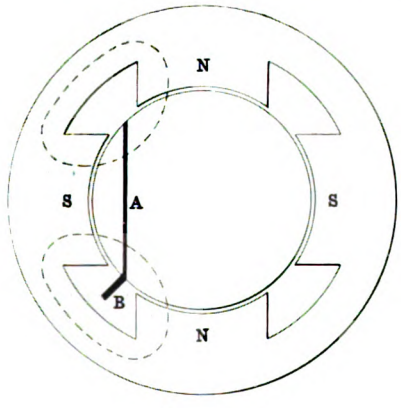

FIG. 1.

able value induced in the short-circuited coil, which is out of phase with the current, bad and deleterious sparking must result unless some very special method is used to counteract these defects. In the motor we are describing the rotor winding is so arranged that the coil short-circuited by the brush encloses little or no magnetic flux, *i.e.*, is parallel to the transformer flux, with the consequence that commutation is brought under similar conditions as in continuous-current motors, and can be provided for with, it is claimed, equally good results. This is accomplished without any complicated connections. The rotor coils are wound across a particular fractional pitch—much less than anything previously employed—and the brushes are placed in a position so that the short-circuited coil lies parallel to the transformer flux as shown in Fig. 2.

With this arrangement there are zones on the rotor in which the current flows in opposing directions in

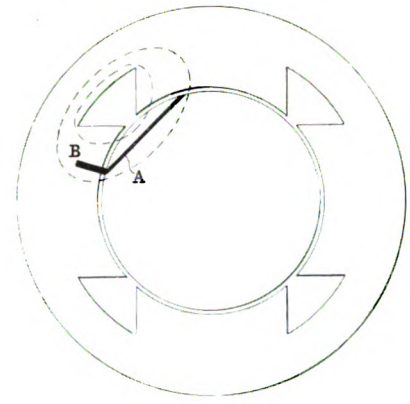

FIG. 2.

adjacent wires. At first sight it would appear that this method of winding would result in considerable loss of torque, and, if it were employed on a continuous-current motor, the resultant torque with equal currents would be less than half what it would be with an ordinary winding. In this case, however, it is claimed that this mode of winding actually increases the resulting torque. In the first case, by eliminating the heavy currents in the short-circuited coils, a troublesome source of back torque is also eliminated. Also the effect of the currents in the rotor conductors causes a displacement in phase of the magnetic flux in a portion only of the solar face, and to obtain the best results it is necessary that the coils doing motor work should be designed with shortened step to suit this. This arrangement of the winding is such that the total ampere turns reacting on the motor flux and producing a torque are not lessened.

It is claimed that, with this winding, equally good commutation is obtained with any brush position between that of maximum and minimum torque; and that this feature makes it possible to govern the speed of the motor by shifting the brush position only. When a shunt characteristic is desired a simple centrifugal governor is employed, arranged to vary the position of the brushes to suit the load. The fact that the friction of the brushes causes the brush rocker to tend to revolve in the direction of rotation greatly facilitates this control. As the brush rocker and brushes would revolve were they not prevented from doing so by the governor, it is only necessary that this latter should exert a force equal to the friction of the brushes, and the slightest deviation from this amount will cause the brushes to advance or recede. The speed can easily be governed by this means within 5 per cent. of the normal. When a variable speed motor is required for direct gearing to a machine—such as a printing press—excellent results are said to be obtained by simply attaching a cord to the brush rocker, by means of which the speed can be varied from a very low speed to full speed.

If a variable speed motor with a shunt characteristic is desired, the motor is assembled with a governor

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and the speed is varied by adjusting the tension of the governor spring. This spring is in an accessible position, so that a distance control can be arranged by levers or by means of an auxiliary motor.

We are informed that tests taken on a 5 h.p. motor at 900 r.p.m. on a single-phase circuit of 200 volts 50 periods, showed the machine to have a full load efficiency of 85 per cent., and a half load efficiency of 77 per cent., a power factor of 0·85, and further that a starting torque of one pound per 100 volt-amperes at 1 ft. radius was developed between normal starting torque and 2½ times full load torque. It is also stated that the speed range is practically unlimited, and that a motor may be switched straight into circuit without a controller or starter of any kind, and 1½ times full load torque will be developed with approximately full load current, and twice full load torque with 1¼ to 1½ times full load current, according to the speed and size of the motor and general conditions.

As previously mentioned, the machine can be assembled as an ordinary variable speed power motor

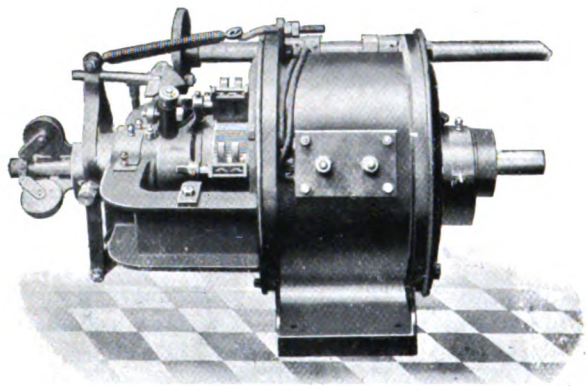

FIG. 3.—JACOBY MOTOR WITH SPEED-REGULATING GEAR.

with the same characteristics as a series wound continuous-current machine. It then has its speed regulated and direction of rotation controlled by rocking the brush gear, or alternatively its speed varied only by an ordinary rheostat put in series with its stator winding. Any suitable mechanical coupling gear may be attached to the brush rocker so that the necessary convenient control be obtained.

The illustration above shows the motor with brush rocking gear coupled to an automatic centrifugal governor, switch, and controlling shaft, the form of assembly supplied where it is desired to control the speed of the motor automatically, as for electric lifts and similar drives. This condition is obtained by the centrifugal governor automatically throwing the brush gear into a position which limits the speed of the motor, the maximum speed being determined within a wide range by adjustment of the spring tension anchored to the housing lug on the top of the yoke. This motor is primarily controlled by turning the controlling shaft through an arc of, say, 150 degrees in either direction to and from a neutral point, the direction of rotation of the motor being the opposite to that in which the gear is rocked from the neutral point.

This motor has been placed on the market by Messrs. Bergtheil & Young, Ltd., of 12 Camomile Street, London, E.C., and is being manufactured at their London works. The motor is known as the "Bandy" patent variable speed single-phase motor.

Electric Headlights for Locomotives.—The Georgia legislature, according to the *Railway Gazette*, has just passed a law requiring railways to use electric headlights on the locomotives of all through trains.—The legislature also passed a Bill providing for the punishment of telegraph companies which may fail to deliver a telegram promptly.

PARIS TO NEW YORK WIRELESS TELEGRAPHY AND TELEPHONY

AS was recently announced in our columns, a contract has been made between the Metropolitan Life Insurance Co. and the De Forest Radio-Telephone Co., under which the latter company is to establish a powerful wireless telephone station in connection with the 700 ft. tower of the Insurance Co.'s building at No. 1 Madison Street, New York.

Negotiations were begun early last spring, when Dr. Lee De Forest was conducting some wireless telephone experiments for the French Government at the Eiffel Tower in Paris. During the course of these experiments, we are informed that wireless messages from the station at Glace Bay, Nova Scotia, were received in Paris, while the wireless telephone using the high antenna on the tower was heard at distances of several hundred miles, although the apparatus then employed was only of 2 h.p. capacity. Dr. Forest then made formal application through the United States Minister, Mr. White, to the French Ministry of War, which controls the wireless station on the Eiffel Tower, in order to obtain permission to carry on experiments between Paris and New York. The officials to whom the matter was referred entertained the proposal willingly, and steps were taken immediately to increase the power of the Eiffel Tower station up to 30 kw.

As soon as the new tower on the Metropolitan Life Insurance Co.'s building is completed, an antenna consisting of six or eight small copper wires will be fastened on its topmost balcony on the 52nd floor just under the lantern. These wires will be insulated from the metal frame of the tower and will run down diagonally, clear to one of the ends of the main building, where the apparatus will be placed in a pent-house. In this way the wires will be over 700 ft. long, and sufficiently clear of the steel frame of the tower. The station will be 150 ft. above the roadway beneath. At the New York end the apparatus will be of 10 kw. capacity, and the De Forest Co. estimate that it will be capable of covering a distance of 1,000 miles with the present type of apparatus.

Experiments will probably then be made between New York, Philadelphia, Boston, Chicago, and Cuba, with the idea of gradually improving the apparatus until communication with Paris is possible. The apparatus has been under construction for some time, and it is hoped that the new station will be in operation by November 1st.

It is also announced that one of the first duties which the new station will take up, will be to send hourly bulletins of news and weather reports to the ships at present equipped with wireless telegraph and telephone apparatus on the De Forest system. From the information issued by the De Forest Co., it appears that it is also contemplated to transmit gramophone music by this means to the ships at sea.

We are informed that the wave-length used will be about 1½ miles, but a change-over from this length to shorter lengths will be possible. The company is also confident that there will be no interference with other systems.

In a letter enclosing these particulars, Dr. De Forest informs us that he expects that it may take two years to establish the wireless telegraph service between New York and Paris, and from five to ten years before the wireless telephone experiments are actually completely successful. He assures us that he does not contemplate a public "opening day," but that the service will be established gradually, as experimental trials merge more and more into commercial ones.

Electric Power Supply in South Africa.—According to a Transvaal correspondent of the *British South African Export Gazette*, the extensions to the power station at Brakpan have just been completed. This station is the property of the Victoria Falls Power Co., Ltd. To the old equipment of four three-phase generators of 750-kw. capacity each, generating at 2,500 volts, and driven by four reciprocating steam engines, with 10 boilers of 500-h.p., there have been added two three-phase turbo-generators, and eight Babcock and Wilcox water-tube boilers, thus more than trebling the capacity of the station. The new generators are each of 3,000-kw. capacity, generating at 10,000 volts. The pressure is transformed up to 40,000. The turbines are of the A.E.G.-Curtis direct-coupled type, and the boilers have a capacity of 1,500-h.p. each. The company's Germiston station, which is still in course of construction, will possess even double the capacity of the new plant at Brakpan when completed early next year. Meanwhile, the Johannesburg Corporation have decided not to continue the arrangement under which they have been taking current from the company, but have, instead, called for tenders at very short notice for the supply of new generating plant, consisting of a 1,000-kw. steam dynamo, boiler, condensing plant, and pipes, estimated to cost £21,000, and to be erected by December 15th, 1908.

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THE SEVENTY-EIGHTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

(By our Special Correspondents)

THE Dublin meeting of the British Association opened on Wednesday, September 2nd, with the presidential address of Mr. Francis Darwin, M.A., Ph.D., LL.D., F.R.S., delivered in the Great Hall of the Royal University of Ireland. There was an exceptionally large attendance, the number of members being close upon 3,000, and the spacious hall was filled to its utmost capacity. An unusual element of stateliness was lent to the meeting by the presence of the Earl of Aberdeen, the Irish Viceroy, whose entrance was heralded by the strains of the National Anthem.

The presidential address dealt mainly with movement in plants. The speaker, a third son of the famous Charles Darwin, defended his father's position connected with the inheritance of acquired characters, and made an eloquent plea for the recognition of an elementary memory, a rudimentary "soul," in plants, quoting numerous illustrations of their apparent intelligence.

In the afternoon a meeting of the General Committee of the Association had taken place, at which it was reported that Prof. J. J. Thomson had been unanimously nominated by the Committee as President of the Association during next year's meeting, which will be held at Winnepeg.

THURSDAY, SEPTEMBER 3RD.

Mr. Dugald Clerk's Presidential Address to the Engineering Section.

Mr. DUGALD CLERK, F.R.S., in his Presidential Address to the Engineering Section (Section G), dealt with the history of thermodynamics. At the middle of the last century, he said, the science of thermodynamics did not exist, although the steam engine had attained to a high degree of perfection. The steam engine had been successfully applied to all the great duties of the mine, the waterworks, the factory, the railway, and the steamship. The engines were mechanically excellent; the fuel economy was good, and they were built in units of thousands of horse-power. Steam power, in fact, was revolutionising the whole of the social and industrial conditions of the globe. Notwithstanding this great material and engineering success, the world was in complete darkness as to the connection between steam motive-power and heat. It was seen that motive power of almost any magnitude could be obtained by the agency of heat; but how it was obtained and how much power was connected with a given quantity of heat was quite unknown. The fuel consumptions of existing engines were known, and certain modes of improving economy were evident, and engineers were busily engaged in testing these modes by the slow but sure methods of invention, design, construction, and operation in practical work; but in this they had but little aid from pure science.

Men of the first rank in intellect—Newton, Cavendish, Rumford, Young and Davy—had long before expressed the opinion that heat was not material in its nature, but was a mode of motion; but their opinions, although to some extent supported by experiment, had made little impression upon the scientific world, and in 1850 the most distinguished physicists still adhered to the "caloric" or material theory of heat.

Carnot had, however, in 1824, published in Paris a pamphlet entitled "Reflections upon the Motive Power of Heat." He saw that heat and motive power were connected in some manner, and he endeavoured to settle in a quantitative way the limits of that connection by the invention of an ideal series of operations by means of which the greatest conceivable amount of mechanical power may be obtained from a given quantity of heat under given circumstances. For the purpose of his demonstration he assumed only two things: (1) That if heat be added to any body under standard conditions of temperature, pressure, and volume, and the body be carried through any series of mechanical processes, returning ultimately to the standard condition of temperature, pressure, and volume, then the quantity of heat added to the body would be the same as that which had been discharged from it; (2) No process can exist whereby a given mechanical energy can increase its own quantity. On these indisputable assumptions he based his ideal cycle, which consists of four simple and easily imagined operations, occurring within a cylinder behind a piston, so arranged that during the cycle work can be done by the working fluid upon the piston or work be done by the piston on the working fluid.

First Operation.—The given volume of the working fluid is to be imagined as confined at its highest temperature and pressure behind the piston, and heat is to be added to keep the temperature constant, while the fluid expands, moving the piston and doing work upon it.

Second Operation.—The supply of heat is cut off, and the working fluid expands also doing work on the piston, while its temperature falls to the lowest point, and its volume increases to its maximum.

Third Operation.—The piston returns, compressing the working fluid, but allowing the heat of compression to escape, so that the temperature remains during the operation at its lowest point.

Fourth Operation.—The piston compresses the working fluid, without allowing any loss of heat, to such an extent that the temperature rises again to its highest point, and the working fluid exists at the end of this operation at the same volume, pressure, and temperature as at the beginning.

This assumed series of operations would give a certain available work area, the indicated power of the engine, inasmuch as the work done by the working fluid would be greater than that done upon it. If however it be assumed that in all the operations the direction of motion of the piston be reversed, then compression without loss of heat would take place in the second operation; further compression, but with sufficient heat loss to keep temperature constant, would occur on the first operation; the fourth operation would follow with expansion, and the third operation would conclude also with expansion. The engine would be reversed by beginning with the second operation, moving the piston backwards in the order second, first, fourth, third. Carnot showed that this reverse operation would be performed by exactly the same amount of work as was given out by the direct operation, and that an amount of heat would be returned at the higher temperature equal to that which was added in the first case.

An engine which fulfils these conditions, Carnot stated, will give the greatest amount of work which can be obtained from a given quantity of heat falling through a given temperature range. And it is evident that this must be so, because, if the existence of any engine is assumed, under the same conditions giving a greater amount of work from the same heat, then that engine could drive a Carnot engine in the reverse direction in such proportion as to return to the higher temperature a greater amount of heat than it abstracted, and so mechanical energy could be obtained without any heat fall whatever. This marvellous demonstration is obviously independent of the nature of the working fluid; it applies equally to all working substances, whether solid, liquid, or gaseous, whether the physical state changes or not. It at once gives a standard of the limit of mechanical power which could possibly be obtained from a given amount of heat and a given temperature fall.

To reduce this limit to numerical values it was necessary, however, to experiment on any one working fluid within the desired temperature range in order to determine the work area in its relation to heat quantity and temperature fall. Carnot's writings show that he intended to make such observations; and, had he succeeded, thermodynamics would have become a science at an early date. Carnot's death, however, in 1832, at the early age of thirty-six years, prevented this development.

Carnot's work remained practically without notice for thirteen years after his death, when, fortunately, it attracted the attention of William Thomson during his attendance at the Laboratory of Regnault in the year 1845. Thomson, who was then twenty-one years of age, and had already attained a considerable scientific reputation, took up the study of Carnot's work with enthusiasm. He became Professor of Natural Philosophy in the University of Glasgow in 1846, and in 1848 he read a Paper before the Cambridge Philosophical Society "On an

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Absolute Thermometric Scale founded on Carnot's Theory of the Motive Power of Heat and calculated from Regnault's Observations." Like Carnot, Thomson accepted the "material" or "caloric" theory of the nature of heat, although, like Carnot also, he had doubts as to its truth. He carried Carnot's reasoning much further, and deduced from the Carnot cycle a thermometric scale which was absolute in the sense that it defined the idea of temperature independently of the properties of any particular body.

Thomson followed up his absolute thermometric scale work with an investigation entitled "Carnot's Theory of the Motive Power of Heat," described in a Paper read in 1849 before the Royal Society of Edinburgh, in which he calculated from Regnault's experiments on steam the power developed by a Carnot reversible engine when using one centigrade heat unit; that is, the heat necessary to heat one pound of water through 1° C. for temperatures from 1° to 231° C., the temperature falling in the engine in each case to 0° C.

The Paper is of great interest because it shows clearly how fully the distinguished author realised the necessity for re-examining the standard ideas of the nature of heat. Two paragraphs make this very clear :—

"7. Since the time when Carnot thus expressed himself the necessity of a most careful examination of the entire experimental basis of the theory of heat has become more and more urgent. Especially all those assumptions depending on the idea that heat is a substance, invariable in quantity, not convertible into any other element, and incapable of being generated by any physical agency; in fact, the acknowledged principles of latent heat would require to be tested by a most searching investigation before they ought to be admitted, as they usually have been, by almost everyone who has been engaged on the subject, whether in combining the results of experimental research or in general theoretical investigations.

"8. The extremely important discoveries recently made by Mr. Joule, of Manchester, that heat is evolved in every part of a closed electric conductor moving in the neighbourhood of a magnet, and that heat is generated by the friction of fluids in motion, seem to overturn the opinion commonly held that heat cannot be generated, but only produced from a source where it has previously existed either in a sensible or in a latent condition. In the present state of science, however, no operation is known by which heat can be absorbed into a body without either elevating its temperature or becoming latent, and producing some alteration in its physical condition; and the fundamental axiom adopted by Carnot may be considered as still the most probable basis for an investigation of the motive power of heat, although this, and with it every other branch of the theory of heat, may ultimately require to be reconstructed upon another foundation when our experimental data are more complete. On this understanding, and to avoid a repetition of doubts, I shall refer to Carnot's fundamental principle, in all that follows, as if its truth were thoroughly established."

In these two paragraphs Thomson summed up the whole situation in 1849, and promised further investigation and further attempts to deduce the nature of the connection between heat and work. Thomson's promises of further investigation were fulfilled in 1850, in which year he definitely accepted the dynamical theory of heat and finally abandoned the material. His conclusions are given in a Memoir of the first importance which was read before the Royal Society of Edinburgh in 1851. It was entitled "On the Dynamical Theory of Heat."

Before dealing with it, however, Mr. Dugald Clerk dealt with the work of Joule and others on another side of thermodynamics. Long before 1850 the equivalence of mechanical work and heat quantity had been accepted by many scientific men, and Rumford had, indeed, made measurements of a rough kind. It remained, however, for Joule experimentally to determine the mechanical equivalent in the most accurate manner and place what is now known as the first law of thermodynamics upon the sure basis of absolute experimental determination. His first Paper was read before the Cork Meeting of the British Association in 1843, and at the Oxford Meeting in 1847 he read another—"On the Mechanical Equivalent of Heat"—describing the results of experiments with paddles rotating in liquids driven by falling weights. By these years of work he had absolutely demonstrated the equivalence of heat quantity and mechanical work, so that no loophole of escape seemed possible; it appeared as if the material theory was rendered intellectually impossible to the trained intellect. This was not the fact, however, as is evident from both Joule's and Thomson's accounts of that British Association Meeting.

Joule's earlier Paper had been coolly received. Indeed, it is evident that the idea of a mechanical equivalent of heat was still distasteful to the physicists of the day, and its discussion was looked upon with dislike. Joule, at the 1847 Meeting, addressed a small audience, and the account of his experiments was received without enthusiasm. This adverse atmosphere, so discouraging to the investigator, was quickly removed, however, when a young man rose to make his remarks, and, by his enthusiastic comment and clear reasoning, at once succeeded in attracting the interest of those present. This young man was William Thomson, Professor of Natural Philosophy in the University of Glasgow. Speaking of this, his first meeting with Joule, at Manchester, forty-six years later, Lord Kelvin said :—

"I can never forget the British Association at Oxford in the year 1847, when in one of the Sections I heard a Paper read by a very unassuming young man, who betrayed no consciousness in his manner that he had a great idea to unfold. I was tremendously struck with the Paper. I had first thought it could not be true because it was different from Carnot's theory, and immediately after the reading of the Paper I had a few words of conversation with the author, James Joule, which was the beginning of our forty years' acquaintance and friendship. . . . I gained ideas which had never entered my mind before, and I thought I, too, suggested something worthy of Joule's consideration when I told him of Carnot's theory."

This Meeting, Mr. Clerk continued, was indeed fateful for the future of the science of thermodynamics, as it resulted in co-operation between two men of giant intellect, who between them performed most of the experimental work which was necessary to make thermodynamics an exact science. Their work alone sufficed to place the first and second laws of thermodynamics on the firm footing of accurate experiment and logical deduction.

Although Thomson was much struck by Joule's experiments, he did not accept the dynamical theory of heat at once. As he stated himself : "I had first thought that it could not be true because it was different from Carnot's theory." Joule's discoveries at this date may be thus expressed :—Heat and mechanical energy are mutually convertible, and heat requires for its production, and produces by its disappearance, mechanical energy in the proportion of 1,390 foot-pounds for each centigrade heat unit, a heat unit being the amount of heat necessary to heat one pound of water through 1° C. Knowing, as Thomson did, that mechanical energy could be produced by the agency of heat, but that its amount varied with the temperature and temperature fall, Joule's discoveries seemed antagonistic to Carnot's demonstration; and, convinced as he was that Carnot's law was true, he naturally felt at first that there must be some other way of looking at Joule's results than that adopted by Joule himself. Joule had proved the generation of heat by means of mechanical work; Thomson required the proof of the converse case—the disappearance of heat when mechanical work was done by the working fluid.

This proof was forthcoming in the results of experiments on the compression and expansion of air. The Carnot and Joule principles were reconciled in Thomson's Paper of 1851, and the important deduction made of an absolute zero of temperature of −273° on the Centigrade scale. The introduction of the idea of the mechanical equivalent of heat led at once to an absolute zero of temperature, and allowed of the determination of this physical lower limit by the use of the Carnot cycle for investigating the efficiency of a perfect engine using any working fluid. Air was the working fluid actually investigated, and the determination of its properties at ordinary temperatures was a vitally important result of the co-operation of Thomson and Joule. Their experiments lasted for many years, and their rigorous investigation disclosed the fact that internal work was done in expanding a gas; in fact, that in a gas expanding isothermally doing work, part of the heat only disappeared in external work and part was absorbed in separating the molecules.

The Joule and Carnot laws are now known as the first and second laws of thermodynamics.

The second law, in modern form may be stated thus :—

Although heat and work are mutually convertible and in definite and invariable proportions, yet no conceivable heat engine is able to convert all the heat given to it into work. Apart altogether from practical limitations, a certain portion of the heat must be passed from the hot body to the cold body in order that the remainder may assume the form of mechanical energy.

The proportion of the total heat convertible into mechanical energy depends on the absolute temperatures of the hot and cold bodies; it is unity *minus* the lower absolute temperature upon the upper absolute temperature.

During Thomson's struggle to reconcile the two apparently opposing laws, Clausius, who had seen the same difficulty, arrived independently at its solution and published a Paper, "On the Motive Power of Heat and the Laws of Heat which may be deduced therefrom," at the Berlin Academy in

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February, 1850. In this Paper, Clausius discussed Thomson's difficulties, and also arrived at the conclusion that the Carnot cycle may be reconciled to Joule's law by the omission of the supposition that during the third process the same amount of heat is discharged from the cool body as was taken in from the hot one. In his 1851 Paper, Thomson gave Clausius full credit for priority, but stated that he had been working on the same problem and had arrived at the same solution in the year 1850, before he had seen Clausius' work.

Rankine, as early as 1849, arrived at the general equation of thermodynamics which expresses the relation between heat and mechanical energy, and indicated the result of his investigations to the Royal Society of Edinburgh in February, 1850. Rankine thus arrived independently at the same result as Clausius about the same time. Both Rankine and Clausius, however, adopted certain theories as to the molecular structures and motions of gases, and their demonstrations to some extent depended upon their theories. To Thomson and Joule we are deeply indebted for the rigid proof of the two laws and for the rigid deduction of the modern scale of temperature and the determination of absolute zero in its modern form.

The brilliant work of Meyer, published so early as 1842, is held by some to have anticipated to a large extent both the work of Thomson and of Joule. Undoubtedly Meyer formulated true ideas and carried his generalisations through a wide range. Helmholtz also very early arrived at similar conclusions to those of Joule and Thomson. There is some little danger to the present generation, said Mr. Clerk, of forgetting what they owe to Thomson and Joule. To appreciate the step made by them it is necessary to consider the position of motive power produced by heat at about the middle of the last century. At that time many attempts had been made to displace the steam engine as a heat engine by air engines in various forms—both engines heated externally and those heated internally, now known as internal-combustion engines. Papers read at the Institution of Civil Engineers in 1845 and 1853, and the discussion of those Papers by eminent men of the day, supply an accurate measure of the knowledge possessed by the engineer of the principles of action of his heat engines. Many distinguished names occur in these Papers and Discussions, including James Stirling, Robert Stephenson, Sir George Cayley, Charles Manby, James Leslie, C. W. Siemens, Hawksley, Pole, W. G. Armstrong (afterwards Lord Armstrong), Edward Woods, E. A. Cooper, D. K. Clark, Benjamin Cheverton, Goldsworthy Gurney, George P. Bidder, Prof. Faraday, Isambard K. Brunel, Captain Fitzroy, and F. Braithwaite. At the date of the later of these discussions Brunel had already designed the *Great Eastern*, in 1852, with its engines of 11,000 h.p. Armstrong was a Fellow of the Royal Society, and had started the Elswick Works and invented the Armstrong gun. Robert Stephenson was at the height of his fame. He was then a Member of Parliament, President of the Institution of Civil Engineers, and a Fellow of the Royal Society. Siemens was a young man, but was busy on the regeneration furnace; he had considered regeneration as applied to steam engines, although his work on the air engine was still to come.

Of all the distinguished engineers who spoke, Siemens alone had thoroughly apprehended the value of Joule's results and understood the full bearing of the mechanical equivalent of heat. He had not, however, understood Carnot's reasoning on the Carnot cycle, or Thomson's deductions from Carnot. He was under the impression that heat added in any way to a working fluid, raising the temperature, could be entirely converted into work by a sufficient expansion. He had not appreciated that, even if expansion be carried far enough to reduce the temperature to the original temperature before heat addition, yet complete conversion of the entire mechanical equivalent was impossible. When so able a man as Siemens had at this stage only reached partial enlightenment, it was evident that much hard work and clear thinking required to be done before a well-founded theory of heat motive-power could be obtained.

The data for such a theory was accumulating. Regnault produced his admirable investigations, and succeeded in solving many problems; but he did not settle the questions to the extent he had hoped. Even at the present time doubt arises as to the very values he gave for the specific heat of air and steam. The problem proved much more difficult than he had anticipated, and for modern engine purposes it cannot be considered as wholly solved now—fifty-five years later.

In concluding his address, Mr. Dugald Clerk said :—The broad laws of thermodynamics have placed the theory of the heat engine in a position of certainty, which was much needed. It would be a mistake to assume, however, that even the determination of the mechanical equivalent of heat and the second law of thermodynamics expressed in terms of an absolute thermometric scale had solved all the difficulties of the engineer desiring to determine the efficiency of his heat engines. Thomson, Joule, Rankine, and their great Continental colleagues, it is true, settled once and for all the broad laws of thermodynamics, but the Carnot cycle is a cycle which is, as has been repeatedly shown, an impossible one in practice. Accordingly actual engines have to operate upon imperfect cycles. The theory of these imperfect cycles has been worked out mostly during the last twenty-five years, although Rankine made a beginning in dealing with the theory of the Joule air engine. For the first time he showed the existence of what may be termed a cycle of constant efficiency in the case of the Joule air engine. Assuming constant specific heat for the working fluid, he calculates the efficiency of what we now call a constant-pressure air engine between certain limits of temperature, and he gives the efficiency of the fluid where U = energy exerted and H_1 = heat received, and r = ratio of compression and expansion :—

$$\frac{U}{H_1} = 1 - \frac{1}{r^{0.408}};$$

that is, he indicates in this formula that the thermal efficiency is independent of the maximum temperature as long as that maximum temperature exceeds the temperature of adiabatic compression. He makes no statement, however, that this engine is within a certain range independent of the maximum temperature; that is, that increasing maximum temperature does not increase efficiency. Subsequent work has shown that, on a simple assumption, such as constant specific heat, many engine cycles exist of a practicable nature having high theoretical efficiencies where the theoretical efficiency depends on one thing only—the ratio of compression. Some misunderstanding has arisen with regard to these imperfect cycles, and it has even been thought that such imperfect cycles would be contrary to the second law of thermodynamics. Lord Kelvin himself was of this opinion in 1881. I vividly remember a conversation I had with him at the Crown Iron Works, in Glasgow, over the results I had obtained from one of my early gas engines. I had then come to the conclusion that the "Otto" cycle as ordinarily operated was a cycle of constant efficiency, and I explained this to Lord Kelvin. He had not followed such cycles, and his view then was that no such cycle could exist, because he thought it was contrary to the second law of thermodynamics. Some idea of this kind has been held by many scientific men, and has prevented the minute investigation of imperfect cycles of different kinds, because of the feeling that the whole question of efficiency was entirely settled by the nature of the temperature limits; that is, by the maximum and minimum temperatures at the disposal of the engineer. It is true that these values, as has been shown, must always determine the extreme limit of possible efficiencies between certain temperatures, and in cycles of constant efficiency the particular efficiency of the cycle is always less than the efficiency of a Carnot cycle engine working between the same limits of superior and inferior temperature. The investigation, however, of these imperfect cycles is much more difficult than the broad investigation of the general thermodynamic laws, because it requires accurate knowledge of the properties of the working fluid dealt with under conditions rendering observation extremely difficult.

The modern internal-combustion motor is the successor to the air engine so fully discussed by eminent engineers of fifty-five years ago; and the forebodings of even so eminent a man as Faraday as to its ultimate success have proved unfounded. Great difficulties have been encountered and many discrepancies have had to be explained, but a minute study of the nature of the working fluid has rendered it more and more possible to calculate the efficiencies to be expected under practical conditions. At the present time we can deal with almost any cycle or any working fluid with some fair approximation to an accurate result. Much work, however, is required before all problems of the working fluid can be said to be solved with regard to any heat engine. Indeed, it may be said that under modern conditions of the use of steam even the properties of the working fluid—steam—have not yet been satisfactorily determined. The mere question of specific heat, for example, of steam and its variations with temperature and pressure is now under review, and important experiments are in progress in Britain and on the Continent to determine those properties. The properties of the working fluid of the internal-combustion motor are also the subject of earnest study by many Continental and British investigators. Notwithstanding all the perplexities involved in the minute study of the imperfect heat cycles, we are in a very different position to-day compared with the engineer of 1853. We know all the broad laws as to the conversion of heat into work or of work into heat; and, numerous as are the problems yet to be solved, we at least profit by the guiding light set out for us by Kelvin, Joule, and Rankine.

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Sir WILLIAM WHITE, in moving a vote of thanks for this interesting address, said that it showed under what difficulties engineers were working fifty-five years ago. He was glad that the President had referred to the work of Prof. Rankine (whose pupil he was), and whose work combined in a remarkable way both theoretical knowledge and its practical application.

Mr. DUGALD CLERK, in replying, said he wished to make it quite plain that he did not wish to appear to be casting any slur on the engineers of fifty years ago when he stated that as far as thermodynamic engines were concerned, they were working with machines that they did not understand. He would go further than that, and would state that it was the duty of the engineer to construct what was required, if he was able, without waiting until he thoroughly understood the theory of his machine; in fact, this was generally the order in which things had been accomplished. The engineer produced a machine that worked, and then the inquiring or scientific mind came along and ascertained how it worked.

Steam Turbines and Turbo-generators.

Mr. GERALD STONEY (of Messrs. C. A. Parsons & Co.), who read a Paper on "Recent Advances in Steam Turbines," said very rapid development of the steam turbine, both on land and for marine propulsion, had taken place since he read a Paper on the subject at the B.A. meeting at York two years ago. Eight years ago the largest steam turbine on land was 1,000 kw., and this was considered an immense machine at the time; now there are large numbers ranging from 5,000 to 8,000 kw. running and under construction.

Leaving out of consideration the Laval turbine with a single reaction wheel, which requires gearing and is impracticable for large sizes, he divided steam turbines into two classes :—

Firstly, the Parsons turbine, in which there is both action and reaction, and the expansion takes place equally in the moving and fixed blades; and secondly, those in which the whole of the expansion takes place in the fixed blades, the velocity of the steam being taken up without expansion by the moving blades. This latter class can then be sub-divided into those in which at each stage there is only a single row of moving blades as in the Rateau and Zoelly turbines, or one in which there are several rows of moving and fixed blades in each stage, which take up the velocity without any additional expansion, as in the Curtis. There are again various combinations, consisting of mixtures of one or more classes, but none of these have as yet been manufactured to any large extent. The oldest type, and one which is more in use than any other, is the Parsons, but in America the Curtis has been manufactured in large numbers, and on the Continent the Zoelly, Rateau, and A.E.G., although both in America and on the Continent Mr. Stoney claims that the Parsons has taken a leading position.

Turbo-Generator Design.—Hand in hand with the development of the steam turbine, Mr. Stoney continued, has gone the development of the various machinery to be driven by it, and in this direction electrical machinery has been prominent. For many years continuous-current turbo-dynamos were looked at askance by engineers on account of commutation troubles, for it is easy to see that the ordinary constants applicable to slow speed dynamos to secure sparkless commutation are far exceeded when the speed is raised to that of turbine-driven dynamos. On this account it was early seen that some sort of compensating winding to improve the commutation and compensate for the reaction of the armature was necessary. Commutating poles alone have not proved satisfactory in practice, there being nearly always considerable difficulty in securing good commutation with them, and as a consequence commutating poles combined with compensating windings—the commutating poles giving the reactance voltage necessary for commutation and the compensating winding compensating for armature reaction—have been adopted by many firms. But even better commutation can be secured by a compensating winding alone, in which the ampere-turns of the compensating winding exceed the ampere-turns of the armature to such an extent as to give a commutating field in the gap between the pole-pieces.

Such compensation winding is generally chiefly concentrated on the pole-pieces, and is made, Mr. Stoney said, with from 2 to $2\frac{1}{2}$ times the number of ampere-turns of the armature, in order both to compensate for leakage and to give a good commutating field; and since this method of compensating has no iron commutating pole, it has the advantage that there is no self-induction to cause time lag at sudden changes of load, and, as the field of the gap between the poles is entirely in air it instantly responds to changes of current in the compensating winding, and thus the sparking found when there is a sudden change of load with commutating poles is avoided, and the risk of a flash-over largely reduced. Also since there is no iron to become saturated, the commutating field is always strictly proportional to the load, and thus the trouble due to saturation causing sparking at some loads and not at others is avoided. This advantage is specially prominent where the dynamo is required to give varying voltages and to compensate at any of them without outside adjustment of the compensating windings by diverters or otherwise.

The adoption of these devices has made it possible to make turbo-dynamos of large size, and now as much as 1,500 kw. is put into a single armature, whereas before such compensating devices were adopted 500 kw. was the maximum, and even then the commutation was anything but satisfactory.

In turbo alternators there is practically now—except for small sizes and low voltages—one standard pattern—that is, a revolving field rotating inside a stator. In the stator there is little variation in design, except in regard to the ventilating arrangements, which have to be very ample on account of the comparatively large quantity of heat to be removed from a small volume.

One point which has received great attention in recent years is the staying of the end windings of such alternators, it having been found that, owing to their great length, when a "short" took place the stresses on the winding were such as to break the insulation and cause disaster. The amount of these forces has been vastly more than was ever anticipated, and if the windings are not thoroughly stayed, such movements may be set up as to cause disaster. In the rotors there are two prominent types, the barrel and the salient pole, and much discussion has ensued as to the advantages of the one or the other. After considerable experience of both, the author says that on the whole he prefers the salient pole type at present. Ample ventilation is much easier to provide for, and improvements made in protecting and supporting the field coils of this type of rotor have resulted in a design giving great reliability with the maximum use of the space available. One improvement has been enclosing every coil in a tight sheath of sheet steel, so that any movement which may take place due to centrifugal force is between the steel sheath and the body of the rotor, and thus the insulation is protected from any rubbing which might cause it to be cut through and consequently to break down.

Voltage regulation of alternators is also of considerable importance, as owing to the inductive load required by induction motors there is a heavy demagnetising effect on the rotor, and consequent drop of voltage when the load rises. Several methods have been proposed for compounding alternators, most of them requiring a separate commutator or moving contacts altering the resistance of the exciter or main windings, but a method of compounding alternators has recently been brought out which is being largely used with good results. In this apparatus the current supplied by the machine is made to act on the exciter field system in such a way as to reduce the leakage, artificially increased in the first instance, and so raise the voltage of the exciter, and increase the excitation of the alternator, so that any desired amount of compounding required can be obtained. This arrangement has been recently described in a Paper before the Institution of Electrical Engineers (see ELECTRICAL ENGINEERING, Vol. III., p. 546).

Exhaust Steam Turbines.—In many parts of the country reciprocating engines are running non-condensing, and it has now been found that the exhaust steam from them is of great value. Such exhaust steam cannot be practically utilised by reciprocating engines on account of the huge size and volume of the cylinders required, but it is quite otherwise with the steam turbine, where the large volumes of the low pressure steam are exactly what are required for the highest economy. These considerations have led to the introduction of exhaust steam turbines, taking steam at atmospheric pressure and exhausting into a condenser. When it is remembered that there is as much power in the steam from atmospheric pressure down to $27\frac{1}{2}$ in. as there is from 150 lb. down to atmospheric pressure, it is easily seen that the power of a non-condensing plant can be doubled by the addition of an exhaust steam turbine and condenser, and in cases where there is not a supply of cooling water, improvements in cooling towers have enabled them to be put up both cheaply and well. In this connection the use of intermittent supplies of exhaust steam, such as that obtained from engines running intermittently, as in rolling-mills or winding-engines at collieries, has received a great impetus by the utilisation of thermal accumulators, in which the intermittent supply of steam is alternately condensed and re-evaporated, so that a constant flow is obtained for use in the exhaust steam turbine.

Mixed Pressure Turbines.—Yet another refinement has been introduced by the use of mixed pressure turbines, in which there is a low pressure part sufficiently large to give full power when working with exhaust steam, and if the supply of this fails, a high pressure part is brought automatically into action using steam direct from the boilers, and thus there is economical

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running, whether the reciprocating engines supplying the exhaust steam are working or not.

Condensing Plant.—In all turbines the question of vacuum is a very important one, and various improvements have been made in condensers to enable high vacua to be obtained. The importance of this will be seen when it is remembered that in the average steam turbine 1 in. of vacuum is equivalent to from 4 per cent. to 5 per cent. of steam consumption, or, in other words, it may be taken that for every 3° F. by which the temperature due to the vacuum is reduced, a gain of steam consumption of 1 per cent. is made.

In this connection increase of circulating water is very important. A very usual amount is about 30 times, but if this is increased to 45, the gain in consumption is 4 per cent., and if increased to 65 times a further gain of 2 per cent. is made. As a rule, extra circulating water can be pumped without much difficulty, the extra power required for this being very small. but generally the temperature of the inlet to the condenser is fixed by the supply of water available.

The great desirability then in a condenser is to obtain the temperature due to the vacuum as close as possible to that of the water leaving the condenser, as, of course, the maximum vacuum possible is that due to the temperature of this water. In ordinary condensers it is generally found that this difference amounts to 20 to 25° F., and among the various arrangements to reduce this may be mentioned dry air pumps, and also the arrangement of baffles and pumps in the "contraflo" condenser. But a method which has been very satisfactory in practice is what is called a "vacuum augmentor," which is simply a small jet of steam drawing the air and vapour from the condenser, and delivering it through a small auxiliary condenser to an ordinary air pump, so that while there may be, say, a vacuum of only 27½ in. at the air pump, 28½ in. or 29 in. may be attained in the main condenser. Such an appliance is especially valuable when, as is often the case on board ships at sea, the system has considerable air leaks. With this arrangement the difference between the temperature of the water leaving the condenser and that due to the vacuum can be reduced to about 5° or 6° F., and this when condensing up to 12 lb. of steam per hour per square foot of condenser. As will be seen, this shows an economy in the turbine of some 6 per cent. in steam consumption above an ordinary condenser, and when it is remembered that the steam jet of the augmentor uses only about 0·6 of 1 per cent., or only one-tenth of the steam consumption gained. it is easy to see that a great benefit is derived from the use of such an arrangement.

The remainder of the Paper dealt with marine work.

DISCUSSION.

Prof. FITZGERALD asked what happened in the h.p. end of a mixed turbine when it was being driven only by exhaust steam; did the blades merely churn the air, or did they act in any way as an air-compressor?

Sir WILLIAM WHITE said he thought the turbine that he bought in 1884 or 1885 was the first one Parsons ever made. He bought it to experiment with, as its possible advantages were so obvious. He had had much to do with the application of the turbine to marine work, and was a member of the Cunard Commission that had recommended that turbines should be supplied to the *Mauretania* and *Lusitania*. It was his opinion (and the opinion of many others) that the reciprocating engine must give way to the turbine. Many people were stating that very shortly the steam turbine would have to give way to the internal combustion engine, but he thought, after listening to the address they had just heard on thermodynamics, that much work had yet to be done before that was accomplished. The author of the Paper had not mentioned that in America the Curtis turbine had just been applied to marine work.

In the application of turbines to marine work it must be realised that, with regard to size, progress had been made in one stride, that had taken fifty years in the case of the reciprocating engine. The principal object the designer had in view was to produce a machine efficient as a whole, and with this object in view the efficiencies of turbine itself had to be sacrificed, to a certain extent, to get screw propeller efficiency. The laws governing the efficiency of screws were well known up to 180 or 200 r.p.m., but not above, and it was thought well to keep the turbine speed within these limits.

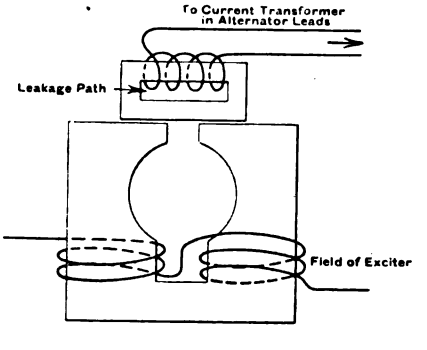
Owing to the much lower speed at which marine turbines had to run, they had not quite so great advantages in point of reduced dimensions as in the case of the stationary turbine. He did not think the size of engines for marine purposes would increase much in the near future; the new Cunarders cost 1½ millions each, and he thought not many companies would care to exceed this. Attention would probably now be concentrated more on reducing working expenses by lightening the coal bill, and he thought, in this respect, the combination of reciprocating and turbine plant would constitute a revolution in marine propulsion.

Mr. PRICE asked for further information with regard to the system of controlling the voltage regulation curve of an alternator by varying the magnetic leakage in the exciter.

Mr. WORBY BEAUMONT made some remarks emphasising certain points referred to in the Paper, particularly the fact that the consideration of propeller efficiencies impaired both the lightness and efficiency of marine turbines; he also referred to the great possibilities for further economies by the combination of reciprocating and turbine plant in one vessel.

Mr. DUGALD CLERK said he thought that he himself had made the first brake-test on a turbine. This was in 1885. The machine ran at 10,000 r.p.m.

Mr. STONEY in replying said, with regard to Prof. Fitzgerald's inquiry, the high pressure end of a mixed turbine, when not being worked with h.p. steam, merely churned the air. There was no compressor action; the blades would have to be shaped differently to effect this. The loss by air churning would be about 5 per cent. of the power developed in the l.p. part. In replying to Mr. Price's query *re* the leakage path method of controlling voltage regulation, he drew the following diagram :—



As the alternating current increases it magnetises to a greater extent the iron in the leakage path, less of the flux in the iron circuit of the exciter passes through this path owing to the increased reluctance, and consequently more flux passes through the armature of the exciter. Mr. Stoney mentioned that the capabilities of the turbine with exhaust steam was being utilised in many places now, particularly in the Newcastle district, where the Supply Company had erected several waste heat plants, utilising the exhaust steam from existing reciprocating plant, and he thought in this respect the turbine was a universal benefactor in that it made it possible to reduce the present waste of coal, our store of which was rapidly disappearing.

Our correspondents mention appreciably an admirable innovation, due to the Dublin Local Committee, by which a system of index boards and telephone connections enable anyone sitting in any section to see at a glance what Papers are being read at that moment in any other section.

Section A. (Physics.)

The Presidential Address to Section A was delivered by Dr. W. N. Shaw, F.R.S., and dealt, as one might expect, with the subject of Meteorology. After the usual vote of thanks, the President announced that M. Teisserenc de Bort, who was to have opened the discussion on the recently discovered isothermal layer of the atmosphere, was unfortunately prevented from attending. The discussion was, however, opened by Prof. A. L. Rotch, and continued by Mr. C. J. P. Cave, Mr. W. H. Dines, F.R.S., Mr. E. Gold, Prof. Trouton, Prof. J. J. Thomson (who subjected the discovery to some rather searching criticism), Dr. Walker (of the Indian Meteorological Office), and Prof. H. H. Turner. Prof. Barrett then delivered an address on "A New Form of Combined Optometer and Entoptoscope," exhibiting and explaining the instrument. A lively discussion ensued, in which Sir W. de W. Abney, Dr. Glazebrook, Mr. Milne, and others took part.

Practical Standards for Electrical Measurements.

In the afternoon Dr. R. T. Glazebrook read the report of the Committee on "Experiments for Improving the Construction of Practical Standards for Electrical Measurements."

The Committee consisted of Lord Rayleigh (chairman), Dr. R. T. Glazebrook (Secretary), Professors W. E. Ayrton, J. Perry, W. G. Adams, and G. Carey Foster, Sir Oliver J. Lodge, Dr A. Muirhead, Sir W. H. Preece, Professors A. Schuster, J. A. Fleming, and J. J. Thomson, Dr. W N. Shaw, Dr. J. T. Bottomley, Rev. T. C. Fitzpatrick, Dr. G. Johnstone Stoney, Professor S. P. Thompson, Mr. J. Rennie, Principal E. H.

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Griffiths, Sir A. W. Rücker, Professor H. L. Callendar, and Messrs. G. Matthey, A. P. Trotter, T. Mather, and F. E. Smith.

The Committee suggest that their reports from 1862 up to the present time, which are now out of print, might be reprinted as a memorial to Lord Kelvin. It is hoped that the proposed International Congress, to be held in London in October, will settle in a definite manner the few matters relating to the fundamental units which are still outstanding, and will organise a method whereby a close agreement may be maintained among the electrical standards in use throughout the world.

The measurements of certain of the fundamental units, which have been in progress for some time at the National Physical Laboratory, have been brought to a conclusion, and the results were published in three Papers in the "Philosophical Transactions" of the Royal Society.

From the first of these it appears that to a very high degree of accuracy the electromotive force of the Weston cadmium cell, as set up at the National Physical Laboratory, when expressed in terms of the ampere (10^{-1} C.G.S. units of current) and the international ohm is 1·0183$_0$ at a temperature of 17° C.

The second Paper dealt with the preparation of the Weston cadmium cell, and contained a comparison between cells set up at the laboratory and others constructed elsewhere, the general conclusion being that cells can be prepared by different persons in different countries which will agree in E.M.F. to 1 or 2 parts in 100,000.

In the third Paper was an account of a comparison of some six forms of silver voltameters, and it was shown that the silver deposited by a current of one ampere in all these various forms was the same if proper precautions were taken, and amounts to 1·11827 milligrammes per second.

After this work was completed a comparison was made by Messrs. T. Mather and F. E. Smith, by the kindness of Mr. Trotter, between the ampere standard of the Board of Trade and the ampere as realised by the new Ayrton Jones balance at the National Physical Laboratory. The comparison, an account of which appeared in the "Proceedings of the Royal Society," A, vol. 80, 1908, was very satisfactory. It was found that the Board of Trade ampere will deposit silver at the rate of 1·1179$_1$ milligrammes per second, a value which is nearly identical with the number 1·1179$_1$ given by Lord Rayleigh and Mrs. Sidgwick in 1884. Indirectly the E.M.F. of the normal Weston cadmium cell was found to be 1·0187$_0$ Board of Trade volt at 17° C., the Board of Trade volt being defined as the potential difference between the terminals of a resistance of one Board of Trade ohm when one Board of Trade ampere is passing through it.

During the year the ten mercury standards at the National Physical Laboratory have again been set up and intercompared. An account of this work is given in an appendix to the report by Mr. F. E. Smith, and shows that, except in the case of one tube, where there was an apparent change of 3 to 4 parts in 100,000, the resistances agree within one part in 100,000.

Mr. Smith has also compared with the mercury tubes a large series of wire standard resistances, including those made by Matthiessen and Hockin for the B. A. Committee in 1865–67, and various other old standards kindly lent to the Committee by their owners for the purpose. The general conclusion is that all the original coils except two, which are made of platinum, have changed appreciably since they were constructed, though since 1888, during a period of twenty years, for which the coils have been very carefully watched, the changes also in A, B, C, H, and "Flat" have been small. F and G have, however, in the same period changed considerably.

Resistance at 16°·0 in terms of the original B.A. unit (1867).

Coil.	Material.	1867.	1876.	1879-81.	1888.	1908.	Maximum Change.
A	Pt. Ir.	1·00000	1·00377	1·00056	1·00147	1·00122	0·00147
B	Pt. Ir.	1·00029	1·00121	1·00080	1·00104	1·00098	0·00092
C	Au. Ag.	1·00050	1·00141	1·00101	1·00146	1·00173	0·00123
D	Pt.	1·00092	1·00092	1·00092	1·00092	1·00092	0·00000
E	Pt.	1·00152	1·00152	1·00152	1·00152	1·00152	0·00000
F	Pt. Ag.	—	—	1·00016	1·00072	1·00160	0·00144
G	Pt. Ag.	1·00022	1·00030	0·99982	1·00025	1·00175	0·00193
H	Pt. Ag.	1·00020	—	—	1·00042	1·00044	0·00024
Flat	Pt. Ag.	—	—	1·00079	1·00120	1·00125	0·00046

The mean resistance of six other platinum-silver coils, first measured in 1888, appears to have increased since that time by 14 parts in 100,000; and five more platinum-silver coils, first measured in 1894–7, have now a greater mean value by eight parts in 100,000. It would appear also that in many of the variable coils the changes have occurred mainly, if not entirely, at the soft-soldered joints, and with a view of testing this the Committee have authorised the Secretary to open and examine one of the coils.

A comparison has also been made by Mr. Smith of all the manganin resistances in the possession of the Standards Department of the laboratory. The manganin standards are in constant use, and have proved of very great value. They not only facilitate electrical measurements, but they bring them to a far higher degree of accuracy than was formerly attainable. Nevertheless, the variations in these resistances have in many cases been a source of trouble, and attempts have been made, and are being continued, to construct standard coils of manganin which shall remain practically constant in resistance. Since 1905 the manganin standards have been intercompared at least four times every year, and the probable changes have been deduced from occasional comparisons with mercury standards and from tables of difference values, due regard being also paid to the past history of the coils. As an example of the comparisons, the case is taken of seven one-ohm coils which were intercompared in January, April, July, and October, 1906. The observed differences are below.

Coils.	Differences in 1×10^{-5} ohm at 17°·0 C.				
	Jan. 1906.	April 1906.	July 1906.	Oct. 1906.	Maximum Difference.
1690-780	6·82	6·87	7·05	5·93	1·12
1690-2351	2·17	2·35	2·04	1·47	0·88
1690-2483	0·26	0·48	0·26	−0·30	0·78
1690 381	−5·80	−6·05	−5·97	−6·27	0·47
1690-L·17	15·63	13·41	12·69	11·80	3·83
1690 L·18	16·69	16·05	15·54	14·92	1·67

The mean difference in the values of all the manganin coils for 1908 and 1903 is 12·6 parts in 100,000. The oldest coils are about seventeen years old, others are about thirteen and eight years old, and the remainder from five to six years old. In general, Mr. Smith has found that the older the coil the more constant does it appear to be.

The possible causes of the changes in the manganin resistances are classified under the following heads:—Change in structure of the alloy; surface action; humidity effect; change in the soldered joints connecting the wires of high-resistance coils to the current leads; change at the junctions of the potential leads with the resistance standard. Only the first of these appears to explain fully the gradual rise in resistance.

Of the manganin standards examined, says Mr. Smith, some have kept remarkably constant, while others are practically useless as standards. It must not be concluded, he adds, that all manganin resistances are subject to such changes. Drs. Jaeger and Lindeck have shown that the manganin standards of the Reichsanstalt keep very constant, and the manganin coils at the Bureau of Standards also appear to be of a fairly constant type, though subject to considerable cyclic changes owing to variable atmospheric humidity.

At the Conference on Electrical Units, held at the Reichsanstalt in 1905, it was suggested that the Jena glass 59^{III} was, from its good elastic properties, the best glass to employ for mercury resistances, and accordingly efforts have been made to get some suitable tubes. Five tubes have recently been secured, after great difficulty, which will probably do for standards, but the difficulty of drawing them is a serious obstacle to their use. A number of tubes of French glass, "verre dur," are also on order.

The grant of £50 made to the Committee at Leicester has been spent in great part in the purchase of materials for the Weston cells and the silver voltameter research, and in obtaining suitable tubes for use for standards of resistance.

Progress has also been made during the year in the design of the Lorenz apparatus, to be given by the Drapers' Company, and the manufacture of the bed and the heavy-metal work has been entrusted to Messrs. Armstrong, Whitworth & Co., who have kindly undertaken it. The marble cylinders required have been deliverd at the National Physical Laboratory.

Preparations for the holding of an International Congress on Electrical Units in London in October next are well advanced, and specifications dealing with the international ohm, the international ampere, and the Weston cadmium cell, which have been prepared at the National Physical Laboratory, after consultation with other workers to serve as a basis of discussion at the Congress, are given below with a view of making them known.

Specifications for the Practical Realisation of the Definitions of the International Ohm and International Ampere, and Instructions for the Preparation of the Weston Cadmium Cell.

The present specifications are intended mainly to serve as a guide to the standardising institutions of the various countries in order to obtain, as far as possible, complete agreement in the units of electric measurements. Certain instructions, such as the purification of mercury, have therefore been omitted,

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but all which is thought to be essential for an exact reproduction of conditions is still included.

The International Ohm.

The international ohm shall be equal to the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross sectional area, and of 106·300 centimetres in length, arranged in accordance with the following specification.

The column of mercury shall be of circular section, or nearly so, and shall be contained in a tube of suitable glass which has been carefully annealed. The tube shall be straight to the eye, and the maximum variation in its area of cross section shall not exceed 2 parts in 100. The tube is to be carefully calibrated, and the correction for its conicality determined.

In determining the weight of mercury contained by the tube when filled at the temperature of melting ice, the column of mercury is to be bounded by planes at the terminal cross sections of the tube. The tube should not be unduly heated, and it should be filled with mercury by exhaustion of air.

The axial length of the tube should be measured at 0° C. if possible, otherwise the coefficient of expansion of the glass should be determined and the axial length of the tube at 0° C. calculated from axial measurements made very near to that temperature. To facilitate measurements of the axial length, the ends of the tube should be ground very slightly convex.

For the electrical measurements the end of the tube are to be connected to spherical bulbs of glass, the slightly convex ends of the tube forming, very nearly, portions of the internal spherical surfaces of the bulbs. Each bulb is to be provided with a current and a potential lead, the point of entry of the former, and an end of the tube being at opposite ends of a diameter of the bulb. The potential lead shall be situated in a plane midway between the point of entry of the current lead and the end of the tube, and at right angles to the line connecting them.

Contact with the mercury shall be made by means of platinum wires.

The diameter of a bulb is to be from 30 to 33 times the diameter of the terminating section of that end of the tube to which it is connected.

If L is the axial length in centimetres of the mercury column contained by the tube at 0° C., W the weight of the column in grammes, and μ the correction for the conicality of the tube, the resistance of the column at 0° C. is

$$\mu \frac{L}{(106{\cdot}300)^2} \cdot \frac{14{\cdot}4521}{W} = 0{\cdot}001278982\, \mu \frac{L^2}{W} \text{ international ohms.}$$

When the spherical bulbs are fitted to the ends of the tube and the whole filled with mercury, if r is the mean radius of the tube and r_1, r_2, the mean radii in centimetres of the terminal sections, the resistance at 0° C. between the potential leads is

$$0{\cdot}001278982 \frac{L^2}{W}\left\{\mu + 0{\cdot}80 r^2 \left(\frac{r_1 + r_2}{r_1 r_2}\right)\right\}^* \text{ international ohms,}$$

correct to 1 per cent. of the added resistance

$$0{\cdot}001278982 \frac{L}{W}\left\{0{\cdot}80 r^2 \left(\frac{r_1 + r_2}{r_1 r_2}\right)\right\}^*$$

The electrical measurements are to be carried out at 0° C., the tube and spherical vessels being surrounded by melting ice and about 15 centimetres below the upper surface of the ice. The connecting wires employed for the current and potential leads must be thin, the flow of heat through them to the mercury being insufficient to warm the mercury as to produce appreciable error.

The insulation resistance between the mercury column and the ice surrounding the tube must not be less than 10,000,000 ohms.

The current employed in comparing the mercury resistance with other resistances shall be limited by the condition that the mercury shall not be warmed sufficiently to produce appreciable error.

The mean of at least five tubes must be taken to determine the value of the mercury unit.

The mean of at least three fillings shall be taken as the value of the resistance of a tube.

Specification for the Practical Application of the Definition of the International Ampere.

Conditions under which silver is to be deposited to measure currents from 0·5 to 8 amperes :—

The solution shall consist of from 15 parts to 25 parts by weight of pure crystallised silver nitrate in 100 parts of distilled water free from chlorine. It shall be used for one determination of current only.

In cases in which it is desired to measure a current of about 1 ampere the anode shall consist of a disc or plate of pure silver about 60 square centimeres in area and 3 or 4 millimetres in thickness. It is supported by a silver rod riveted through its centre. The anode shall be inserted into a cup of filter paper separately supported.

The kathode shall consist of a platinum bowl about 10 centimetres in diameter and 7 centimetres in depth.

About 300 cubic centimetres of the silver-nitrate solution are to be placed in the kathode bowl, and the anode is to be supported near the top of the solution and is to be just covered by it. Not more than from 7 to 10 grammes of silver should be deposited.

(For the measurement of smaller currents, say from $\frac{1}{4}$ to $\frac{1}{3}$ ampere, a bowl holding about 60 cubic centimetres of solution may be used, the anode being proportionately reduced in size and from 2 to 3 grammes of silver being deposited.)

The deposit should be rinsed with distilled water free from chlorine until the addition of a drop of neutral solution of sodium chloride in water, to the wash water, produces no milkiness. The kathode bowl is then nearly filled with distilled water and left for at least three hours; it should be rinsed three times, the last of these wash waters remaining in the bowl for ten minutes. This last wash water should give no milkiness when added to a neutral solution of sodium chloride in water. The deposit is to be dried in an electric oven at a temperature of about 160° C.; it is placed in a desiccator to cool, and is afterwards weighed.

The mass of the deposit, expressed in grammes, divided by the number of seconds during which the current has been passed and by 0·001118, gives the mean current in amperes.

Preparation of the Weston Cadmium Standard Cell.

The cell has mercury for its positive electrode, and an amalgam consisting of from 12 to 12·5 parts by weight of cadmium in 100 parts of the amalgam for its negative electrode. The electrolyte consists of a saturated solution of cadmium sulphate, and solid cadmium sulphate is contained within the cell. A paste, consisting of solid mercurous sulphate, mercury, and solid cadmium sulphate, rests on the positive electrode.

For the positive electrode, pure distilled mercury should be used.

The amalgam may be made either by electrodeposition or by mechanical mixing. It should be fused and freed from oxide by washing with dilute sulphuric acid.

For the preparation of the cadmium sulphate crystals and solution, commercially pure recrystallised cadmium sulphate should be dissolved in pure distilled water so as to form a clear saturated solution. Evaporation at about 35° C. is then allowed to proceed, when crystals separate from the solution. The crystals are washed with successive small quantities of distilled water, and part of them is dissolved in distilled water to form a saturated solution. The solution should be neutral to congo red.

The mercurous sulphate should be quite pure, and its crystals should not be so small as to have an abnormal solubility or so large as to be inefficient as a depolariser. The following is an example of a method for preparing the salt satisfactorily :—

Add 15 cubic centimetres of pure strong nitric acid to 100 grammes of pure mercury, and place on one side until the action is over or nearly over. Transfer the mercurous nitrate thus formed, together with the excess of mercury, to a beaker containing about 200 cubic centimetres of dilute nitric acid (1 volume of acid to about 40 volumes of water); a clear solution should result. Prepare about 1 litre of dilute sulphuric acid (1 volume of acid to 3 of water), and while the mixture is hot add the acid mercurous nitrate solution to it. The solution should be added as a very fine stream from the narrow orifice of a pipette, and the mixture violently agitated during the mixing. Mercurous sulphate is precipitated. Decant the hot clear liquid and wash the precipitate twice by decantation with dilute sulphuric acid (1 volume of acid to 6 of water). The precipitate should then be filtered and washed three times with dilute sulphuric acid (1 to 6), and afterwards 6 or 7 times with saturated cadmium sulphate solution to remove the acid. The mercurous sulphate should then be flooded with saturated cadmium sulphate solution and left for one hour, after which the solution is tested with congo red paper. In general no acid will be detected, and if so the mercurous sulphate is ready for use.

To set up the cell the H form of vessel is the most convenient. The platinum wires inside the vessel should be amalgamated by passing an electric current to each in turn through an acid solution of mercurous nitrate. The vessel must afterwards be washed out twice with dilute nitric acid and several times with distilled water; it must be free from stains and scrupulously clean; it is dried by the application of heat. The amalgam is fused and its surface flooded with very dilute sulphuric acid; sufficient of it to cover the amalgamated platinum wire completely should then be introduced into one of the limbs of the H vessel. To free from acid the amalgam may be remelted and washed with distilled water. Into the other limb of the vessel sufficient mercury is introduced to cover the amalgamated platinum wire completely. Then the paste, finely powdered crystals of cadmium sulphate, and saturated cadmium sulphate solution are added in the order named and the cell sealed.

* The end correction factor is given in these formulæ as 0·80: this value is, however, subject to amendment.

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Its electromotive force at 20° C. is $1{\cdot}018_5$ volt.

The electromotive force at any other temperature (t) may be obtained from the equation :—

$$E_t = 1{\cdot}018_5 - 0{\cdot}000038\,(t-20) - 0{\cdot}00000065\,(t-20)^2,$$

the limits of temperature being—(these have not yet been fixed).

DISCUSSION.

Principal GRIFFITHS (Cardiff) asked whether any care had been taken to get pure platinum for the coils referred to on p. 390. The temperature coefficient, as shown, was rather low.

Prof. J. J. THOMSON said it seemed to him more a matter of connections than of material, as the platinum silver alloys figured both among the best and the worst standards.

Dr. GLAZEBROOK said that the platinum standards dated from 1865 and 1867, and were presumably as pure as could be got at that time, and possibly better than the more recent ones. The wire resistances had the advantage of a low temperature coefficient, but thermoelectric disturbances could only be eliminated by using mercury.

The Committee asked for a renewed grant of £100 to prosecute the researches, and this was referred to the Committee of Recommendations.

The Educational Science and Chemistry Sections.

In his Presidential Address to the Educational Science Section, Prof. MIALL put in a plea for useful knowledge as against mere book-learning, and for the use of scientific method in acquiring it. Referring to technical education, he said :—

Technical education may be pursued in at least three ways : (1) We may seek to qualify the pupil for his calling by a thorough training in some science or art, and then, by the application under the guidance of an expert, of that science or art to a particular industry. The experience of at least two generations seems to show that this method is really effective; it does what it professes to do. (2) The second method aims at no more than supplying information directly applicable to the industry in question. Surely this is the least profitable of the three. The information is not accurately lodged, either in the memory or in the note-books of the students; it soon becomes obsolete in consequence of the advance of knowledge; and it does little to cultivate intelligence or the power of doing. Where intelligence and the power of doing already exist, mere information may be valuable, but the best storehouse of information is the printed book. (3) Lastly, we may aim at nothing more than facility by repetition. Such practical arts as reading, writing, drawing, needlework, and cookery are largely acquired by imitation and constant practice. Skill in these arts is a tool, whose profitable application depends much upon the intelligence and enterprise of the possessor. Independent attempts to meet difficulties, friendly criticism of these attempts, questioning about the causes of failure, are the expedients which a wise and experienced teacher, ever at hand, would employ. Such a teacher is, of course, rarely to be had, but is now and then found in a sensible mother. Perhaps the best substitute for the sensible mother would be plain, practical lessons on elementary science, such as the Edgeworths, Dawes, and Henslow used to give.

In his Address to the Chemical Section, Prof. F. S. KIPPING attributed the unsatisfactory state of the chemical industries in this country to the erroneous views which were held as to the functions and the training of a works chemist, and advocated an extension of the present period of training and the making of research work compulsory as far as possible.

FRIDAY, SEPTEMBER 4TH.

Section A divided into three departments : (a) mathematics, (b) general physics, (c) cosmical physics and astronomy. Departments (a) and (c) met at 10 a.m., while the meeting of the general physics department was postponed till 11.30 in order to allow its members to take part in the discussion on the report of the Committee on "Gaseous Explosions" in the Engineering Section. The Chemical Section also took part in this discussion.

The Committee consisted of Sir W. H. Preece (Chairman), Mr. Dugald Clerk and Professor Bertram Hopkinson (Joint Secretaries), Professors Bone, Burstall, Callendar, Coker, Dalby, Dixon, Hele-Shaw, Smithells, and Watson, Dr. Harker, Lieut.-Colonel Holden, Dr. Petavel and Captain Sankey. They were appointed for the investigation of gaseous explosions, with special reference to temperature, and this is their first report. To engineers the investigation of gaseous explosions is chiefly of interest because of its bearing upon the theory of the internal combustion engine, and the Committee have hitherto considered it mainly from this point of view.

The first part of the report deals with the measurement of the internal energy and specific heats of gases at high temperatures, and the second part with the measurement of these high temperatures. The previous work done in this direction is summarised and reviewed, and additional experiments carried out by members of the Committee are described. The report is of considerable length, occupying 33 pages.

Nothing of special electrical interest occurred in the mathematical department, the Papers being the purest of pure mathematics.

The department of General Physics attracted a large audience on account of the communications announced from Sir William Ramsay, Sir James Dewar, and Professor Rutherford.

Radio-activity.

Sir WILLIAM RAMSAY, K.C.B., F.R.S., read a Paper entitled "Do the Radio-active Gases (Emanations) belong to the Argon Series?" He endeavoured to assign positions in the periodic system to the emanations of thorium, radium, and actinium. The known elements of the Argon Series, with their atomic weights, are : helium, 4; neon, 20; argon, 40; krypton, 83; xenon, 130. The further atomic weights to be expected are 172, 218, and 262. The atomic weight of radium being 227, that of radium emanation is mostly likely 218. The unassigned numbers, 172 and 262, may belong to either thorium or actinium emanation. The author was inclined to assign the value 172 provisionally to thorium emanation, and 262 to actinium emanation. In the vertical column the radium series would be : Bismuth 208, (unknown 215), (unknown 217); radium emanation, 218, (unknown 223), and radium 227. A similar vertical column of somewhat lower atomic weights must then include 172 thorium emanation. The whole of the elements of that column would then probably be very unstable, which would account for their being as yet undiscovered.

In the discussion which followed,

Prof. RUTHERFORD said he admired Sir Wm. Ramsay's trust in the periodic system, which he personally did not share. If the α-particles are helium atoms of atomic weight 4, the genesis of radium might be represented as follows :—

Uranium 238·5
-2α : Ionium, 230·5
$-\alpha$: Radium, 226·5.
$-\alpha$: Radium emanation, 222·5.

and so on, down to lead, 206·5. The value, 222·5, for the atomic weight of radium emanation was not far from Ramsay's 218. No very accurate results could be got from diffusion experiments. He very much doubted the value 262 for actinium emanation, being rather inclined to regard actinium as a side-branch of the radium genealogy. He hoped to clear up the matter within a year by determining the relative number of α-particles emitted by the various bodies.

Sir OLIVER LODGE said he had followed with much interest the gradual demonstration of the remarkable fact that these emanations were actual chemical substances.

Mr. BUSS was surprised to hear that diffusion would shed little light on atomic weights. He had recently compared the emanations of thorium and actinium by that method, and found that of actinium distinctly lighter.

Sir WILLIAM RAMSAY pointed out that Prof. Rutherford had left out of account the production of neon. Would that not "upset the coach"?

Prof. RUTHERFORD : I am certain of the production of helium, but I regard the production of neon as anything but certain.

Mr. W. MAKOWER read a Paper on "The Number and Absorption of the β-particles Emitted by Radium," in the course of which he described the special precautions taken to eliminate secondary radiation. He found the number of electrons emitted by radium C in equilibrium with one gramme of radium to be 3×10^{10} per second, or rather less than previous values. He concluded that no β-particles are deflected or "scattered," but either totally absorbed or transmitted in the original direction.

Prof. RUTHERFORD said the experiments described gave a method of arriving at the comparative number of β-particles and α-particles emitted. The simplest supposition was that the numbers were equal. He agreed as to the absence of scattering.

Prof. MACCLELLAND said that recent work showed a distinct scattering in the direction of the reflected ray. This scattering was quite distinct from secondary radiation, which proceeded equally in all directions.

Prof. J. J. THOMSON said there was absolutely no doubt that β-particles were scattered by metals. There would be no absorption but for that. He described Crowther's experiment, carried

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out at the Cavendish Laboratory, in which the ionisation was measured in the direction of a straight beam of β-rays traversing a thin metallic film, and also outside the beam. About nine-tenths of the ionisation was outside the beam.

Prof. WILSON hazarded the guess that α-particles were positive electrons about 1,000 times smaller than β-particles.

Sir OLIVER LODGE wished a distinction to be made between absorption by conductors and by non-conductors. Scattering would naturally be expected in metals, and the curve of absorption should show a parallelism with the curve of opacity. He would like to ask Prof. Thomson if there was any analogy between his recent resuscitation of the corpuscular theory of light and the behaviour of β-rays, which were absorbed according to the same sort of law.

Prof. THOMSON said he preferred to answer that question privately.

Mr. MAKOWER, in replying, said he did not claim that his experiments were quite conclusive. All he maintained was that when β-rays are stopped they are stopped suddenly.

MONDAY, SEPTEMBER 7TH.

In the Engineering Section three Papers were discussed simultaneously, one by Capt. H. R. Sankey, dealing with the utilisation of peat, the second by Mr. J. Emerson Dowson on producer gas, and the third by Mr. Philip W. Robson on suction gas plants.

Peat.

The following is an abstract of the Paper by Captain H. R. Sankey, on "The Utilisation of Peat for Making Gas or Charcoal with Recovery of By-Products":—

The much-discussed subject of the utilisation of peat has during the last few years been revived owing to developments in gas producers and in gas engines, and at the moment it is of considerable interest in Ireland in connection with the Bill which has been promoted in Parliament to obtain powers to produce gas from peat, to use this gas for generating electricity by means of gas engines and dynamos, and to distribute electric power to works which will probably be established in the immediate neighbourhood of the power station and throughout a certain prescribed district. It is proposed to put the power station alongside the Grand Canal, not far from Robertstown, about 25 miles from Dublin.

Previous attempts to utilise peat for power failed because they were based on drying the peat, so as to contain no more than 25 per cent. of water, and in some cases the expense of "briquetting" was incurred; the peat was then transported to the place where power was required and burnt in steam boilers fitted with specially designed furnaces. Such peat could not compete with coal; moreover, the valuable by-products were not recovered.

In the proposed scheme the peat will only be partially dried—that is, will still contain 60 per cent. of water; it will be used on the spot to make gas, so as to get the benefit of the great thermal efficiency of gas engines and to save the cost of carriage. The by-products will be recovered, the profit on which will at least cover the cost of getting and drying the peat. It will be possible to supply power to works in the immediate neighbourhood of the power station as cheaply as can be done from water-power. Many of those industries which are dependent upon cheap power will undoubtedly be attracted.

Great progress has been made in Germany in the utilisation of peat. Although no complete electric-power undertaking is at present working on the above lines, all the various links in the chain are separately and successfully in operation; many of these links have been "Made in Germany," why should not the complete chain be put together in Ireland?

There are several methods of getting and drying peat. Apparently, the most suitable, when it is desired to obtain peat nearly all the year round, is to dig with a grab, and pass the peat through a Dornberg press. The peat then rapidly dries to 60 per cent., except in very wet weather in the winter, and to tide over this period a reserve of peat must be accumulated.

The producers used for making gas from peat are similar to those used with bituminous coal, but they are larger in dimensions for the same power. The gas issuing from the producers passes through the recovery plant, thence to the gas engines. The gas in passing through the recovery plant is cleaned in a very perfect manner, and therefore troubles due to tar and dust are entirely obviated.

Sulphate of ammonia is the principal by-product. The amount obtained depends on the percentage of nitrogen in the peat. The proposed power station at Robertstown will be capable of making 3,000 tons of sulphate per annum.

The other important by-products are acetate of lime, methyl alcohol, and tar containing paraffin wax and oils. An excellent waggon grease can be made from the tar, the output of which at Robertstown ought to be about 2,000 barrels per annum. The monetary value of these by-products will be about equal to that of the sulphate of ammonia.

An excellent charcoal can be made from peat, instead of gas, together with the by-products enumerated above, and the process has been in operation near Oldenberg for over ten years. The most up-to-date factory, however, is at Beuerberg, near Munich, and it has been at work for three years. The charcoal obtained from peat is of excellent quality, and can be used to advantage to replace wood charcoal. It is used in large quantities in Germany in connection with the manufacture of steel.

Producer Gas.

Mr. J. EMERSON DOWSON, in his Paper on "Producer Gas," said that his first Paper on the subject was read at the York meeting of the Association in 1881, and after a lapse of over a quarter of a century he thought it might be useful to take some account of the progress which had been made, and to offer a few passing remarks which practical experience suggested.

The first internally-fired gas producer was devised by Bischof in 1839, but little progress was made in our country until the late Sir William Siemens introduced the combined gas producer and regenerative furnace invented by his brother, Frederick Siemens, in 1857. It depended on the syphon action of a long cooling tube which caused an indraught of air to the producer, and made the gas flow to the furnace. In connection with this producer Siemens used various furnaces of special construction, and in all he heated the ingoing air and re-heated the gas by the outgoing products of combustion, the currents being reversed at short intervals. This was his regenerative system, and with it he attained exceedingly high temperatures with a low consumption of fuel. Since then various improvements have been made, the syphon tube has been abandoned, and the reversals of the currents are only used in special cases, as they occasionally lead to troublesome explosions. The more modern practice is to work the producer with a jet of steam at pressure which injects air, and the gas is delivered to the furnace at pressure; the cooling of the gas is thus avoided, and the hot gas flows continuously in one direction from the producer to the furnace. Only the air is heated by the outgoing products of combustion. In this way no unburnt gas can reach the air before the two meet in the combustion-chamber, consequently there is no risk of explosion in the flues. The process is simplified, and the cost of construction and the ground space required are lessened. The success of this type of furnace, Mr. Dowson continued, has been chiefly due to the heating of the air by the waste heat of the products of combustion, and for this useful outcome of theory and practice we are certainly indebted to the brothers Siemens. In this connection he mentioned that he had often been consulted by manufacturers and others who have had the idea that if they converted the coal into gas, in a producer, they could burn the gas with cold air in an ordinary coal-fired furnace, and get the same high temperature as with a coal fire. This is impossible, as about 50 per cent. of the producer gas consists of nitrogen, and the nitrogen content of the products of combustion is also high; the calorific power of the gas is therefore low, while the heat capacity of the products is comparatively high. The flame temperature is consequently low, especially if the gas is burnt with cold air. To attain high temperatures in a furnace with producer gas at low pressure it is not only desirable that the gas should be hot, but it is essential to heat the air, and obviously the most economical way of doing this is with the waste heat of the products of combustion. When worked in this way in a fairly large furnace it is not difficult to attain a temperature of 1,500 degrees Cent. (2,730 degrees Fahr.), and still higher temperatures can be reached if special arrangements are made.

In connection with furnace work, he also referred to Dr. Mond's system of making producer-gas with recovery of ammonium sulphate as a by-product. This plant can only be used on a large scale, and it needs coal containing a rather high percentage of nitrogen, as the formation of ammonia gas is an essential part of the process. A large excess of steam is sent into the producer to prevent the destruction of the ammonia gas, which is afterwards recovered as a sulphate by mixing it with free sulphuric acid. The gas which leaves this plant, after being washed, &c., has about the same calorific power, and about the same flame temperature, as ordinary producer gas. The advantage to the manufacturer is that the by-product reduces the cost of the fuel: but out of this saving he must pay for interest on the capital outlay, and for the wear of a rather complicated and costly plant.

The applications of producer-gas are numerous and varied, but in proportion to the immense amount of heating required in

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the various industries throughout the kingdom, the author feels that still more progress would have been made if manufacturers and others knew a little more about the subject technically. Often they do not seem to understand the treatment of gas or what can be done with it. For instance, it not infrequently happens that persons who have a gas plant to serve an engine think that they can take a branch pipe off the main to the engine for some heating work, and they then wonder why the flames jump, and why the result is unsatisfactory.

Undoubtedly the greatest development in the use of producer-gas has been with gas engines, especially during the last few years. A gas engine was worked for the first time with producer gas in 1879, the gas being made in a plant devised by the author; it was a small engine, and developed only 3¼ b.h.p. It consumed about five times more producer-gas than it would have consumed of ordinary town gas, although theoretically the comparative consumption of the two gases should have been as 4 :1. This showed that the weaker gas was not used to the best advantage. At the present time its treatment is better understood, and many important modifications have been made in gas engines. The calorific power of producer-gas of this type remains about the same as in 1879, but now it is necessary to use only four volumes of it for one of ordinary town gas. The improvements in the gas engine have been in large measure due to a better understanding of the thermodynamic problems involved. We are chiefly indebted to Mr. Dugald Clerk, for his investigations in this direction, and there are now many skilled workers who are giving close attention to this interesting and important subject.

Until the last few years the producer-gas used for gas engines was generally made with a jet of steam at pressure which injected the air required, but sometimes air at pressure was forced into the producer by means of a fan or blower. The gas made in either of these ways leaves the producer at pressure, and is now generally known as "pressure" gas. In some of the early gas-producers used for furnace work, air was drawn into the producer by suction—notably in the case of the Siemens producer already referred to—and in recent years the idea of working the producer by suction, instead of by pressure, has been reverted to in connection with gas engines. As early as 1862 Dr. Jacques Arbos, of Barcelona, patented a combination of gas plant and gas engine, in which the latter drew gas direct from the producer, and as this was about the time that a good deal of attention was being given to the Siemens suction producer and furnace it is not unlikely that he was inspired by this, and sought to apply the principle of suction from a gas engine. However, it was not a very practical arrangement, and there is no record of its having been actually used. The first to give effect to this idea in a practical way was M. Léon Bénier, of Paris. His first patent was in 1891, and in the early plants he made, the engine had a suction pump at the side of the motor cylinder, which drew gas from the producer and forced it into the cylinder. The combination was carefully tested by Prof. Aimé Witz, but the results were not satisfactory, and the next step of importance was to do away with the pump, and to use the suction of the engine (on the out-stroke of the piston) to draw gas from the producer. Various other modifications in detail, especially as to the way of producing steam, have since been introduced by different makers, and what is known as a "suction plant" is now extensively used. Mr. Dowson emphasised the fact that the chemical reactions on which the production of gas made with steam and air depends are identical in all types of producers. On several occasions manufacturers have spoken to him as though suction-gas were some new discovery; and they seemed rather surprised, if not disappointed, to learn that it was but an old friend in a new dress. He has even seen some engineers' specifications in which the strange and rather contradictory term "pressure-suction gas" is used. The names "pressure" and "suction" gas are not ideal, they are not scientific, but they are conventional terms which have been generally adopted to convey definite meanings; and it will only lead to confusion if these meanings are misunderstood or the terms are wrongly used.

The calorific power of pressure-gas made with a jet of superheated steam is usually considerably higher than that of suction-gas. In the former the percentages of hydrogen and carbon monoxide are higher, while the percentage of nitrogen is lower: and if the gas is to be used for heating purposes in small burners, or in blow-pipes, it is better to use pressure-gas than suction-gas. In many operations it would in fact be almost impossible to use suction-gas, as after the gas had been washed and cooled its flame temperature would be too low, especially if air at pressure were used to burn the gas. But for driving gas engines, suction-gas is extensively used with excellent results, provided the engines are properly adjusted for it. Suction-gas contains a smaller percentage of combustible gas than pressure-gas contains; and although it requires less air for its combustion, the loss from fluid friction is greater, and for these reasons an engine worked by suction-gas develops a lower maximum power than it would with pressure-gas. This loss in maximum power is not important in a small or moderate-sized engine, but it is more serious in an engine of, say, 200 h.p. or upwards, and for a given power larger cylinders must be used for suction-gas. On the other hand, the fuel consumption in a complete pressure-gas plant with an independent boiler is higher than in a suction plant, and its heat efficiency is necessarily lower than that of a suction plant which produces its own steam. If, however, the steam for the pressure plant is raised by the sensible heat of the gas produced, as is often done, the fuel consumption and the heat efficiencies of the pressure and suction plants are alike. We may therefore assume that under these conditions the heat liberated by the exothermic reactions is recovered in each case to about the same extent by the endothermic reactions.

In considering the two types of plant, the author's general conclusions are as follows:—"A suction plant has certain practical advantages—it costs less and occupies a smaller ground space, but the gas made in it is not so strong as in the older form of pressure plant, and in some cases this advantage of the latter is important. The fuel consumption per h.p.-hour, and the labour required, are the same in both types of plant, provided the steam required is raised without an independent boiler. The consumption of water is the same in both types. It is also worth mentioning that where there are several engines to serve, the arrangement of the gas-pipes is greatly simplified, and their cost is proportionally reduced, when the gas can be taken from a small gas-holder instead of from several suction plants."

In engine work, the Paper concluded, there are now hundreds of thousands of horse-power working regularly and satisfactorily with producer-gas. In this connection the gas plant has come to stay, and steam power has a serious rival; in some cases the pressure type is better than the suction type, in others suction is better than pressure. Each has its own province, and in each the consumption of anthracite is now guaranteed not to exceed 1 lb. per b.h.p.-hour under a full or three-quarter load. With low loads the consumption is a little more. For engines or for heating with small burners the best and cleanest gas is made with anthracite, as it does not yield tar; this not only simplifies and cheapens the plant, but it also reduces the cost of labour in working. When anthracite is too dear ordinary gas-coke can be used, provided that it is well carbonised, that it does not contain too much sulphur, and that it is not mixed with pieces of coal. Non-caking bituminous coal is almost invariably used for large furnace work, and there are some plants which make gas from this fuel for engine and other work. But these plants are rather complicated and costly, and they cannot be used for small powers. They require constant attendance, whereas a plant working with anthracite or coke can be left for several hours—what is gained by using the cheaper bituminous coal for small plants is lost by the additional cost of labour, &c. It is probable that in the course of time these drawbacks will be overcome, but for the present anthracite and coke can be used, and with these the adoption of producer-gas continues to advance most satisfactorily.

Suction Gas Plants.

Mr. PHILIP W. ROBSON, in his Paper on this subject, said that in the two years which have intervened since Prof. Dalby first described the suction gas producer before this Association, the demand for such apparatus has shown a steady and continuous growth both in this country and abroad. The Author has selected three typical cases where the load demand and general requirements are widely different, and in each case the figures given represent average ascertained costs over at least a 12 months' period of working, and has tabulated them in Table I. opposite.

The significance of these figures, the author added, will be appreciated from the fact that, if in case A current was taken from a public supply at ½d. per unit, the total cost of same would be £4,708 per annum. As the actual working costs with suction gas are £1,907, the difference between the latter and the cost of electricity at the assumed low rate of ½d. per unit represents a saving of £2,801 in favour of the gas power installation. This saving would entirely defray the initial total cost of the latter in a little over 18 months. He states that in the weaving shed referred to, the engine has been started up punctually every morning without fail, and the only stoppage in 12 months was that due on one occasion to a heated connecting rod brass. In the case of the cement works, rotary

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kilns are being operated, and the engines are regularly run for periods of from six weeks to two months night and day without stoppage. On the question of reliability, he also quotes the following figures from Mr. Michael Longridge's last annual report :—

Table I.

Ascertained Total Power Costs with National Gas Engines.

	Case A. Cement works.	Case B. Weaving shed.	Case C. Small Factory.
Size of installation in B.H.P.	450·0	300·0	20·0
Average working load, B.H.P.	360·0	220·0	7·8
Total B.H.P.-hours per annum	2,726,000	610,500	21,200
Initial total cost of installation (including foundations	£4,230	£2,640	£250
Total annual charges :	£ s. d.	£ s. d.	£ s. d.
Interest and depreciation.	423 0 0	264 0 0	25 0 0
Repairs and sundries	50 0 0	30 0 0	3 10 0
Fuel	1,298 4 8	135 4 2	15 11 0
Oil	135 3 10	10 0 0	2 0 0
Water (taken from canal in cases A and B)	—	—	7 5 0
Attendance, &c.	423 17 4	135 0 0	12 10 0
Total	2,330 5 10	574 4 2	65 16 0
Total cost per B.H.P.-hour	0·205d.	0·225d.	0·745d.
*Equivalent cost per Board of Trade Unit	0·245d.	0·27d.	0·79d.

* This means that if current were delivered from a public supply to a motor of 90 per cent. efficiency in cases A and B, and a motor of 80 per cent. in Case C, the rate of charges for such current would have to be those stated to give the equivalent cost per B.H.P.-hour also mentioned above. If, however, the standing charges in respect of the motors and electrical installation generally are added, this rate would have to be greatly reduced to equal the gas engine installation in economy.

Rates of Breakdowns.

Steam engines	1 in 8·1.
Electric motors	1 in 8·2.
Gas and oil engines	1 in 12·4.

The following is an abstract of the remainder of the Paper :—

We have been greatly aided in the successful development of these producers through having a suitable fuel at hand in England and Scotland and in several parts of Ireland. Up to the present, for reasons which will be explained later, suction producers have only been made to work on a commercial scale with non-bituminous fuels, such as anthracite and coke, both of which are easily obtainable in the industrial centres of the kingdom. In England, Welsh anthracite was obtainable until two years ago for about 20s. per ton, at which figure there was no difficulty in obtaining the much advertised "10 b.h.p. for one penny" in fuel cost. With the rise in the price of anthracite, gas plant makers adapted their apparatus to work with gas coke, which can be bought at from 10s. to 15s. per ton, and as the consumption of such coke in a well-designed producer need not exceed 25 per cent. more than anthracite for the same power, it will be seen that it is in any case more economical to use it. In Scotland, suitable anthracite can be obtained at from 10s. to 15s. per ton, and the local supplies of anthracite in most of our colonies and in France and Spain are now being successfully used for suction producers, whilst in other countries charcoal is plentiful and comparatively cheap.

The principle of working all suction producers is similar : the gas inlet valve on the engine cylinder is directly connected to the producer, which usually consists of the furnace or generator coupled to a cooling vessel or scrubber. During the suction stroke of the cycle the inlet valve of the engine is opened, and the gas accumulated in the intervening pipes between the engine and the producer is drawn forward into the working cylinder together with a proper proportion of air. A corresponding amount of mixed air and steam flows into the furnace of the producer and reacts there with the fuel, with the result that gas is evolved of an amount equal in volume (after being cooled in the scrubber) to that drawn away. Hence the yield of gas entirely depends upon the suction effect exerted by the engine through the gas inlet valve; the latter being in turn under the automatic control of the engine governor in the extent to which it is allowed to open causes the amount of gas to be automatically regulated to suit variations of load. All the attention that is necessary, therefore, whilst the plant is working, is to keep the generator charged with fuel—an operation occupying from two to three minutes every two hours.

The conditions under which combustible gas is produced in the generator so as to give the best efficiency have been carefully investigated. Obviously, the fuel must be gasified in such a way as to lose a minimum quantity of heat in the producer, so that as large a balance as is possible is available for useful work in the engine. The only burnable gas which can be obtained in the usual way by the partial combustion of the carbon constituents of the fuel is carbon monoxide (CO) as expressed by the equation

$$2C+O_2=2CO, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (a)$$

but the production of this gas is attended by an evolution of 30 per cent. of the heat of the carbon reacted on. Unless this heat were to a large extent recovered the efficiency of the producer would, obviously, be very low, and besides the cumulative effect of a continual liberation of heat in this degree would be to set up a very high temperature in the producer which would tend to the formation of excessive clinker and which would also cause many other difficulties.

A simple practical means of utilising this heat and enriching the gas at the same time is by the method so generally adopted now of saturating or partially saturating the air passing to the furnace with steam. This steam reacts with incandescent carbon in two alternative ways—

$$C+2H_2O=CO_2+2H_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (b)$$

$$C+H_2O=CO+H_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (c)$$

In both of these reactions a combustible gas results, and they both require heat to enable them to take place. This is supplied by the liberated heat just referred to, which results from the direct combination of the oxygen of the air with the carbon of the fuel to form carbon monoxide, and hence, broadly speaking, the degree in which the reduction of steam according to either of the foregoing equations can take place with advantage depends entirely on the amount of heat available from the production of monoxide in the primary reaction according to equation (*a*).

The decomposition of steam in the presence of heated carbon, however, begins at a comparatively low temperature (between 500° C. and 600° C.), and hence if too much steam is used the fire becomes unduly cooled, which is undesirable.

A further advantage which follows from the use of steam is the enrichment of the gas made, for the hydrogen evolved by the reaction (*b*) and the monoxide and hydrogen in reaction (*c*) are combustible gases produced apart from reactions with atmospheric oxygen, which in all cases carries with it four times its volume of nitrogen. This latter is a diluent in all producer gas and passes through the furnace unchanged.

In all suction producers directly connected to the engine and automatically regulated thereby, successful working depends also upon the absence of any serious restriction to the flow of gas from the furnace to the engine cylinder. If there is a restriction for any reason, the weight of charge drawn into the working cylinder of the engine is reduced and a loss of power results which may make all the difference between success and failure. The very simple form of generator and scrubber in the ordinary suction plant using non-bituminous fuel makes it possible to avoid undue restriction; even when gas coke or poor anthracite is used, each of which yields a certain amount of tarry matter and consequently requires the addition of a suitable tar extractor to the scrubber, the suction pressure can be kept sufficiently low to prevent the volume of charge becoming unduly diminished.

Bituminous fuels contain upwards of 30 per cent. of volatile matter, which distils off at such temperatures as are found in the upper part of a suction producer. Now, of these volatiles, 6 per cent. and upwards is tarry matter, which condenses out as the temperature of the gas is lowered in the scrubber and gas mains. These latter would quickly become clogged up, and, in addition, so large a proportion of tar would be carried forward to the engine that the successful working of the latter would be vitiated. It is this tar difficulty which is the chief trouble to be dealt with in making a successful suction producer to work with bituminous fuels, for the addition of extra cleaning apparatus to extract the tar in a sufficient degree would necessarily have the effect of greatly increasing frictional resistance to the passage of the gas from the generator to the engine, and would otherwise destroy that simplicity of arrangement which we have seen to be essential. Attempts have been made to decompose the tar by working the producer on the down-draught principle, which has the effect of compelling the volatiles to pass through the hot zone of the furnace before leaving the producer. By another plan the gas outlet is in the middle of the producer and air is supplied both at the top and at the bottom, the action which is aimed at being to use the upper half of the producer as a down-draught furnace for distilling and fixing the volatiles, while the lower half is supplied with the residual coked fuel and works as an ordinary

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up-draught furnace. It is, however, extremely doubtful whether a successful solution of the difficulty will be arrived at by either of these two methods. In pressure producers many plans for reducing the tar within the producer by passing the volatiles through the hot zone of the furnace have been carefully tried from time to time, but without a sufficient measure of practical success to warrant the permanent adoption of any of them for use with bituminous steam coal such as is available here. There appears to be no reason for thinking that modifications of these proposals when applied to suction producers will prove to be more efficacious. Calculations given in the Paper suggest a better method for attacking the problem. It is shown that all the sensible heat liberated by the combustion of the carbon of the fuel with the oxygen of the air could be absorbed by the reduction of the steam passing into the furnace along with the air, and that the precise amount of steam which can be reduced depends entirely on the amount of heat which is so liberated. Further, when we account for the whole heat of the carbon in this way and take into full consideration the diluent effect of the nitrogen which is unavoidably present, a gas of sufficient calorific value results for effective use in the engine cylinder. There would, therefore, seem to be no reason why the furnace of the producer should not be devised in such a way that the volatiles are absolutely burnt out after being distilled, the heat of this combustion being afterwards recovered by the decomposition of steam under the conditions already described. By such a method the tar would undoubtedly be eliminated, whilst the efficiency of the system would be high. There are several designers at work on producers of this character, and when the proper proportions and other practical details are understood a considerable measure of success may be hoped for; the simplicity of the cooling and scrubbing arrangements under this system gives good promise of the feasibility of evolving a practical suction plant for use with bituminous fuels. The ordinary plant, however, for gas coke or anthracite may still be expected to hold the field for units up to 100 b.h.p.

The Paper concludes with the following passages:—It is becoming increasingly recognised by leading electrical engineers that it is exceedingly difficult, and in many cases impossible, to supply current for power purposes from central stations at rates sufficiently low to favourably compete with the cost to the consumer if he generates his own power; but as attention has recently been so fully drawn to this aspect of the matter in a comprehensive Paper read before the Institution of Electrical Engineers by Mr. J. F. C. Snell, it is only necessary to refer to it briefly here. Mr. Snell has emphasised the present inability of most electricity undertakings to meet a large demand for power at sufficiently low rates to hold their own with users' own plants, and I understand his remedy to mean the remodelling of central power stations, the writing down of the capital expenditure already incurred in connection with them, and the elimination of independent electricity stations in the smaller towns in favour of a central installation supplying a group of towns.

I think Mr. Snell, who speaks with competent knowledge of electricity undertakings generally, does well to face the position frankly; but in view of such facts relative to the economy and reliability of gas power as I have ventured to refer to here, it will be conceded that there are adequate grounds for the serious doubts which some of us feel as to the wisdom of embarking on the many millions of expenditure which the general adoption of his proposals would entail. The ultimate effect of such proposals, which are chiefly framed with the object of supplying power to factories as distinguished from general electric lighting, would be nothing more than an attempt to do for the power user what he can carry into effect on better terms for himself by the use of gas engines and suction gas producers.

Another important point is that the growing tendency which exists to remove factories out of the large town areas must tend to continually increase the distribution costs of electricity supply, thus making the chances of a margin of profit on any rate which it would be to the advantage of the user to accept even more remote. On the other hand, particular location has little or no influence on the successful and economical working of gas producers.

The following is a report on the joint discussion on these three Papers:—

Mr. CROSSLEY said that Mr. Sankey's paper was very interesting to him, because his company had been experimenting and looking into the case that can be made out for the utilisation of peat. Peat was an ideal substance for producing gas, but it had already been proved that it did not pay to carry the peat, and therefore the plant had to be taken to the peat bogs. The experiments his firm had been engaged in were to answer the questions, could peat be used in a gas producer when it contained as much as 60 per cent. of moisture? and did the peat contain a sufficient quantity of nitrogen to make the collection of ammonium sulphate profitable? He said their experiments had been carried out with a gas plant not specially designed for treating peat, but of the ordinary anthracite type, and the answers they had to make to these questions were, that undoubtedly a good gas can be produced from peat containing as much as 60 per cent. of moisture, and that a large quantity of the peat contained quite enough nitrogen to make the sulphate of ammonium not only a valuable by-product, but actually to pay, by the production of this substance alone. On the bog of Allan in the Kildare district there was a tremendous quantity of peat available; it was right on the banks of the Grand Canal, which offered cheap transit to Dublin and other places. There was also a great quantity of limestone immediately available (with a view to the manufacture of calcium carbide), and anthracite coal could be got from Kilkenny, about 30 miles away. He might say that they would be able to produce electrical energy a great deal cheaper than could be done by large generating stations at the coal pit mouth; in fact, their cost for generating would be about on a par with the large hydro-electric stations. There was no doubt that there were a large number of manufactures at the present time in which the cost of power was the principal item, and in future, instead of as at present their having to go to Norway, Spain, America, and other places to obtain cheap electricity generated from water power, they would be able to get the same facilities on the bog of Allan. Mr. Crossley further stated that they intended establishing a plant capable of dealing with 10 tons of peat per hour, the capital cost of which would be £50,000. The peat experimented with contained 2·2 per cent. of nitrogen, and in their experiments yielded 140 lb. of sulphate of ammonium per ton of dry peat. He believed they would ultimately get better figures than that, and should get 170 lb., *i.e.*, 80 per cent. of the sulphate available; in fact, he did not see why, after further experiments, the whole should not be recovered. He stated that their capital cost of £50,000 could be written off completely in six years, and that they could make a gross profit of £24,000 a year. Going into the cost of the process, he stated that with peat yielding 2·2 per cent. of nitrogen the cost of reducing one ton of ammonium sulphate would be £5 18s., which would sell on the open market at about £11 per ton, but even if they were working with peat yielding 1·6 per cent. of nitrogen or yielding 100 lb. of sulphate per ton of dry peat, it would still be a very profitable investment. The cost of production in this case would be £7 9s. per ton, and, if this was sold at £11 10s. per ton, this would yield a profit of £4 1s., or even if they further reduced the profit to £3 per ton it would return a matter of some £6,000 on the £50,000 outlay. This did not take into account the gas which was produced, part of which could be sold at a very low figure for driving gas engines for the generation of electricity, which, at the price they could offer gas at, would undoubtedly lead to the building up of many industries in the neighbourhood. They could, of course, use the balance of the heat not required for power purposes to help to dry the peat. He stated that Mr. Robson's remarks with reference to the high efficiency of small producer gas plants were most interesting, and it was a well-known and indisputable fact now that in many small plants a horse-power-hour was being generated with the consumption of only ⅝ of pound of coal. With regard to the trouble due to tar when using bituminous coal, Crossleys fan separator worked well and did away with this trouble. He thought that Mr. Robson was rather pessimistic about the use of bituminous coal for suction producers; they had made great progress, and when they had a few plants running, it would soon bring the vendors of anthracite coal on their knees and reduce the ridiculously exorbitant prices which were at present being charged.

Mr. SIEMENS said that Mr. Dowson was not quite right in stating that "the modern practice with producers is to work them with a jet of steam," as if Sir Wm. Siemens had not made this discovery. The speaker distinctly remembered, when working in the drawing office in 1867, drawings of both suction-gas producers and those working with steam jet. He mentioned that since the year 1899 he had had a small 10 h.p. producer gas plant working at his private house, and although his was a comparatively old design compared with those of the present day, he had tested it and found out that it could produce one Board of Trade unit for 20 ounces of anthracite coal. This, of course, included the losses in the gas engine and dynamo. He thought that if makers would again experiment with carrying the gas to the engine in a large and long overhead pipe, in which the passage of the gas would be very slow and in which it would be well cooled, and then collected from this pipe the by-products, good results would be obtained. He stated that he had heard such figures as Mr. Crossley mentioned quoted before on paper, and one disadvantage of quoting such figures was that people had a habit of remembering them afterwards, and might ask, why should we pay £11 per ton for what only costs you £5 to produce? (Mr. Crossley replied to this immediately by stating that the sulphate of ammonium industry was such a huge one that the market would not be brought down by the amount that they would manufacture in Ireland.)

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Mr. RIGBY (engineer to Messrs. Crossley Bros.) stated that he did not agree with the practice recommended by Mr. Dowson of working producer gas furnaces at a temperature of 1,500° C., but thought 600° was a much better temperature. With reference to the percentage of steam used in gas producers, he said, of course, it was well known that you could work between the limits of no steam to 2½ tons of steam per ton of fuel, and although, as shown by Mr. Robson, you could get a richer gas by working with a smaller quantity of steam, it required a fairly large amount of steam to prevent clinkering, and there was not much advantage in getting a rich gas if you were getting rid of clinker and ashes containing perhaps 5 per cent. of carbon. He thought 9 lb. of steam per lb. of coal a good rule, and you burnt your fuel better, but, of course, it depended on the fuel; with a good fuel you could work with a higher temperature, but with a bad fuel you must work with a low temperature in order to prevent clinkering. He did not believe in a down-draught type of producer; they worked well for two or three hours, and then usually gave trouble by the fire getting into holes; neither could he agree with the statement that the trouble that prevented the use of bituminous coal was the difficulty of getting rid of the tar. His firm had solved the tar difficulty for the past five years by means of a centrifugal fan arrangement which worked excellently; the real trouble with the bituminous coal was that of caking, and his firm had practically got over this difficulty by a new type of producer in which the fuel was burnt twice. It was first of all passed on to a grate, where it was slowly burnt, and the caking that occurred was broken up mechanically by vibrating the bars. This broken-up caked coal was then fed down into the producer proper, and the gases that came off from the top grate were brought round underneath the second producer furnace and fed into this with jets of steam. The results they had obtained were admirable, but there were a few details that required to be altered before the plant was put on the market.

Mr. SHERLOCK, who said he had had a great deal of experience in the attempts to utilise peat in the past, at last looked forward with pleasure to a practical scheme being formed for the utilisation of peat. As stated by previous speakers, the situation of Robertstown was admirable, and when fuel for gas engines could be produced as a by-product, surely something ought to be made out of the scheme for utilising it for the generation of electrical energy. He stated that, generally speaking, the average depth of a bog was about 15 ft. This was divided into three strata. The top 5 ft. was practically useless except for making peat litter and using the dust for packing purposes; the next 5 ft. produced useful peat for ordinary burning, but it was the bottom 5 ft. that contained the nitrogen. He had had a sample carefully tested, and the results had been practically no nitrogen in the top 5 ft. and 3 per cent. in the bottom 5 ft., therefore he thought it should be realised that before useful peat for the production of sulphate of ammonium was obtained the top 10 ft. had to be cleared away.

Mr. CROSSLEY immediately rose to his feet, and said that their experience after many experiments was perfectly different; it was the top 5 ft. that contained the largest amount of nitrogen, and that there was no necessity to grab up useless peat before good peat could be obtained.

An interesting Paper by Mr. Walter Rosenhain (National Physical Laboratory) was read on "The Study of Breakages." This necessitated curtailing the discussion on the peat and gas Papers.

A Paper by Prof. Ernest Wilson, which we abstract below, was taken as read:—

Light Aluminium Alloys Exposed to the London Atmosphere.

Prof. ERNEST WILSON explained that specimens of certain light aluminium alloys were placed on the roof of King's College, London, in order to investigate the effects of exposure to London atmosphere. The specimens were in the form of wire 0·126 ins. (3·2 mm.) diameter, and were placed on the roof on June 11th, 1901. They were taken down in June, 1908, and their electrical resistance measured. Only one specimen of each alloy was exposed. The deterioration of the copper alloy was found to increase with the percentage of copper. Those alloys containing zinc as well as copper had very much deteriorated, and the breaking load was not higher than that of commercially pure aluminium. The copper-nickel alloy with the highest tensile strength had considerably deteriorated. Those alloys containing a comparatively high percentage of iron showed little deterioration, and their tensile strength was high. Manganese in fairly large proportions increased tensile strength, and had little effect upon durability. An examination showed that the specimens were not badly pitted. The tensile strengths referred to were those taken originally, and no tests have yet been made to ascertain whether there have been any variations in this respect. The increase in specific resistance ranged from 5 to 55 per cent. for different alloys.

THE NEW AUSTRALIAN TARIFF

ON page 432 of Vol. II. of ELECTRICAL ENGINEERING we gave particulars of those sections of the new Australian tariff connected more or less intimately with the electrical engineering and allied industries. At various times since we have given certain amendments, which were the result of representations made on the part of traders and manufacturers. We now have before us the rates of duty and wording of items as finally passed by the Commonwealth Parliament, and as there are important alterations to be recorded in the original proposals, we give at length those portions of the new tariff of interest to electrical engineers.

The Manufacturers' Association of Great Britain has been very active in its efforts to secure some modification of many of the duties first suggested, which were regarded as detrimental to the interests of British industries. That the Association was extremely successful may be judged from the following alterations which were made in the proposed tariffs upon electrical goods. A 25 per cent. duty upon dynamo-electric machines up to the capacity of 200 h.p., static transformers, and induction coils for all purposes, and electric fans was reduced to 20 per cent.; generators for direct coupling to steam turbines will be admitted free, instead of being liable to a duty of 12½ per cent.; electric fittings consisting wholly or partly of metals, viz., switches, fuses, and lightning arresters are free (the proposed duty was 20 per cent.); and high-speed reciprocating steam engines for direct coupling, or directly coupled to generators or pumps, will also be admitted free of duty, whereas it was intended to impose a tariff of 25 per cent. In the new tariff, electrical machinery is gathered into three distinct groups under Division VI., "Metals and Machinery." Previously, electrical machines were scattered over the metals and machinery portion of the tariff, and the alteration in question was made in deference to the wishes of a deputation of manufacturers of electrical machinery who waited upon the Minister of Customs on September 3rd, 1907.

Originally, there was an all-round duty of 12½ per cent. upon electrical machinery entering Australia without any classification, and it may be recalled that a Royal Commission was appointed by the Commonwealth Parliament to inquire into the effect of the new tariff, as it was put forward in the first instance. The following remarks upon electrical goods appeared amongst the conclusions of the Committee:—

That the present duty of 12½ per cent. is too low for protective purposes, too high as a revenue duty, and that an increased duty to a protective standard on certain special lines of electrical machinery and appliances would give a stimulus to the manufacture of electrical machinery and appliances in Australia. That electrical generators, motors, and fans, and other machinery and appliances have been made in Victoria and Queensland under 25 per cent. protective tariffs which were in operation at some period prior to Federation. That owing to the reduction of duties in Queensland the local production of electric fans, motors, and other appliances in that State ceased; thereafter no attempt was made to compete with importations, and firms which formerly manufactured, are now importing these products. That there seems to be no reason why electrical generators and motors, probably up to a high capacity, and certainly up to 500 horse-power, should not in the future be made in Australia, provided the insulated conductors and insulating

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materials required are admitted free. The parts which could be made in this country are as follows, viz., castings, bedplates, yoke and pole pieces, magnet cores, bearings, slide rails, armature sections, including shaft, core stampings, commutators, brush rocker, and holders. That starting and regulating rheostats, starting switches, and controlling devices for both alternating- and direct-current machinery can be readily made in Australia. That electroliers, electric wall brackets, gas brackets, and gaseliers, globe holders, and adapters, brass pendants and brackets, photometers, incandescent lamps, and gas mantles, reflectors, arc lamps, and globes, testing instruments and meters, should be classed together and subject to the same rate of duty, whether used in connection with gas or electric light.

The Commission recommended an ad val. duty of 25 per cent. on electrical machinery—generators, motors up to the capacity of 500 h.p.; fans, starting and regulating rheostats; ad val. duty of 12½ per cent. on machinery not elsewhere included; 20 per cent. electric and gas appliances.

From the final duties given below it will be seen that the recommendations of this Commission were not adopted absolutely, and we are informed by the Manufacturers' Association of Great Britain that on a number of items where the Commonwealth Government were unable, for various reasons, to reduce the duties on British goods, they met the representations of the Association (in a more effectual way in some cases) by creating or increasing existing preferences.

EXTRACTS FROM AUSTRALIAN CUSTOMS TARIFF, 1908.

All imitations to be dutiable at the rate chargeable on the goods they imitate, unless such rate is less than the rate which would otherwise be chargeable on the imitations.

The term "Iron" includes "Steel."

N.E.I. means "not elsewhere included."

Any article, not otherwise dutiable, composed of a combination of other articles, some of which are dutiable when imported separately, and of others free of duty when imported separately, shall be dealt with as follows:—

(*a*) When the value of the dutiable portion exceeds the value of the free portion, duty shall be charged upon the whole article at the same rate as would be chargeable on that portion of the dutiable portion which, if imported separately, would be liable to the highest rate of duty.

(*b*) When the value of the free portion exceeds the value of the dutiable portion of such article, the whole article shall be admitted free of duty.

IMPORT DUTIES.

Tariff Items.	General Tariff.	Tariff on Goods the Produce or Manufacture of the United Kingdom.
DIVISION VI.—METALS AND MACHINERY.		
142. Lamps, Miners' Safety	Free	
160. Motive Power Machinery and Appliances (except Electric), viz.:—		
(A) Flue-heated Economisers; Mechanical Stokers; Steam Traps; Steam Turbines; Superheaters; Water Purifiers ... ... ad val.	5 per cent.	Free
(B) High-speed Reciprocating Steam Engines for direct coupling or directly coupled to electric generators or to pumps, subject to Departmental By-laws ... ad. val.	5 per cent.	Free
(C) N.E.I. ... ... ad val.	20 per cent.	
176. (D) Coal-cutting machines ad val.	5 per cent.	Free
177. Electrical Machines, Appliances, and parts thereof:—		
(A) Dynamo Electric Machines up to the capacity of 200 horse-power; Static Transformers and Induction Coils for all purposes; Electric Fans... ... ... ad val.	20 per cent.	
(B) Dynamo Electric Machines over the capacity of 200 horse-power ... ad val.	12½ per cent.	
(C) Regulating, Starting, and Controlling Apparatus for all electrical purposes, including Distributing Boards and Switchboards, except Telephone Switchboards ad val.	20 per cent.	
(D) Electric Fittings consisting wholly or partly of metal, viz.:—Switches, Fuses, and Lightning Arresters	Free	
(E) Electric Heating and Cooking Appliances ... ad val.	15 per cent.	10 per cent.
(F) Electric Fittings not containing metal to be dutiable according to material.		
(G) Generators for direct coupling to steam Turbines ad val.	5 per cent.	Free
178. Electrical and Gas Appliances, viz.:—		
(A) Electroliers; Gaseliers; Chandeliers; Pendants; Brackets, Zinc Tubing ad val.	20 per cent.	
(B) Gas meters ... ad val.	5 per cent.	Free
(C) Telephones, Telephone Switchboards and Appliances	Free	
(D) N.E.I. ... ... ad val.	17½ per cent.	10 per cent.
179. Electrical Articles and Materials, viz.:— Accumulators or Storage Batteries; Arc Lamps; Arc Lamp Carbons; Cable and Wire (covered;) Carbon in blocks of 12 square inches and over; Electric Vacuum Tubes; Measuring and Recording Instruments; Prepared Insulating Tape ad val.	5 per cent.	Free
180. Rails, Fish Plates, Fish Bolts, Tie Plates and Rods, Switches, Points, Crossings, and Intersections, for Railways and Tramways ... ... ad val.	15 per cent.	10 per cent.
181. Iron Pipes, Cast and Wrought, n.e.i., and cast-iron fittings for pipes ... ... per ton	40s.	35s.
182. Iron and Steel Tubes or Pipes (except riveted or cast) not more than 6 inches internal diameter; including Flexible Metal Tubes; Galloway and Vertical parallel Boiler Tubes, bent or straight; Water Bore Casings; Wrought and Malleable Iron fittings for pipes; and unpolished metal-cased tubes or pipes	Free	
183. Rolled Iron or Steel Beams, Channels, Joists, Girders, Columns, Trough and Bridge Iron and Steel, not drilled or further manufactured; Shafting, Cold Rolled, Turned, or Planished ... ... ad val.	17½ per cent.	12½ per cent.
193. Anodes, Cathodes, and Hooks for plating purposes ... ad val.	5 per cent.	Free
DIVISION XVI.—MISCELLANEOUS.		
424. Asbestos Pipe and Boiler Covering; Asbestos Mattresses for Boilers ... ... ad val.	20 per cent.	

Electrical Exhibition in New York.—An electrical exhibition is to be held in Madison Square Garden, New York, from October 3rd to 14th, under the auspices of the lighting companies of Greater New York. The exhibition will commemorate the jubilee of the laying of the first submarine cable, of 1858, and the completion of 25 years of continuous electric supply on Manhattan Island. Mr. Thomas A. Edison has taken the honorary presidency, and the vice-presidents are leading men in the industry. One day has been set aside for charity.

Electric Power Transmission in Chili.—According to the *Electrical World*, the Empresa de Traccion y Alumbrado Electricos, of Santiago, is installing a 22,000-h.p. hydro-electric plant at La Florida, whence the electrical energy is to be transmitted to the city over an underground cable at 12,000 volts. This will be sufficient to light and supply power for the works of the city for many years to come. The installation is principally German.

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AN AMERICAN SINGLE-PHASE LIFT MOTOR

MOST of the electric lift installations in this country are worked by continuous-current motors, and with this type of motor an excellent speed control can be obtained. However, in districts in which the supply is in the form of alternating current, there is a considerable demand for a good single-phase lift motor with a good starting torque and freedom from sparking. In a recent issue of the *Electrical World*, a single-phase lift motor which has been brought out by the Century Electric Co., of St. Louis, was described. This motor is built in 5, 7·5, and 10-h.p. sizes, and is claimed to have a very high power factor and a reasonably high efficiency.

The motor is a repulsion-induction commutator machine, being in principle of operation substantially equivalent to a single-phase constant-speed induction motor while in starting condition, but it differs from that type of motor in that it is designed to work normally with the commutator in circuit instead of having it cut out. It, however, has a centrifugal device which short-circuits the armature at synchronism, thus placing the motor armature on short circuit for the purpose of limiting the speed when the lift is driving the motor. This device puts the commutator back in service again as soon as the speed has dropped below synchronism by 10 per cent. The commutator is very large for the output of the motor, and this and careful design of the brush-holders are said to have lessened the deterioration of the commutator to the degree obtained with good continuous-current motors.

The curves in Fig. 1 illustrate the starting characteristics of

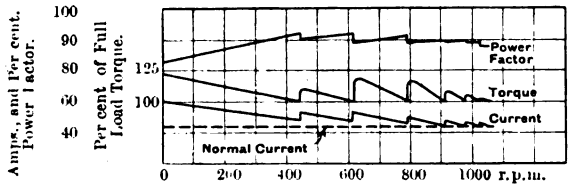


FIG. 1.—STARTING CHARACTERISTICS UNDER NORMAL LOAD WITH CONTROLLER.

this motor when used with a non-inductive controller. The curves were taken from a certain 75-h.p., 1,080 r.p.m., 60-cycle motor, but they are generally characteristic of this line. As will be noted, throughout its entire normal range of operation, the power factor of this motor, while starting with the non-inductive controller, is above 80 per cent., and it rises to above 90 per cent. at certain points.

Fig. 2 shows the operating characteristics of the motor when all of the starting resistance is short-circuited. These curves cover a range of speed from 400 to 1,200 r.p.m., the latter being the synchronous speed of the motor. The ultimate starting

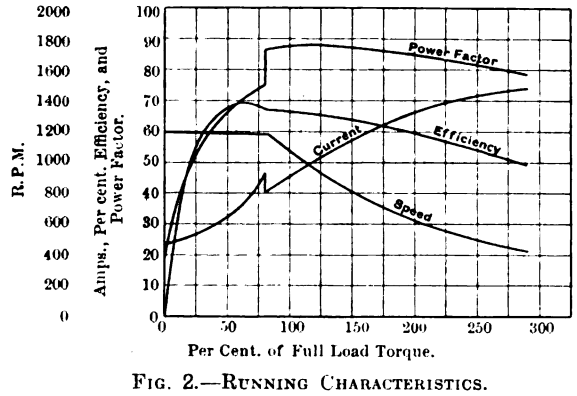


FIG. 2.—RUNNING CHARACTERISTICS.

torque of this motor is stated to be about 400 per cent. of the full-load torque, and is secured with about 200 per cent. of full-load current. Of course, in normal operation a motor will not be required to start on five times its rated load, as in general a lift making a five-second start will require less than 200 per cent. starting torque, even when fully loaded. In normal operation the current consumption indicated in Fig. 1 should be little, if at all, exceeded. The motor gives 120 per cent. of full-load starting torque with 130 per cent. of full-load current. In normal operation these motors seldom take more than 130 per cent. of full-load current; ordinary starts require less than 100 per cent. of full-load torque.

No auxiliary inductive devices, auto-transformers, slip rings, or other supplementary appliances are made use of in connection with this motor. A plain reversing rheostatic controller is connected up to the four terminals of the motor.

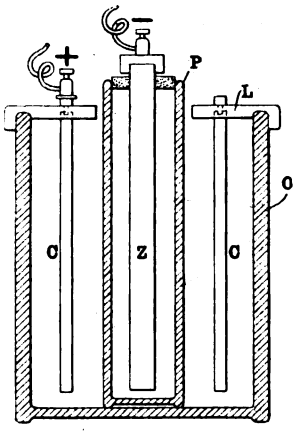
These motors for 60 cycles are also made for a normal operating speed of 810 and a synchronous speed of 900 r.p.m. The power factors are not quite as good as with the higher-speed motors; apart from this change, however, the slower-speed motors possess about the same advantageous characteristics as do the higher-speed machines.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN the *Chemical News* of August 28th James Strachan contributes some notes on "a new primary cell of the Daniell type." In the cell described the copper element is replaced by carbon, the copper sulphate by lead tetrachloride, and the dilute sulphuric acid surrounding the zinc by dilute hydrochloric acid or ammonium chloride. In the ordinary Daniell cell copper is plated out; in this cell lead; thus :—

Daniell cell ... ... $2H+CuSO_4=Cu+H_2SO_4$
New cell ... ... $4H+PbCl_4=Pb+4HCl$.

The form of the cell is illustrated in the figure below.



Within an outer stoneware jar *O*, a number of carbon rods (*C*) are placed, and these are electrically connected by the heavy leaden cover *L* to form the negative element. The rods may conveniently consist of stout arc-light carbons, the ends of which are coppered before the leaden cover is cast round them. A circular aperture in the centre of the lid admits the porous cell *P*, in which the positive element, an amalgamated zinc cylinder (*Z*) is placed. The carbon rods are surrounded with an acid solution of lead tetrachloride, and the zinc with dilute hydrochloric acid (1 : 7 water), or zinc chloride (5 to 10 per cent. solution), or ammonium chloride (15 to 20 per cent. solution); or a mixture of all these excitants may be employed.

Ammonium chloride	100 grm.
Zinc chloride	10 ,,
Hydrochloric acid	20 cc.
Water	to 1 litre.

The lead tetrachloride is prepared by dissolving 100 grm. lead acetate in 300 cc. water and adding 110 grm. of fresh bleaching powder, the mixture being contained in a strong pressure bottle. A vigorous reaction takes place, and when quite cold 700 cc. of strong hydrochloric acid are added, the bottle sealed at once, and cooled under running water. A solution of lead tetrachloride and calcium chloride is thus obtained, and this is directly employed in the cell. As a depolariser it is rapid, efficient, and constant in its action; and as long as any lead tetrachloride remains, polarisation cannot take place. In this respect it resembles the Daniell cell, but has a higher E.M.F. and a lower resistance. The chief disadvantage to lead tetrachloride is the powerful odour of chlorine which is evolved during its preparation and when charging up the cell. While the cell is in use the escape of chlorine fumes is prevented by the closely-fitting lead cover of the cell, the space between the inner edge and the porous foot being sealed, for the time being, with soft paraffin wax. After the cell has been in action for some time the carbon rods become coated with spongy lead, which is easily removed by gentle scraping. If the cell is required to give a large current output, the excitant should be strengthened by the addition of hydrochloric acid, the zinc should be heavily amalgamated, and the carbon rods replaced by carbon plates and surrounded with carbon granules. The E.M.F. of the cell with different solutions was found to be :—

	With zinc.	With iron.
Hydrochloric acid	1·41 ...	0·83
Zinc chloride	1·22 ...	0·75
Ammonium chloride	1·51 ...	0·95

With iron, as, of course, would be expected, the electromotive force is very much less.

Telephony in the Transvaal.—We learn from the *British South African Export Gazette* that a telephone line of over 210 miles in length is to be installed to connect up Pietersburg, Pretoria, and Johannesburg. It will be the longest telephone line in the Transvaal.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9¾—10	
Do. 6% Cum. Second Pref.	10	6	6	10⅛—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½	100—103	
Bromley (Kent) E. L. & Power Co., Ld.	5	5½	—	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—97	
Brompton & Kensington E. S. Co., Ld.	5	10	5%*	6⅜—7¾	
Do. 7% Cum. Pref.	5	7	7	6¾—7½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½	4—4½	
Do. 4% Deb. Red	Stock	4	4	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½	3½—4	
Chelsea Electric Supply Co., Ltd.	5	4½	—	3—3½	
Do. 4½% Deb. Red	Stock	4½	4½	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6	9½—10½	
Do. 6% Cum. Pref.	10	6	6	11¼—12¾	
Do. 5% Deb. Red	Stock	5	5	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ltd.	10	5	—	7⅝—8½	
Do. 6% Cum. Pref.	10	6	6%	10⅝—10⅞	
Do. 4½% Deb. Red	Stock	4½	4½	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E. L. Co.	5	10	4%*	7⅜—8⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E. L. Cos. Db. Rd.	Stock	4	4%	97—101	
London Electric Supply Corporation	3	2½	—	⅜—1⅜	
Do. 6% Pref.	5	6	6	4⅜—4¾ xd	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6⅔	—	4¼—4¼	−¼
Do. 4½% Cum. Pref.	5	4½	4½%	4½—5	+¼
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	84—89	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	5	2½%	5⅛—5⅝	+⅛
Do. £2 Paid	5	8	2½%	3¼—3⅜	
Do. 5% Pref. (fully paid)	5	5	2½%	5¼—5⅜	
Do. £2 Paid	5	5	2½%	3⅛—3⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅞—12⅞	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅝—6⅛	
Do. 4% Deb. Red.	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5%*	7—8	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅜—⅝	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅝—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅛ xd	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103	
Urban Elec. Supply Co., Ltd.	5	5	—	¼—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	7⅞—8½	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅝—5⅞	+⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	92—94	
Central London	Stock	3	3%*	68—70	
Do. 4% Preferred	Stock	4	4%	84—86	−1
Do. Deferred	Stock	2	—	50—53	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	82—84	
City and South London Cons.	Stock	4½	1½%	32—33	
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1895	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	2%*	7—7½	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	½	½%	35—36	−1½
Do. 3½% Preference	Stock	3½	3½	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	73—76	
Do. 3½% Convertible Pref.	Stock	3½	3½%	70—73	
Metropolitan District	Stock	—	—	11—12	−½
Do. 6% Perp. Deb.	Stock	6	6%	116—119	
Do. 4% Deb.	Stock	4	4%	71—76	
Do. Perp. Extension Pref. (5%)	Stock	—	—	19—23	
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	—	48—52	+1
Underground Elec. Railways Co of London 5% Profit Shg. Sec. Notes	Various	5	5%	38—42 xd	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	½—¾	−⅛
Do. 4½% Deb. Red.	Stock	4½	—	85—90	−1
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	92—95	+1
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅜	−⅛
Do. 6% Cum. Pref.	10	6	6	3⅝—4⅜	
Do. 5% Perp. Deb.	Stock	5	5%	96—99	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	—	5½—6⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	75—80	−1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅛—⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—¾	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	93—96	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	78—82	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅜	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—86	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	58—61	
Do. 6% Pref. Ord.	Stock	6	6%*	104—105	
Do. Def. Ord.	Stock	1	—	17⅛—17⅜	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	88½—91½	+2½
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13⅛—13⅝	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—102½	
Do. do. (Mauritius Sub.)	25	4	—	101—103	
Eastern Ext. Australasia & China	10	7	6%	12⅞—13½	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100⅜—102½	
Eastern Telegraph Co.	Stock	7	1½%*	135½—138½	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	103—105	+½
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	27½—29½	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	+½
Do. Deferred	Stock	6	6%*	118—120	−1½
Do. 6% Cum. 1st Pref.	10	6	6%	10—12	
Do. 6% Cum. 2nd Pref.	10	6	6%	10—12	
Do. 5% 3rd Pref.	5	5	2½%	5¼—5⅜	
Do. 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red.	Stock	4	4%	103—105	
Western Telegraph Co., Ltd.	10	7	6%*	13⅜—15⅜	−⅛
Do. 4% Deb.	Stock	4	4%	101½—102½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—½	
Do. 6% Cum. Pref.	1	6	7½	1¼—1⅜	
Babcock & Wilcox, Ord.	1	20	—	3½—4	−⅛
Do. 6% Pref.	1	6	—	1½—1⅝	
British Insulated & Helsby Cables, Ld.	5	10	—	6½—7	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96 xd	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—⅞	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73 xd	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10¾	
Do. 5% Cum. Pref.	5	5	5%	5½—5¾	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	+½
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅛—1⅜	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	90—93	
Dick, Kerr & Co., Ltd.	1	10	—	1¼—1½	+1/16
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅛	+1/16
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	+1
Edison & Swan United "A," £3 paid	5	2/6	—	⅛—⅜	
Do. do. (fully paid)	5	4/2	—	1⅞—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	½—¾	+⅛
Do. 7% Cum. Pref.	2	7	—	1⅜—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	66—71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	86—90	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½—11½ xd	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	15½—16½	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red.	100	4	4%	100½—102½	
Willans & Robinson, Ord. Shs.	1	5	—	¾—1¼	
Do. 6% Cum. Pref.	5	6	6%	2⅜—3	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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CATALOGUES AND PAMPHLETS RECEIVED

"EXCELLO" ARC LAMPS.—An attractive "folder" has been issued by the Union Electric Co., Ltd. Besides enfolding a pun and bearing a device on the outer page excellently contrived to attract attention, it contains various general remarks as to the economy, simplicity, and regularity of the firm's "Excello" flame arc lamp. The folder has been designed for the use of central station engineers, and a quantity of these will be supplied to them gratis, printed with their own name and address, on application to the firm.

COMBINED RAIL-JOINT AND ANCHOR.—A leaflet describing a new pattern of combined rail-joint and anchor has been sent us by Mr. R. Brown, of 16 Great George Street, S.W., from whom further particulars can be obtained. Both joint and anchor are made from an ordinary rail length by sawing off the

FIG. 1.—RAIL ENDS PREPARED FOR JOINTING.

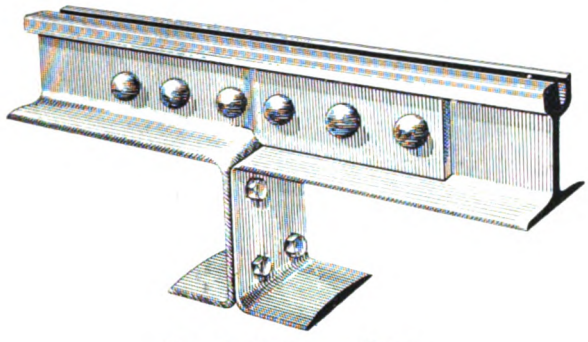

FIG. 2.—COMPLETE JOINT.

head of the rail for a certain distance, and also separating the web from the base. The base, bent downwards, forms the anchor, and the web takes the place of the usual fishplate. The method of making the joint is clearly seen in the illustrations above.

A CORD SHORTENER.—The Berlin firm of Classen & Co. (Barbarossastrasse 16) have sent us particulars of a simple arrangement they have placed on the market for shortening pendant cords to any desired extent. The annexed illustration practically speaks for itself. The material of which the device is made is wood, which is stained and polished. It is seen that the arrangement is such that there should be no possibility of the cord cutting.

CLASSEN CORD-SHORTENER. HALF SCALE.

ARC LAMPS, AUTO-TRANSFORMERS, AND AN AUTOMATIC TRANSFORMER SWITCH.—We have received from the Santoni Arc Lamp & Engineering Co., Ltd., a list containing particulars of their small auto-transformers for metal filament lamps, and also of an automatic transformer switch for switching out the transformer on no-load. The latter was described and illustrated in ELECTRICAL ENGINEERING, Vol. III., p. 440. The same list gives prices and particulars of the "Santoni" flame arc lamps, including the "Perl" enclosed lamp for 100 hours' burning. Reference is also made to the facilities at the Millwall works for executing re-winding of armatures and repairs of all descriptions.

CENTRAL STATION PUBLICATION.—We have received from the Borough Electrical Engineer of Grimsby a little pamphlet, entitled "Cheaper than Gas." This contains illustrations of shop windows lit by arc lamps, and various remarks as to the economy and efficiency of electric lighting. The pamphlet concludes with the statement that the Corporation sold 46 per cent. more electricity last year than in the previous year. An enclosed card extols the various advantages of electric lighting for private houses.

HEATING AND COOKING APPARATUS. A very complete catalogue has just been issued by the General Electric Co., Ltd. A large number of patterns of glow-lamp radiators are listed, together with a large selection of enclosed heaters, which are fitted with two or more heating elements, and an 8 c.p. lamp to show whether the current is on or off. The second portion of the catalogue contains particulars of kettles, saucepans, and other cooking apparatus. Nearly all these are fitted with a patent fusible cut-out, which prevents damage to the utensil if it is switched on without water in it, or allowed to boil dry. The fusible nut does not carry any current, but melts due to an increase of temperature and breaks contact by releasing a spring. The nut itself is composed of a special alloy. Full particulars of the current consumption of the various utensils are given. A novelty is an electric bread-toaster, which toasts both sides of the bread at once. This toaster can be obtained with two heating surfaces for toasting one large piece of bread at a time, or with several heating sections arranged one above the other. A single section one in the catalogue consumes 1,000 watts, and has two heating surfaces each measuring 8 in. by 10 in. To use the toaster the two surfaces are brought in contact by lowering the upper lid. The current is switched on to both portions for four minutes before toasting, and then the top is lifted, the bread inserted and pressed tightly between the sections. After about one and a half minutes the bread will be well toasted on both sides. Electric ovens, water-heaters, hot irons, cigar-lighters, curling-iron heaters, glue-pots, soldering irons, &c., are exhaustively dealt with.

"PIXIELITE" STRIP.—The General Electric Co. have chosen the opportune time of the approach of the Manchester Electrical Exhibition to call attention to their Pixielite lamp holder and strip for decoration and temporary lighting. Fig. 1 shows an Osram lamp in a holder on the strip, and Fig. 2 shows the underside of the holder before sealing, showing the connection and the method of securing the cable. The makers state that when the lamp-holder is connected and sealed it is absolutely water-tight, and that the insulation does not even drop when it is immersed in water. The holders take the ordinary B.C. lamp caps, and are suitable for either Osram or ordinary carbon lamp. As is seen in Fig. 2, the cable is secured to the holder independently of the terminals. The strip is kept in stock in lengths of 50 holders, spaced 12 ins. apart, with the lamps in parallel across the cables; and a special cable is also supplied which permits of the arrangement of the lamps in groups of either two or four in series, each group in parallel across the cable—a convenient arrangement with low voltage metal filament lamps. Any other arrangements are, however, made to order.

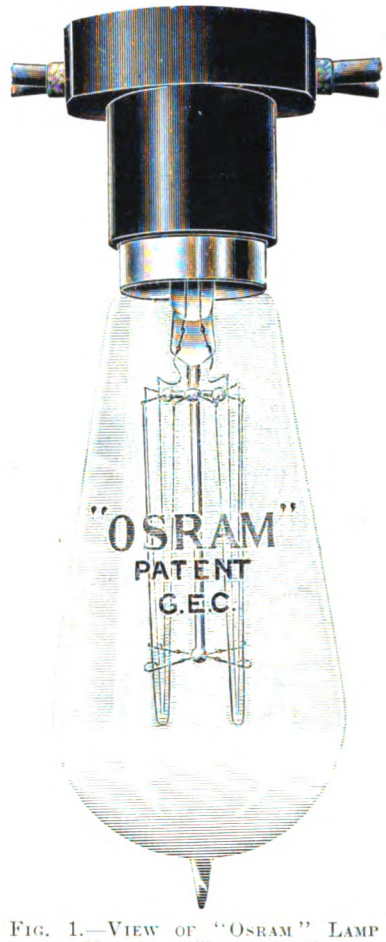

FIG. 1.—VIEW OF "OSRAM" LAMP IN HOLDER. (THE SAME HOLDER IS SUITABLE FOR CARBON LAMPS.)

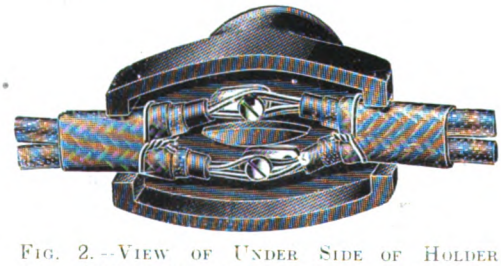

FIG. 2.—VIEW OF UNDER SIDE OF HOLDER (BEFORE SEALING), SHOWING CONNECTIONS AND METHOD OF SECURING THE CABLE.

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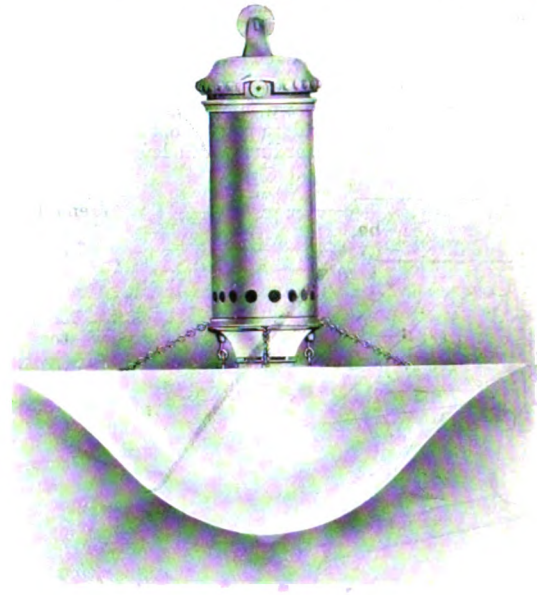
MINIATURE LAMPS.—A neat little catalogue of Howard candelabra and other minature lamps has been issued by Messrs. Neville, Williams & Co. A large number of candelabra lamps of various shapes, with candle-powers of from 2 to 16 are listed. Decorative lamps for series running, and metal and "metalised" filament battery lamps, for which consumptions of 1 and 1·5 watts per candle are claimed respectively, are included in the list. Some errors occur in the tables of current consumption of these lamps, but we have called the firm's attention to them, and they will be corrected in future issues. Surgical and telephone lamps of various shapes and sizes are listed and illustrated. A special multiple metalised filament lamp is supplied for automobiles and yachts, which is said to be much stronger mechanically than the tungsten lamp. This has four or eight straight filaments in parallel arranged as shown in the drawing, and is manufactured for pressures of from 4 to 12 volts, and candle-powers of 16 to 32. The consumption is given at 1·5 watts per candle. Two patterns of porcelain sockets for attaching lamps to "flex" for decorative purposes are also described.

HOWARD MULTIPLE FILAMENT LAMP FOR AUTOMOBILES.

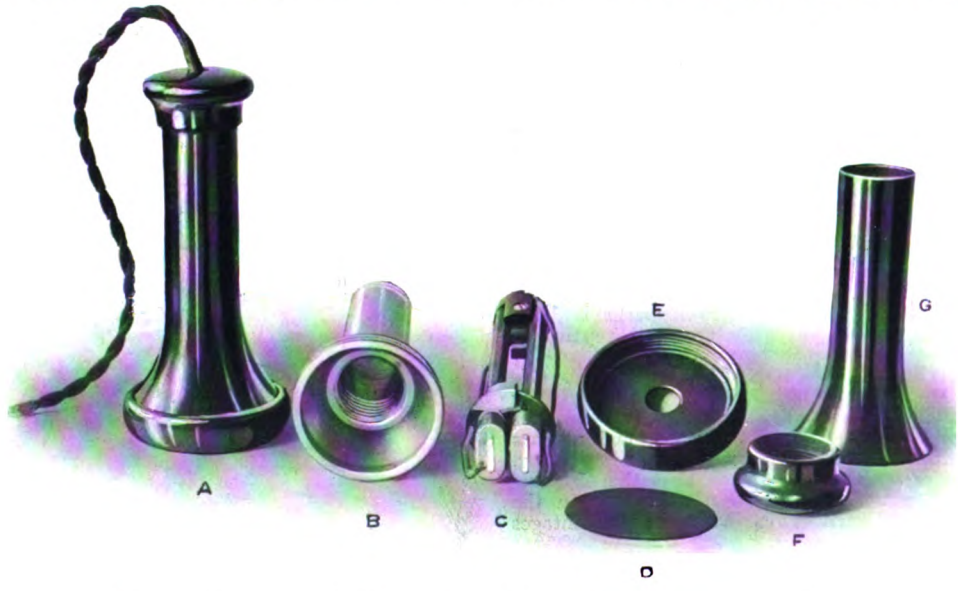
LOCKING LAMP-HOLDER.—A lamp-holder designed to prevent the withdrawal of lamps by unauthorised persons, made by the General Electric Co., is illustrated below. This is useful for large institutions or for cases in which the supply undertaker supplies lighting on a contract basis instead of by meter. The locking device works on the plunger of the holder, and is operated by means of an insulated key. The holder has already been found of special use in street lighting and other outdoor work where metal filament lamps are used, and it is deemed necessary to have an additional precaution against theft. The company's standard lamp-holder, with cord grip, and also their S1001, S1004, and S1006 patterns, with $\frac{3}{8}$ in., $\frac{1}{2}$ in., and $\frac{5}{8}$ in. thread, can be supplied, fitted with this locking device, at a small extra cost. A shade carrier specially made for these lamp-holders is also illustrated above.

LOCKING LAMPHOLDER. "ILEENE" SHADE CARRIER.

"JANDUS" ARC LAMPS.—A pamphlet from Drake & Gorham, Ltd., gives full particulars of the "Jandus" regenerative enclosed flame arc lamp, which was fully described in ELECTRICAL ENGINEERING, Vol. III., p. 299. This lamp is stated to burn for 70 hours with one pair of carbons, and with an efficiency of 0·22 watts per candle. Another new pamphlet from the same firm describes the various other patterns of arc lamps manufactured by the Jandus Arc Lamp & Electric Co., Ltd., which include single and double enclosed arcs, "midget" lamps, lamps for photographic purposes, and inverted lamps with opal glass reflectors, and clear glass cylinders. One of the latter is illustrated above.



TELEPHONE APPARATUS.—The British Insulated & Helsby Cables Co. have sent us a set of pamphlets on telephone apparatus, which are a model of excellent printing and illustrating. We reproduce one of the illustrations below, which depicts various parts of the Post Office pattern double-pole Bell receiver. The complete receiver *A* is seen on the left. *C* shows the permanent magnets and coils attached to a threaded metal collar, which screws into a metal sheath *B*; this holds them rigidly, and also adds additional strength to the receiver case. It is covered by the ebonite sheath *G*. The diaphragm *D* is placed at the end of the metal sheath *B*, and is clamped by the ebonite ear cap *E*, which screws on to *B*, and at the other end the cap *F* is screwed on, and this protects the terminals. The weight of the receiver is 13 ozs., a weight which ensures decided action on the switch-hook. A useful feature in the list is that the spare parts in the receiver are listed with prices, and are given code numbers. A breast-plate transmitter is also listed, which only weighs 4½ ozs. with its cord and band. A number of



BRITISH INSULATED & HELSBY POST OFFICE PATTERN TELEPHONE RECEIVER.

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switchboards in various sizes are included in the set of catalogues, and there are very fine illustrations of the backs of some of these with the panels removed.

THERMO-COUPLES, PYROMETERS, AND TESTING INSTRUMENTS.—Messrs. Siemens Brothers & Co., Ltd., have just issued a supplement to their catalogue No. 502. This gives full information and prices of protecting tubes for thermo-electric pyrometers. The patterns include "Marquardt," quartz, and iron tubes, and a table, showing the type most suited to various kinds of high-temperature work, is given. Another pamphlet gives particulars of several patterns of pyrometers, including water, resistance, thermo-electric and optical pyrometers, and the necessary auxiliary apparatus. A third pamphlet describes several new types of electrical testing instruments, selected from the large catalogue previously mentioned in these columns.

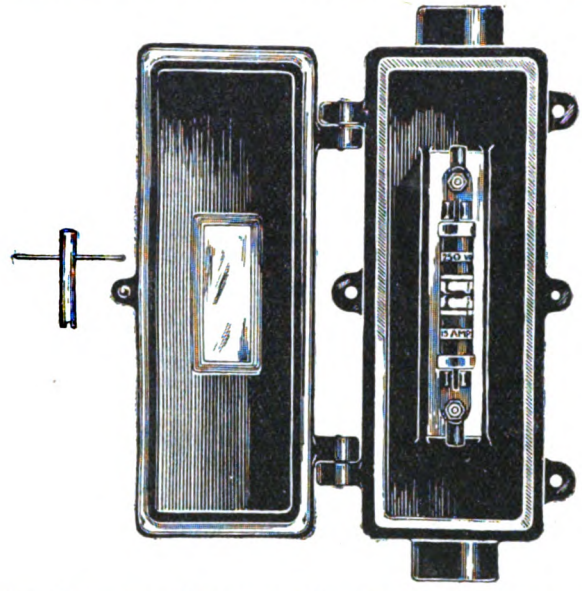
THE WITTON GRIP CONDUIT FITTINGS.—The Armorduct Manufacturing Co. have sent us a booklet containing a Faraday House report relating to their Witton Grip Conduit Fittings, and have also sent us a list of recent installations where this system has been employed.

ADVERTISING NOVELTIES.—Messrs. D. Harper & Co., of 258, 260, 262 Holloway Road, London, have sent us a catalogue of calendars, date cases, pocket books, diaries, &c., and draw attention to the desirability of making use of such methods of advertising in connection with the Manchester Electrical Exhibition.

PHOTOGRAPHIC ARC LAMPS.—A pamphlet is to hand from the Electrical Co., Ltd., in which are described various patterns of arc lamps for use in studios, and in engineers' and architects' drawing offices, for blue printing. Enclosed type lamps, with and without reflectors, and open type lamps with parabolic reflectors, are described. Tables showing the exposure required with the different lamps under varying conditions are given. Starters, adjusters, and carbons are also included in this pamphlet.

SEAMLESS METAL TUBING.—A catalogue received from W. Geipel & Co., describes their "Benedict-Nickel" seamless tubing. This tubing is made by a patent hot-rolling process, with white metal, and has the appearance of bright nickel. It is said to have a tensile strength of 50 per cent. higher than brass, and a very high resistance to bursting strain. The tubing is recommended for condenser tubes, plumbing work, railings, and many other purposes. It is said to be free from corrosion, and the electrolytic action met with in alloys. Tables giving weights, costs, and dimensions of the standard sections are given in the catalogue.

WATERTIGHT FUSE-BOX.—Simplex Conduits, Limited, have designed a new pattern of watertight house-service fuse-box, as shown in the accompanying illustration. It is of the usual form, but the addition of a lip on the cover and a circular india-rubber band allows of a watertight joint being made between the cover and the box itself. The most novel departure in connection with this is the arrangement for fastening, which



is done by means of a screwed key, by which the necessary pressure on the rubber band is obtained. The box is suitable for use with conduit up to 1 in. in diameter, either socket or screwed, and a small window is provided at the front for inspection purposes. Simplex standard enclosed fuses are used with this box. The price comes out at only a few pence more than that of the usual form of non-watertight box.

LOCAL NOTES

ABERDEEN: *Electricity Accounts.*—The annual report of Mr. J. A. Bell, City Electrical Engineer, for the year ended July 31st, states that 264 new consumers were connected during that period. Although no large works have been coupled up, the addition to the motor load is 316 h.p. Negotiations are practically completed with the Admiralty for a supply for wireless telegraphy at Stoneywood. On January 1st the department took over the Deeside and District Electricity Supply Co.'s undertaking, and since that time the supply for the Cults district has been continued from the steam station at Cults. The mains department has been exceptionally busy during the year, the conversion of the copper strip culverts to cables laid on the solid system having been completed in Union Street, Castle Street, and portions of Bridge Street, Market Street, Union Terrace, and King Street. Owing to the fall in the price of copper, these alterations have been carried out at a cost of £5,761, which has been taken from the reserve fund, the estimate being £7,917. The laying of extra high tension cables to Cults, it is expected, will be completed by the end of this month. The total number of units sold during the year for all purposes was 5,104,036, an increase of 309,529 over the preceding year. The output for private lighting was 69,395 units, and for power 181,352, in excess of last year. The cost of fuel rose to £8,376, an increase of £3,033, of which £2,270 is attributable to the increased price of coal.

Electricity Estimates.—The estimated revenue from the electricity department for the current year is £45,689, which is £2,000 in excess of the estimates for last year.

ASHTON: *Hospital Lighting.*—Although the new workhouse hospital has been wired for electric lighting, the Board of Guardians seem very chary of coming to a decision as to completing the installation. The Ashton Corporation, having borne the expense of laying a cable up to the workhouse walls, has made an offer to supply a minimum of 40,000 units per annum at 2d. per unit, but it is anticipated that the maximum demand will approximate 65,000 units. It is calculated that upon a minimum supply of 40,000 units there would be a difference of £107 in favour of gas, but the comparison, of course, does not end here. One member of the Guardians at the last meeting endeavoured to bring the matter to a head, but discussion of it has again been postponed.

AUSTRALIA: *New South Wales Tramway Finances.*—The report of the Chief Commissioner of Railways for the year ended June 30th shows that the length of tramways now open is 132¾ miles. The total capital expenditure during the year was £3,732,991, the revenue was £1,011,934, an increase of £103,293 over the previous year.

BARROW-IN-FURNESS: *Electricity Accounts.*—The report and accounts of the Corporation Electricity Department for the year ended March 31st, 1908, have been issued. The number of 8-c.p. lamps (or equivalent) now connected are 69,749 compared with 64,213 last year. Similarly, the number of motors has increased from 124, with an aggregate horse-power of 804, to 137, with an aggregate horse-power of 864. The number of consumers is now 724, against 668. The number of units sold was 1,047,776, against 948,747, an increase of 10·4 per cent. This is the largest increase in output since the acquisition of the tramway supply, and although it is principally due to the large motors connected towards the end of the last financial year, it is satisfactory to note that there has been an increase in the output for lighting in spite of the fact that a large number of consumers have reduced their consumption (in some cases as much as 40 per cent.) by the use of metal filament lamps. The accounts show that the capital expenditure on March 31st was £110,872. The total revenue was £12,428, compared with £11,798 for the previous year, and the total costs £6,440, compared with £5,360. The gross profit was therefore £5,988, against £6,437. After meeting interest on loans and sinking fund there is a deficit of £791, compared with a profit of £33 last year. The combined maximum demand from both traction and general supply was 892 kw., and the combined load factor 13·41 per cent., against 13·45 per cent. last year. The average price obtained for private supply was 3·25d., the figure for last year being 3·52d., and for public supply and traction 2·8d. against 2·9d. The works costs amounted to 1·094d., and the total costs to 1·474d. per unit. The figures for the previous year were 0·987d. and 1·356d. per unit respectively. The deficit of £971 is attributed to an increase of 25 per cent. in the price of coal, and an increase of £375 in capital charges upon plant, which is only partially employed.

BELFAST: *I.M.E.A. Expenses Surcharged.*—At the weekly meeting of the Tramways and Electrical Committee on Monday

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the assistant accountant reported that the Local Government Board auditor had made several surcharges, those affecting the Committee being the subscriptions to the Municipal Electrical Association, and the expenses of delegates attending their conferences. The Finance Committee had appealed against those surcharges.

BIRMINGHAM: *Tram Track Experiments.*—The Birmingham Corporation have been experimenting with the new brake, which has been invented by Mr. A. W. Maley, late Assistant Engineer to the Leeds Corporation Tramways. This brake, which was described fully in ELECTRICAL ENGINEERING, Vol. II., p. 851, is a combination of the mechanical track and magnetic brakes. One reason that has induced the Birmingham Tramways Committee to experiment with new brakes is the accident upon the Warstone Lane route a short while ago. The experiments with the new brake were made upon the Garrison Lane gradient, which, although not the steepest in the city, has a fall of about 1 in 15. The Assistant Manager of the tramways, Mr. C. M. Hill, had charge of the car. One of the experiments was to allow the car to travel down the hill at over twenty miles an hour, but he was able to pull it up within fifty yards by means of the new brake. Rain was falling, and the track was wet and greasy, but no sand was used to assist the brakes. In another trial the car dashed down the hill at an estimated speed of about thirty miles an hour, and it was brought to an absolute standstill within eighty yards about halfway down the hill. The final experiment was to allow the car to run backwards, but it was safely brought to a stop. The results of the trials are to be reported to the Tramway Committee, and it is considered probable that the Maley brake will be adopted.

BOLTON: *Tramway Extension.*—Residents in the outlying village of Darcy Lever are petitioning the Corporation for a tramcar service in place of the motor-'bus which now serves the neighbourhood. The Tramways Committee fear the laying of lines to Darcy Lever would prove unremunerative.

BRADFORD: *Tramway Accounts.*—The annual report and statement of accounts of the Tramways Department to March 31st, 1908, have been issued. The total revenue from all sources is £243,148, an increase of £5,637 over the previous year. The car mileage was 5,331,007, an increase of 163,746. The number of passengers carried was 47,839,569, compared with 46,728,977. The total expenditure, excluding interest and sinking fund, was £167,994, and the gross profit of £75,154 is a net increase of £2,630. After meeting interest, repayment of mortgage loans, sinking fund, there is a balance of £17,238, which has been carried to the reserve and renewals accounts, which now stands at £52,229, after meeting this year's renewals. The profit last year was £145,364. Comment is made in the report upon the cost of electricity, and it is stated that if the Bradford Tramways Department could purchase electricity as cheaply as the neighbouring cities of Leeds and Sheffield, the power account would be about £15,000 less.

BRENTFORD: *Condition of Tramway Track.*—The District Council, at its first meeting after the summer vacation, again had under consideration the question of the state of the tramway track of the London United Tramways Co. A letter was submitted from Sir J. Clifton Robinson *apropos* of Col. Yorke's report on the recent Board of Trade inspection of the section of the tramways in the Brentford district, emphasising the assurance of the company's intention to carry out their obligations with all possible dispatch. The District Council agreed to a request from the Hampton Council to appoint representatives to a conference with regard to the state of the track.

BRIGHOUSE: *Electricity Supply.*—We mentioned last week that the Local Government Board had refused a loan in connection with a bulk supply from the Yorkshire Electric Power Co. We now give a few further particulars. The Corporation supply was started in 1898, being a continuous-current two-wire system at a voltage of 110. The development has, however, been on a very small scale, and the undertaking has proved an unprofitable one to the Corporation. In 1906 certain tramways were authorised by the West Riding Tramways Act under the provisions of which certain lines are to be constructed in Brighouse, and a supply therefore is to be taken from the Corporation. In view of this requirement, and with a desire to develop the existing supply for power as well as for lighting, the Brighouse Corporation entered into negotiations with the Yorkshire Electric Power Company for a bulk supply, and an agreement has been entered into. The Corporation proposes to alter their present system to three-wire 240-volt supply, and the general and tramway supply will be given from the sub-station situate in the centre of the town, the Power Company's supply being brought into the sub-station as three-phase current at 10,000 volts, and converted by means of rotary converters to direct current. The period of agreement is 14 years, and current is to be supplied on a sliding scale at £6 per kilowatt of maximum demand per annum, plus ¼d. per unit, with a guarantee that the maximum price shall not exceed 1·25 pence per unit. On this scale there is no doubt that the Corporation should be able to offer a power supply at very tempting rates, and in view of the very considerable importance industrially of Brighouse this is much to be desired. The sub-station will be provided by the Corporation, and the converting machinery by the Power Company, the distributing mains in Brighouse being the Corporation's. Messrs. Lacey, Sillar & Leigh are the consulting engineers to the Corporation. The step taken by Brighouse in shutting down their existing generating works is one for which there are several precedents, and it is a proceeding which will undoubtedly be followed by many other municipalities in districts where power companies are supplying. There are still a number of small municipal generating stations where the costs of production are so high that a cheap power supply cannot be offered to the ratepayers. Some of these are even now running at a loss, and unless very considerable further capital expenditure is made the only alternative open to them is to take a bulk supply.

BURNLEY: *Tramways.*—The Tramway Committee have considered recommendations by the promoters of the Blackburn, Whalley, and Padiham Light Railway asking for the approval of the Burnley Corporation of draft clauses to be inserted in an order to revive their powers. The draft clauses provided: (*a*) that Padiham Council might within six months from expiration of Corporation's lease of tramways in Padiham district give notice requiring the Light Railway Co. to sell to them that portion of company's undertaking within their district. The second clause related to working agreements with other councils or corporations. A letter was also read from the Padiham Council asking whether the Corporation would entertain a proposal to extend their present tramway from the terminus at Padiham to the top of Padiham, and, if so, whether the Corporation would receive a deputation from the Council on the subject. It was agreed to support the proposals of the light railway promoters, but the Corporation could not see their way to extend the tramway beyond the existing terminus at Padiham.

Watt Meters on Tramcars.—A proposal by the Tramways Committee to fix wattmeters on the tramcars in order to test the quantity of power used per car, has been referred back, after a long discussion.

BURSLEM: *Electricity Extensions.*—A deputation has been appointed to wait upon the Local Government Board, to urge the necessity of granting the Council powers to borrow £12,000 for the purpose of the electric lighting undertaking.

Noisy Tramcars.—A resolution has been carried by the Council requesting the Potteries Tramway Co. to effect an immediate improvement in the tramcars running in the town. It is stated that the jolting of the cars causes pictures to fall from the walls of houses along the route, and that the noise of the cars causes temporary cessation of work in schools.

CAMBORNE: *Mining Exhibition.*—A mining exhibition has been held here during the week, the whole of the arc lamps for the interior and exterior lighting of which have been supplied by the Union Electric Co., the lamps being of the "Excello" and "Koh-i-noor" types. The company has also a stand in the centre of the exhibition, upon which is a large motor-driven air compressor, and a direct-coupled triple-cylinder plunger pump, 3 ins. diameter, and 6 ins. stroke, delivering 735 gallons of water per hour. Owing, however, to want of space, and the short duration of the exhibition, this pump is not at work, but it will be transferred to the Manchester Exhibition, and there be actually at work as part of the company's exhibit. Other apparatus on the stand include a direct-coupled, electrically-driven centrifugal pump, alternating and direct-current motors, motor starters, measuring instruments, circuit breakers, safety fuses, &c.

DARWEN: *Electricity Charges.*—The Darwen Town Council have this week agreed to fix the following charges from October 1st to consumers of electricity for motors for the day-load only:—The first 500 units per quarter, 2d. per unit; the second 500 units per quarter, 1½d. per unit; above, 1d. per unit.

DOVER: *Electricity Extensions.*—The Engineer has reported that there are some 60 probable consumers in the St. Margarets district, representing 920 30 to 35 watt lamps. He also reports that there are several other probable consumers, representing some 200 lights, making a probable total of 1,120 lamps. Upon the basis of 1,500 lamps, he estimates that an expenditure of £3,000 will have to be incurred to supply the district.

DUNDEE: *Tramway Fares.*—The Tramway Manager has been instructed to prepare a report upon (1) a universal penny fare within the burgh boundary, starting at certain recognised points, and (2) a universal penny fare to passengers who may join the cars between any of these recognised starting points.

Tramway Accounts.—The annual report of the Tramway Committee for the past year shows that the gross receipts were £60,572, and the working expenses £39,879. Renewals absorb £4,000, and after allowing for interest, sinking fund, and depreciation, there is a surplus of £40, which is carried to reserve. The number of passengers carried have increased by 621,225, and the receipts by £2,900.

EASTBOURNE: *Electric Omnibuses.*—A suggestion that a service of electric omnibuses should be instituted has been rejected by the Watch Committee on the ground that the needs of the borough are sufficiently met by the existing service of municipal petrol omnibuses.

EAST STEYNING: *Electrical Charges.*—The question of the charges by the Brighton Corporation for electric supply is still

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a subject for discussion between the respective Town Clerks. The matter has arisen through the decision of the Brighton Corporation a short time ago to abandon the maximum demand system of charging.

FARNHAM: *Electric Lighting.*—The Council is still unable to come to terms with the local electric light company with regard to the erection of overhead wires. It appears that the company has not been able to comply with a previous resolution of the Council with regard to placing the standards, wherever possible, at the backs of houses, in the plan which they have submitted. A resolution to the effect that the plan be rejected for this reason resulted in five votes for it and five against it, but the chairman gave his casting vote in favour of the resolution. Eventually a resolution was passed by six votes to three, referring the matter to the Public Works Committee, and asking them to specify in what way the plan does not comply with the conditions laid down by the Council.

FARNWORTH: *Electricity Accounts.*—There has been a loss of £322 on the past year's working of the electricity undertaking. The units generated number 973,086, of which 339,281 are for lighting and power for private consumption, 416,775 for traction and car shed, 55,930 for street lighting. The works cost per unit is 0·96, and the average price has been 1·16d. per unit.

FELIXSTOWE: *Proposed Purchase of Electricity Works.*—The Lighting Committee have presented a report dealing with the purchase of the works of the Suffolk Electricity Supply Co. The company have offered to accept £8,000, and the committee, after interviewing the Consulting Engineer, recommended that the only course open to the Council is to buy out the company on or before June 30th, 1909, and in the meantime to erect a steam generating plant. The company will be required to remove the four-cylinder gas engine and the producer set at their works, which has been the chief cause of the nuisances, and the buildings would afterwards be used as a sub-station. The Suffolk Electricity Supply Co. started as a private company in 1898 without a Provisional Order, but the Council obtained a Provisional Order in 1900. As, however, it was thought unlikely that sanction would be given to carrying on a competitive business, an agreement was entered into with the company, which was finally sealed on May 18th, 1903, for the purchase of their concern at £8,000, exclusive of the overhead mains. This agreement, however, the Board of Trade did not sanction, and it is now recommended that the company's offer of £8,000 be accepted on the conditions that the purchase includes the whole of the undertaking, with the exception of the gas engine and producer plant, that the transfer shall take place on June 30th, 1909, that all extensions in the meantime be made with the sanction of the Council, and that application be made to the Local Government Board and the Board of Trade for sanction to the proposal. After a good deal of discussion at the last meeting of the Council it was decided to bring the report up again at a special meeting on the 16th inst.

HASTINGS: *Trolley Omnibuses.*—A proposal that the Hastings Tramways Co. shall introduce a system of trolley omnibuses for the narrow streets of the town is to receive consideration.

Electricity Charges.—At the last meeting of the Corporation, Councillor Cox moved a resolution that the price of electrical energy to private consumers should be increased by 1d. per unit. After criticising the undertaking at some length, he stated that the amount now charged for energy was insufficient to cover the working costs After a long discussion the motion was defeated by 20 votes to 8.

HERNE BAY: *Provisional Order.*—The Council is to apply for an electric lighting Provisional Order.

LEEDS: *Tramway Receipts.*—During the twenty-two weeks of the present financial year, the total receipts upon the Corporation tramways have amounted to £148,571, an increase of £4,687 over the receipts for the corresponding period of last year.

LIVERPOOL: *Tramway Receipts.*—For the 35 weeks from January 1st to August 29th, the receipts of the tramways department amounted to £372,853, compared with £380,049 in the corresponding period of last year. The passengers carried have also decreased, the figures being 80,908,191 against 82,384,421. The chairman of the Finance and Traffic Sub-Committee has stated that the falling off in traffic has been general upon all the routes, and can only be attributed to the lamentable condition of trade.

LONDON: *Battersea: Tramways.*—The Borough Council has consented to the doubling and reconstruction of the tramway from Lavender Hill to Chelsea Bridge, the London County Council having agreed to pay £6,500 to the Council for releasing them from the obligation to pave and maintain any part of the roadway outside the track.

Islington: London and District Electricity Supply Bill.—A resolution has been passed by the Liberal and Radical Association recording that they view with profound alarm the London and District Electricity Supply Bill, as it will confer immense powers over a vast area, which could only result in the creation of a gigantic monopoly

Kensington: Conference Expenses Surcharged.—The Town Clerk is communicating with the Metropolitan Councils relative to the action of the District Auditor in taking exception to certain expenditure incurred by officials of the Kensington Council in attending technical conferences, explaining that whilst the Local Government Board had allowed the expenditure in pursuance of the Local Authorities (Expenses) Act, 1887, the Board had intimated that they will not undertake to sanction similar expenditure in the future. The Kensington Council considers that it is highly desirable that the Metropolitan Borough Councils should have the power to incur reasonable expenditure in respect of the attendance of members and officials at conferences having a bearing upon their duties, and a communication has been addressed to the London County Council asking them to insert in their next General Powers Bill a clause giving this power to the Borough Councils of the Metropolis. Co-operation is asked in the matter.

Shoreditch: Electricity Accounts.—The Electric Lighting Committee report that there is a gross profit upon the undertaking for the year ended March 31st, 1908, of £19,548, but after meeting capital charges there is a deficit of £236. It is pointed out, however, that the accounts are prepared on a slightly different basis to previous years. In accordance with a suggestion by the district auditor, the accrued proportions of interest and repayment, wages, &c., have been taken into account, and the additional amount thus cast upon the accounts for 1907-8 is £3,025; thus, but for this alteration, there would have been a surplus of £2,789. In addition, the committee state that the price of coal has been 21 per cent. higher than in previous years, whilst the income has increased by 8·52 per cent. The total expenses, including loan charges, have only increased by 3·57 per cent. The destructor accounts show a deficiency of £2,401 upon electricity revenue account.

MANCHESTER: *Trolley Omnibuses.*—It is understood that the deputation of the Manchester Tramways Committee which visited Germany to inquire into the working of the trolley omnibuses there, will advise the adoption of the system in certain suburbs of the city. The full report of the deputation, however, is now being prepared. The *Manchester Guardian* states that an official statement of the total expenses per car mile of a trackless tramline in one of the Rhine districts puts the management, legal, and clerical expenses at 0·561 pence; salaries, wages, and uniforms, 2·303 pence; power, 0·948 pence; renewal of rubber tyres (one pair of wheels), 0·658; other maintenance and repairs, 0·252; material, oil, light, tools, &c., 0·271; fire insurance, employers' liability assurance, contribution to road maintenance, sick and benefit funds, &c., 0·387; total cost, 5·38 pence. The working expense per car mile in Manchester last year was 7·07 pence, and thus a saving of nearly 2d. per car mile in this report appears possible under the trackless system. The cost of the power is largely in favour of the trackless system. The cost of power per car mile in Manchester is 2·02 pence; and while the cost of road maintenance will continue to be pretty much the same from year to year under the trackless system, it is pointed out that complete renewals of lines will, from time to time, be required in the case of the ordinary tramlines.

OLDBURY: *Transfer of Electric Lighting Provisional Order.*—The Electric Lighting Provisional Order obtained by the Council in 1900 has now been transferred to the Birmingham & Midland Tramways Co., the company paying the costs incurred by the Council in obtaining the order in addition to interest. The sum to be paid amounts to £536.

ONTARIO: *Electric Supply.*—It is stated that legal action is to be taken to restrain the Ontario Government from proceeding with the construction of the electric transmission line from Niagara. It is urged that as the Government has some £3,500,000 invested in the Canadian Electrical Investments Co. and the Toronto Electric Light Co., it cannot properly enter into competition with these private concerns.

PARAGUAY: *Telegraphs.*—A British Consular report states that during the year 1907 telegraphic communication has been established between Asuncion and Villa Encarnación. This line consists of 1,945 kiloms. (1,208 miles) of wire, at a cost of about 32,344 dol. (gold) (£6,469). A cable between the same town and Posadas, to which allusion has already been made, is shortly to be laid, and will thus connect Paraguay and Argentina by one single line. Telegraphic communication between the town of Villa Encarnación and Bella Vista on the Brazilian frontier is also in course of construction, and will, when completed, unite these two countries as well. A wire from the village of Yhú to the River Paraná, opposite the Yguazú Falls, is also contemplated.

PERTH (W.A.): *Tramway Receipts.*—The gross receipts of the Perth Electric Tramways Co., from January 1st to August 28th, amounted to £48,170, a decrease of £995 on the receipts for the corresponding period of 1907.

REDDITCH: *Electric Lighting Accounts.*—The report of the Electricity Supply Committee for the past year shows a loss of £509. It has been explained that the demand for energy for power purposes has decreased mainly on account of the removal of a large industrial concern to Birmingham, and exceptionally bad trade at other works. These losses and the increased cost of fuel, it is computed, represent a loss of over £800.

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ROCHDALE: *Tramway Extensions.*—An agreement has been come to between the Corporation and the Whitworth District Council regarding the running of tramways in Whitworth. The lines, which will have a length of about three miles, will be constructed by the Rochdale Corporation, who will defray the cost, the Whitworth District Council applying for the Provisional Order.

SCOTLAND: *Telegraph System.*—The Post Office telegraph authorities are at present removing the telegraph poles and wires from the banks of the Union Canal, Glasgow, in consequence of the construction of the underground telegraph cable. A new arrangement has also been introduced into West Lothian and Stirlingshire districts. The poles have been transferred from the canal to the public highway, the telephone wires being above the telegraph wires. Between Edinburgh and Linlithgow the new underground cable is now in operation.

STOCKPORT: *Electricity Profits.*—The annual accounts of the Corporation for the year show that there has been a profit of £10,369 upon the tramways and £3,276 upon the electricity department.

SUNDERLAND: *Position of Electricity Undertaking.*—Alderman John Turnbull intends to bring forward a motion urging a complete independent valuation of the electricity works and the production of the detailed cost of power to each private consumer. The Alderman maintains that the electrical undertaking is in an unsound financial position.

WIGAN: *Electricity Charges.*—An offer by Messrs. Sharrock and Gaskell for a supply of electricity to their collieries at ½d. per unit has been accepted by the Electricity Committee. At the last meeting of the Corporation exception was taken to the acceptance of this offer on the grounds that it was unremunerative. An amendment that the matter be referred back to the Electricity Committee for further consideration was, however, rejected.

WOKING: *Telephonic Communication.*—Hitherto considerable delays have been experienced in telephonic communication between London and Woking, in consequence of the calls having to be made through Guildford, and some resentment has been felt at the anomalous position that whereas Woking is in the 3d. radius, the calls to London have been charged at 6d., because they have had to go *via* Guildford, which is in the 6d. area. Mr. F. J. Marnham, the member for the Chertsey Division of Surrey, which includes Woking, has taken the matter up with the Postmaster-General, and a petition signed by practically every subscriber to the telephone system has been presented. A communication has now been received from Mr. A. M. Ogilvie, on behalf of the Postmaster-General, stating that a direct line between Woking and London will be erected very shortly. It will not be possible, however, to reduce the fee until additional wires can be brought into use.

YORK: *Electricity Accounts.*—During July, 85,744 units were generated and 69,368 sold. The works costs for the month were 1·31d. per unit, against 1·06d. per unit for July last year, whilst the total costs, including less rates, &c., were 1·83d. per unit against 1·56d. per unit for the corresponding period of 1907.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ACCRINGTON.—The Local Government Board has sanctioned the borrowing of £7,500 for the purpose of the electricity undertaking.

CHELTENHAM.—A recommendation by the Electricity Committee for the expenditure of £700 upon new generating plant has been adopted. The new plant includes a condenser and motor-generator.

CLACTON.—The consulting engineer to the Corporation recommends the installation of a suction-gas plant at an estimated cost of £750, with a view to the more efficient and economical working of the electricity undertaking. It is also recommended that a travelling crane and meters be purchased at a cost of £265.

COLCHESTER.—A new high-tension cable is to be made from Barrack Street to Hythe Quay at a cost of £750.

DOVER.—Application is to be made to the Local Government Board for sanction to a loan of £3,000 for electricity extensions.

EGYPT.—Tenders are invited by the Minister of the Interior for the installation of an electrical works in the town of Zagazig. Tenders must be received at Cairo by October 29th, and a guarantee equal to 10 per cent. of the amount of the tender will be required.

HEANOR.—The Council has under consideration the question of erecting electricity works.

JOHANNESBURG.—Tenders will shortly be invited for 1,000 kw. steam turbo-generating set, which must be erected by December 15th.

PENDLEBURY.—We understand that Messrs. Andrews, Knolls & Sons, colliery proprietors, contemplate introducing electrical machinery at their various collieries at the Pendleton and Pendlebury districts, near Manchester.

PONTYPRIDD.—Tenders are invited for the supply and delivery of small house service paper-insulated cables, and small vulcanised rubber wires. Particulars from the Engineer to the Council, Mr. J. E. Teasdel, fee £1 1s., returnable, and tenders to the Clerk by September 21st.

Miscellaneous

BELGIUM.—The municipal authorities invite tenders for the electric lighting of the municipal "Salle de Fêtes, place de Meir." A deposit of 12,000 francs (£480) is required. Specifications may be seen at the Commercial Intelligence Branch of the Board of Trade.

BLACKBURN.—The Tramways Committee has decided to terminate the present contract for advertising rates on the tramcars. The chairman and vice-chairman of the Tramways Committee are to deal with the question.

GERMANY.—Tenders are invited by September 25th for eleven electric travelling cranes by the Finanzdeputation of the Hamburg Town Council. Specifications may be purchased for 15 marks at Schretanat II., Finanzdeputation, Hamburg, and tenders by the 25th inst.

HALIFAX.—The Town Council has sanctioned the construction of a loop line between Great Albion Street and North Parade, Waterhouse Street, to allow a through communication between Illingsworth and Skircoat Green.

MERSEY RAILWAY CO.—Tenders are invited for stores, including electrical sundries. Specimens may be inspected on the 14th and 15th inst., and tenders are to be sent in by September 18th. Particulars from the Secretary, Worcester House, Walbrook, London, E.C.

NORWAY.—An electric lighting installation is required at the Moss Station, Christiania. Tenders to Distriktsingeniorenskontor, Christiania, by September 19th.

SOUTH AFRICA.—It is stated that a telephone is to be erected between Pietersburg and Pretoria and Johannesburg, a distance of 210 miles, and that a telephone system is to be installed in Beira.

SPAIN.—The *Gaceta de Madrid* of August 26th contains a notice to the effect that D. Salvador Andreu, of Barcelona, has applied to the Direccion General de Obras Publicas, Madrid, for a concession for the construction of an electric tramway from the Plaza de Mosen Verdagner (Vallvidrera), following the Sarria-Vallvidrera road to the Torrente de Raventerola; other offers to compete with this may be made to the above-mentioned "Direccion" within one month from the date of publication of the present notice in the *Gaceta*.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations, and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Addition to premises in Roach Road, Poplar, for International Harvester Co., 80 Finsbury Pavement, E.C.

Public conveniences (£1,000), at Bow (electric light to be installed). Harley Heckford, Borough Surveyor, Town Hall, Poplar.

E.C.—Alterations (£1,000), Temple Church. Architect, Reginald Blomfield, 1 New Court, Temple, E.C.

N.E.—Twenty new warehouses and addition to existing warehouse, Morning Lane, Hackney. Architects, Hodson and Whitehead, 7 Finsbury Square, E.C.

Four houses, Upper Clapton. Architect, G. H. Paine, 62 Moorgate Street, E.C.

Workshop, Hackney. Builder, G. Keetch, 49 De Beauvoir Road, Hackney.

Six houses, Hackney. Builders, W. M. Dabbs & Son, 19a Gaulton Road, Lower Clapton, N.E.

Additions to factory, Homerton. Builder, G. S. Garey, 48a Old Street Hill, Clapton Common, N.E.

S.E.—Additions to Amersham Arms public-house, 388 New Cross Road, S.E. Proprietor, S. P. Janes.

S.W.—Offices for L. and N.W. Railway Co. Builders, H. and E. Lea, Camden Works, Great Church Lane, Hammersmith.

Alteration of premises, Victoria Street, for branch Williams Deacons' Bank. Builders, W. Cubitt & Co., 258 Gray's Inn Road, W.C.

W.—Buildings, Aldford Street, Mayfair. Builders, Foster & Dicksee, Rugby.

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Alterations, residence, Curzon Street. Builders, Geo. Andrews & Co., 59 Craven Road, Lancaster Gate, W.

Alterations, residence, Grosvenor Street. Builders, Dove Bros., 15 Studd Street, Islington.

Stabling, &c., Reeves Mews. Builders, Maple & Co., Tottenham Court Road, W.

Alterations, Dundee Dye Works, Tottenham Court Road. Builders, Dove Bros., 15 Studd Street, Islington.

New clubhouse for Automobile Club on site of old War Office, Pall Mall. Architect, Purchase, 20 and 22 Maddox Street, W.

PROVINCES.

ABERYSTWYTH.—Hostel (£40,000). H. C. Fryer, Clerk Cardigan County Council.

BARNSTABLE.—Buildings in Charles Street. Builders, Cook and Sons, Bear Street, Barnstable.

BRISTOL.—Sunday schools (£3,000). Plans prepared by Rev. Canon Scales, Basingstoke.

BURSLEM.—Shops (£2,249). Architect, E. T. Watkin, Swan Chambers, Burslem.

CAMBRIDGE.—Extension of post office. H.M. Office of Works, Storey's Gate, S.W.

CARDIFF.—Additions, &c., to laundry (£550). Architect, H. Budgeon, 95 St. Mary Street, Cardiff.

COLNE.—Additions to Ball Grove Tannery. Builders, W. & J. Sagar, Park Road, Barnoldswick.

Two houses. Architects, G. Bower, 60 Market Street, Colne.

DARWEN.—School (£8,200). R. W. Smith-Saville, Surveyor, Town Council.

DUDLEY.—Additions to 116 and 118 Wolverhampton Street, for Davonport's City Brewery, Ltd.

Bakery in North Street for Dudley Co-operative Society.

Additions to schools. J. M. Wynne, Secretary Education Committee.

EALING.—School, Cranmere Avenue. Charles Jones, Borough Surveyor, Town Hall.

EASTBOURNE.—Alterations and additions to residence, Hampden Park. Architect, C. Wood, Whitley Road, Eastbourne.

Four houses, Brassey Avenue. Architects, Mitchell & Ford, 7 Gildredge Road, Eastbourne.

Alterations to "Red Lion" Inn for Southdown and East Grinstead Breweries, Ltd. (W. Bussey, Surveyor.)

Houses, Milton Road. Builders, L. P. Newman, 24 Ocklynge Road, Old Town, Eastbourne.

Houses. Architect, F. G. Cooke, 3 Hyde Gardens, Eastbourne.

Alterations, Sussex Hotel.

Addition to laundry. Architects, Mitchell & Ford, 7 Gildredge Road, Eastbourne.

Shops and flats. Architect, C. L. Morgan, King's Road, Haslemere, Surrey.

EBBW VALE.—Church, seating 500. Architect, G. E. Halliday, 14 High Street, Cardiff.

EXETER.—Extension (£9,000) of Hele's School. Secretary to the Governors.

HEBDEN BRIDGE.—Alterations, secondary school. Secretary to the Governors.

ILKESTON.—School (700 places). Architect not yet appointed. W. Lisset, Town Clerk.

KENDAL.—Fourteen houses. Architect, J. Banks, Kendal.

Infants' school. Architect, S. Shaw, 45 Highgate, Kendal.

LOWESTOFT.—Houses. Architect, W. J. Roberts, 124 London Road, Lowestoft.

Five houses. Architect, A. E. Clarke, Stanford Street, Lowestoft.

Painter's shop in Crown Street for Edward Chambers, Carriage Works, Crown Street, Lowestoft.

LUTON.—Carnegie Library (£10,000). Geo. Sell, Town Clerk.

MALTON (YORKS).—Grammar school. Architect, W. H. Brierley, York.

NEWCASTLE (Staffs.).—Wesleyan Sunday School (£800). Architect, R. T. Longden, 68 Moorland Street, Burslem, Staffs.

NETHERNE.—Isolation hospital and cottages in connection with Surrey County Asylum. Architect, Geo. T. Hine, 35 Parliament Street, Westminster.

NORBURY.—Shops and houses. Builders, Whitehead & Co., Clapham Road, S.W.

NORWICH.—Swimming bath (£2,860). E. A. Collins, Engineer, Town Council.

SOUTHPORT.—School (£11,214). F. W. Teague, Secretary, Education Committee.

SUTTON (Surrey).—Extension of premises for Wootton Bros., drapers. Builder, Wm. Salter, Webber Street, Lambeth.

WILLESDEN.—New railway station at Chapter Road. Architect, Matthew Garhutt, Bishop's Road Station, Paddington.

TENDERS RECEIVED AND ACCEPTED

BELFAST.—The tender of Messrs. W. J. Campbell & Sons for the construction of twelve sets of wooden shutters at the generating station at £40 has been accepted.

BRISTOL.—The following tenders have been accepted :—Superstructure of Shirehampton sub-station, Messrs. T. Lovell and Sons, £419; switchgear at Avonmouth Dock, British Thomson-Houston Co., £177 5s.; two power-distribution boards at Avonmouth Dock, Messrs. Siemens Bros. Dynamo Works, £366.

BRITISH MANNESMANN TUBE CO. (SOUTH WALES).—Messrs. Willans & Robinson have received an order for a surface condensing plant.

BURNLEY.—It has been decided to extend the height of the chimney at the new electricity works by another 30 ft. at a cost of £264. The tender of Messrs. Mullins & Durkin for the boiler-house and chimney now amounts to £3,522.

The following tenders have been accepted :—Five car-bodies at £339 each, Messrs. Hurst, Nelson & Co.; electrical equipment for five cars at £262 10s. per car, British Thomson-Houston Co.; the trucks for the five cars are to be made in the shops of the tramways department at an estimated cost of £110 per car, and the accessories for the cars will be ordered at an estimated cost of £82 per car.

CORNWALL.—In consequence of the cost of wiring, &c., of the Asylum buildings having been estimated at about £3,000, it has been decided to accept the tender of the local gas company for the lighting of the building.

DEWSBURY.—A surface condensing plant is being supplied by Messrs. Willans & Robinson.

DUBLIN.—The following tenders have been received for the electric lighting of Sir Patrick Dunn's Hospital and Nursing Home :—Aston Bros. (accepted), £871; W. Coates & Son, £958; Barrett & Co., £997; Cummins & Co., £1,025; Maguire & Gatchell, £1,043; Egan & Tatlow, £1,172; Eaton & Davidson, £1,347. The tender of Messrs. Ferranti, Ltd., at £185, has been accepted for the supply of feeder panels at the Fleet Street station, and a tender by the same firm at £829 has also been accepted for a sub-station switchboard. The tender of the British Electric Transformer Co. has been accepted for the supply of a transformer plant at £1,698.

EDMUNDSONS ELECTRICITY CORPORATION.—An order has been placed with Messrs. Willans & Robinson for a surface condenser plant.

GUILDFORD.—Tenders have been received from the Guildford Electric Light Company and from the Guildford Gas Company for the lighting of the Upper High Street. The Electric Lighting company offered to do the work at £50 plus maintenance, whilst the Gas Company's estimate was £84 plus maintenance. The Electric Light Company undertake to erect 8 lamps of 15,000 c.p. each, and this offer was accepted subject to twenty tradesmen agreeing to share the cost of the scheme. It is stated that already eighteen signatures have been secured.

JAPAN.—Three sets of surface condensing plant are being shipped to Japan by Messrs. Willans & Robinson.

LONDON: *Battersea.*—Electric mains are to be extended (200 yards) at an estimated cost of £79 6s.

Hackney.—The Electric Lighting Committee has accepted the tender of Greenhill & Markham, 11 Great Sutton Street, E.C., at £346 16s. 8d., for painting and repairing work at the electricity and destructor works. In reference to the coal contract, the committee has reported that recently the Engineer rejected two barges of coal supplied by J. Hudson & Co., under their contract for the supply of 2,000 tons of Broomhill nutty slack coal at 12s. 3d. per ton. Hudson & Co. were then informed that the Council would have to buy against them as provided by the contract, and 110 tons of Cowdenbeath washed peas had to be purchased from Cory & Son, at 10s. 3d. per ton. Of the 2,000 tons of coal contracted for with Hudson & Co., 1,163½ tons have been received at the contract price of 12s. 3d. per ton, which, together with the 110 tons ordered against them from Cory & Son, leaves a balance of 726½ tons.

NELSON.—A tender for the supply of coal to the electricity works for the ensuing half-year from Mr. W. H. Shaw, of Haslingden, has been accepted.

WESTERN AUSTRALIA.—A surface condensing plant has been shipped by Messrs. Willans & Robinson.

WESTMINSTER ELECTRIC SUPPLY CORPORATION.—Messrs. Kennedy & Jenkin, the consulting engineers to the Westminster Electric Supply Corporation, have placed an order for five surface condenser plants with Messrs. Willans & Robinson.

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COMPANIES' MEETINGS AND REPORTS

ABERDEEN SUBURBAN TRAMWAYS CO.—At the half-yearly meeting last week, the report and accounts, given in our issue for August 27th, were adopted. Mr. G. J. Walker, who presided, said that although the profit earned for the half-year to July 31st was greater than that earned during any corresponding half-year since they started, it was still not up to their desires. The profit for the half-year just ended was £835 10s., against £813 for the corresponding half-year of 1907. Last year, in consequence of the uncertainty with regard to their supply of energy from the Corporation, the directors considered it injudicious to pay a dividend, but since then the Corporation had agreed to refer the question of the price to be paid by the company at the termination of the existing agreement to a Board of Trade arbiter, and the directors were at present engaged in adjusting the exact terms of the agreement in reference to the arbiter. He was in hopes that this matter would be amicably adjusted very soon.

DUMBARTON BURGH & COUNTY TRAMWAYS CO.—At the first ordinary general meeting held in Edinburgh on Friday, the report and accounts given in our last issue were adopted. Major Charles Heaton Ellis, who presided, said that great credit was due to Messrs. J. G. White & Co., the contractors, for the expeditious manner in which the work had been carried out, enabling the company to benefit by the holiday and summer traffic this year. It was intended in a few weeks to make an issue of £80,000 five per cent. debentures, which would enable the company to discharge all its liabilities. The traffic receipts, he said, were continuing very satisfactorily, and he thought they had undoubtedly a valuable property.

DUNDEE, BROUGHTY & DISTRICT TRAMWAYS CO.—The report for the year ended July 31st shows a profit, including the sum brought forward, of £3,324. A final dividend is recommended upon the 6 per cent. preference shares, carrying forward £324. Before arriving at these figures, the directors of the statutory company have set aside £1,200 as depreciation, which fund now amounts to £2,500. The gross receipts from the tramways were £12,609. The meeting is on the 18th inst.

KENT COLLIERIES CO.—The report of the directors for the period of eleven months to May 31st, 1908, has been issued. It is stated that work on No. 3 pit was continued in the autumn of last year, but in view of the length of time that would be taken in remedying the defects in the electric pumping plant which had been supplied for this pit, and the great expense in running the plant owing to its inefficiency and its non-compliance with the guarantee given, it was decided to press forward operations by bringing Nos. 2 and 3 pits into communication. The report continues that between June 30th, 1907, and May 31st last there has been an expenditure in connection with the electrical plant of £1,227. The directors have reported from time to time as to the failure of the electrical plant installed in connection with No. 3 pit, and also as to the attitude taken by the electrical contractors in relation thereto. The Official Referee, before whom the case was heard, found that the electrical contractors had not supplied the machinery that they had contracted to supply, and that the guarantees as to steam consumption had not been complied with. From the legal point of view, the Official Referee measured the damages that he awarded to the company at £1,100, but, acting on the advice of counsel, the directors have decided to appeal against the amount of the award on the ground of its being insufficient, and being based on a mode of measuring damages not applicable to the case. (The action in question was reported at length in ELECTRICAL ENGINEERING, Vol. II., pp. 601, 684, 798, 987.)

LISBON ELECTRIC TRAMWAYS CO.—A meeting of the debenture holders was held in London on Thursday, at which a resolution was passed assenting to an alteration of the indenture securing the debenture holders. The resolution relieves the company of the restriction imposed under the terms of the trust deed of not being able to buy in the debentures of the company, and to re-issue them at any future time should this be to the interests of the company.

MANSFIELD & DISTRICT TRAMWAYS CO.—In issuing the accounts for the year ended December 31st, 1907, the directors state that the receipts so far this year show a substantial increase over the corresponding period of 1907, after meeting debenture interest to December 31st, 1907, and the interim dividend on the 6 per cent. cumulative preference shares to June 30th, 1907, the amount at the credit of revenue account is £2,688. The 6 per cent. cumulative preference shares for the half-year to December 31st, 1907, absorbed £1,800, and the remaining £888 carried forward. As the system was still under construction during part of the year, the directors have not dealt with the question of depreciation in the accounts, but intend to do so in future accounts.

MERSEY RAILWAY COMPANY.—The half yearly meeting was held in London on Wednesday last week, when the report and accounts were adopted. Mr. James Falconer, who presided, stated that there had been an increase during the past six months both in the receipts and in the number of passengers carried. The receipts for the year to June 30th were £102,811, whilst during the last half year of working with steam power, ended December 31st, 1907, the receipts amounted to £29,470 against £51,784 during the six months in review. In the same manner the number of passengers had risen from 3,357,000 to 6,867,000. With regard to the average receipt per passenger this had been reduced from 1·89d. in steam working to 1·67d. by electric working. He thought that these results showed in a very striking way the excellent service provided by the Company. The most hopeful feature of the undertaking was that the working expenses were practically stationary, so that as the receipts improved, the net profits were bound to increase to a much larger extent than would have been the case with steam working.

PUEBLA TRAMWAY, LIGHT & POWER CO.—The accounts for the half-year to December 31st, 1907, show a net profit of £7,463, after providing for bond interest, &c. From this surplus has been deducted certain preliminary expenses, leaving a surplus of £6,755, which it is proposed to carry forward.

SHEFFIELD UNITED GAS LIGHT CO.—At the half-yearly meeting on Monday, the Chairman referred to the fact that in May last the City Council decided to substitute electricity for gas in certain districts in the centre of the town, notwithstanding that the cost would be considerably increased. He maintained that the streets were sufficiently well lighted by gas, and the only reason for the change was apparently a desire to assist the electric light department at the expense of the rates. The Gas Company, being ratepayers, had every right to complain, especially in view of the fact that the electric light department only paid in rates for the year ended March 31st, 1907, £1,613, although their profits were given as £49,833. On the other hand, the Gas Company, whose profit was £89,768, paid no less than £18,251 in rates. Whilst it might be argued that the profits of the electric light department were subject to capital charges, the Gas Company's profits were also subject to the payment of dividends; thus the Gas Company paid more than eleven times as much in rates as the electric light department, although their profits were less than double. Therefore, the electric light department was either paying far less than they ought to, or the Gas Company a great deal too much. Carrying the comparison further, the Chairman stated that the combined water, tramways, and electric light department, with a total capital of over £4,000,000 and a profit in 1907 of £286,769, paid only £21,658 in rates against the £18,251 by the Gas Company, whose capital was only £970,355 and their profits £89,768.

YORKSHIRE ELECTRIC POWER CO.—The directors have pleasure in reporting progress during the half-year ending June 30th, 1908. During the half-year to June 30th the receipts from the sale of energy and for work done for consumers, &c., amounted to £8,698, against £7,293 13s. 5d. for the preceding half-year. The profit on the revenue account for the half-year amounts to £1,249, against £836 for the preceding half-year. After payment of mortgage interest the net revenue account shows a profit on the half-year of £363, as against a loss of £139 2s. 11d. for the half-year ending December 31st, 1907. This increase may be considered satisfactory in view of the general slackness of trade and the still prevailing high price of coal. At June 30th, 1908, agreements had been entered into with consumers for a total of 6,578 kilowatts (8,817 h.p.), being an increase of 1,030 kilowatts (1,380 h.p.) during the six months. Most of these agreements have been made during the latter part of the half-year, and the consumers are not yet connected. Amongst the new agreements is one with Electrical Distribution of Yorkshire, Ltd., for a supply of energy for tramway purposes in Ossett and Soothill Nether. New mains in the direction of Barnsley are being erected, and it is expected that a considerable load will be secured adjacent to the route. On July 9th, 1908, an extraordinary meeting of shareholders was held to sanction an issue of £45,000 of second mortgages on the undertaking of the company, for the purpose of providing the capital necessary to extend the company's operations, and £32,055 have been applied for and allotted. The directors have appointed Mr. Arthur Herbert Meysey-Thompson as a director to fill the vacancy caused through the retirement of Sir Richard Mottram. The meeting will be held at Leeds on the 29th inst.

Wireless Telegraphy in the West Indies and the Pacific.—A wireless telegraphy station has been established at the Swan Islands, Gulf of Honduras, and is in operation every day except Sunday. According to the *New York Herald*, the carrying out of a comprehensive scheme of wireless telegraphy connecting all the important islands in the middle of the Southern Pacific Ocean with Australia—a scheme which has long been contemplated—is now assured.

Accident at Messrs. Dick, Kerr & Co.'s Works.—On Friday last an inquest was held at Preston on the body of J. E. Johnson, an employee in the works of Messrs. Dick, Kerr & Co. According to the witnesses the man was working at a switchboard, and had hold of a switch handle, when he suddenly let go and exclaimed that he had had a shock. After walking a few yards, he fell unconscious. The pressure was only between 250 and 300 volts. A verdict of "Accidental death" was returned, but no explanation of how the man received the shock was forthcoming.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £63 10s. to £64 10s. (last week, £63 to £63 10s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A receiving order has been entered against G. H. Smith, electrical engineer, 15 Ashley Road, Altrincham.

Application was made to the Registrar of the London Bankruptcy Court on Tuesday by Mr. J. H. Callcott, Electrical Engineer, Clayton Works, Little East Place, Kennington, London, for approval to a scheme of arrangement whereby £28 per month should be set aside until a composition of 10s. in the £ has been paid. The statement of liabilities amounted to £1,953 and the assets to £5. The scheme was approved.

DISSOLUTION OF PARTNERSHIP.—J. P. Beckett and J H. Trolley, carrying on business as electrical engineers and contractors as J. P. Beckett & Co., at Victoria Street, Great Grimsby, has been dissolved. Debts by J. P. Beckett.

NEW PATENT ACT.—It is announced that the Stolz Electrophone Co., of Chicago, have decided to remove the foreign department of their works to London, in order to meet the requirements of the new Patent Act.

Street Lighting with Metal Filament Lamps.—A novel method of street lighting is being tried in a town in Michigan, U.S.A. According to the *Electrical World*, the installation consists of 15 spans across the street, with eighteen 60 c.p. 75-watt tungsten lamps in series on each span. The spans are 100 feet apart. The installation is said to be very successful from all points of view.

Electrification of Baden Railways.—The Berlin correspondent of the *Times* writes that according to the *Vossische Zeitung* the Paden Government has decided to introduce electric traction on the sections of the State Railway line between Basel and Zell, and between Schopfheim and Säckingen. The Siemens-Schuckert system will be adopted, and the electric energy will be generated at special stations, which are to be erected on the Rhine. The contract for the conversion of the line has been assigned to the firm of Siemens and Schuckert and to the Berlin Allgemeine Elektrizitätsgesellschaft. The new undertaking will be initiated with ten electric locomotives, each of which is, normally, to develop 1,000 horse-power.

Elastic Suspension for Metallic Filaments.—A recent issue of the *Electrical World* contains a description of a form of elastic suspension for the metallic filament of an incandescent lamp, for which a patent has been granted to Paul Druseidt, of Remscheid, Germany. A glass carrier for the filament spiders is supported at each end by spiral springs, and the leading-in wires are connected to the filament by the intermediary of a spring or similar flexible arrangement. Side supporting springs may also be used. It is stated that these springs have a cushioning effect upon the filaments and greatly lengthen the life of the lamp, particularly as they absorb vibrations and prevent friction and breakage of the filaments in their retaining elements or hooks. For this reason a larger number of retaining hooks than at present employed can be advantageously used.

Destruction of Wooden Poles by Birds.—The United States Bureau of Forestry reports that birds are destroying the telephone and telegraph poles in the South and South-west, particularly in Texas, Arizona, and California. In some places 50 per cent. of all the poles along the right-of-way have been riddled by these innocent offenders, which belong to the woodpecker family. One official reported having seen 25 telephone poles with 200 or 300 holes drilled clear through them. Some of the holes were 3 ins. or 4 ins. in diameter. Another counted the white cedar telephone poles along the right-of-way near Covington, Tenn., which had been affected by woodpeckers found that out of 268 poles, 110, or 41 per cent., had been bored. In some cases destruction of the pole takes only a few months, and the weakened condition makes it dangerous for a lineman to climb the pole. The real object of the birds in drilling the holes is uncertain. One telephone man stated that the humming of the wires was mistaken by the birds for insects excavating beneath the surface of the wood, and that they drilled the poles in quest of these imaginary insects. It is very probable, however, that the holes are excavated for an entirely different purpose. The woodpecker is a provident bird. At the proper season it stores up a supply of acorns and other foods for future consumption. In the summer these holes are often found stored with acorns. Many methods for preventing this damage have been suggested, but probably the most successful is preservation with creosote. A line of creosoted poles, opposite the one near Covington, was examined, and not a single hole was found. When it is considered that creosote will not only prevent the damage caused by the woodpecker, but also protect the pole indefinitely against both insects and decay, its great value as a preservative is apparent.

NEW COMPANIES

BAT METER CO.—This company was registered on August 27th, with a capital of £20,000 in £1 shares (12,000 preference), to carry on the business of manufacturers of and dealers in electric, gas, and water meters, &c. The subscribers are: P. Bertin, 23-5 Northdown Street, N., Civil Engineer; E. L. Biggs, 12 Montpelier Road, Holloway, N; J. E. Denney, 3 Great St. Helens, E.C., Chartered Accountant. Private company. The first directors (to number not less than three, nor more than seven) are G. Heely, 1 Waverley Place, St. John's Wood, N.W.; F. A. Brocq, 16 Boulevard de Vaugirard, Paris; and P. Bertin. Qualification, £100. Remuneration, £50 each per annum. Registered office, 3 Eden Street, Hampstead Road, N.W.

H. HOOPER & CO.—This company was registered on September 2nd, with a capital of £5,000 in £1 shares (3,000 6 per cent. cumulative preference), to acquire the business of an electrical engineer and contractor carried on by H. Hooper at 181 High Street, Lewisham, as "H. Hooper & Co." The subscribers are: J. W. Vincent, Chartered Accountant; J. B. Roberts, 49 Hurlingham Court, S.W. Private company. The number of directors is not to be less than two, nor more than five; the first are J. H. Bulkley and H. Hooper (permanent managing directors). Table "A" mainly applies. Registered office, 181 High Street, Lewisham.

INTER-URBAN ELECTRIC CO. (CANADA).—This company has been granted a concession to work electric railways and telephones and to supply electricity for heat, light, and power purposes in the municipalities of West Toronto and York. The capital is $400,000, divided into $40,000 shares of $10 each.

LETCHWORTH ELECTRIC SAW MILLS.—This company was registered on August 31st, with a capital of £1,000 in £1 shares, to acquire the business of a sawmill proprietor, joiner, and timber merchant, carried on by W. Jackson, at Works Road, Letchworth, as the "Electric Saw Mills." The subscribers are:—W. Jackson, H. Martin, F. Pearson. Private company. The number of directors is not to be less than two nor more than seven; the first are W. Jackson, H. Martin, and F. Pearson. Qualification, £50. Remuneration as fixed by the company. Registered office, Works Road, Letchworth.

MACDONALD, SYER & CO.—This company was registered on August 24th, with a capital of £1,000 in £1 shares, to carry on the business of consulting, civil, electrical, constructional, marine, hydraulic, agricultural, aëroplane, cycle, motor, locomotive, gas, tool, mining, textile, sewage, railway, inventors, and general engineers, &c. The subscribers are:—L. I. Woodley, C. S. Syer, J. W. Fletcher, W. E. L. Syer, S. W. Wilkins, J. G. Addinell, G. H. Addenbrooke. Private company. The number of directors is not to be less than two, nor more than five; the first are C. S. Syer (managing director) and J. W. Fletcher. Qualification, 10 shares. Remuneration as fixed by the company or by agreement. Registered offices, 41 Snow Hill, E.C.

ROSARIO & DISTRICT RAILWAY SYNDICATE.—This company was registered on August 21st, with a capital of £60,000 in £1 shares, with objects chiefly indicated by the title. The subscribers are:— J. H. Wilson, and E. J. Lyon. Private company. The first directors are to number not more than four; the subscribers are to appoint the first. Qualification, 250 shares. Remuneration, £150 per annum for the chairman, and £100 each for the others, with 3 per cent. of the profits available for distribution, divided (chairman to receive one-eighth per cent. of the said profits in addition to his share of the said 3 per cent.). Registered by Goddard & Co., St. Michael's House, St. Michael's Alley, Cornhill, E.C.

VICTORIA GARAGE & ELECTRICAL CO.—This company was registered on September 2nd, with a capital of £1,500 in £1 shares, to acquire the business carried on at St. John Street and Parkside, Coventry, as the Victoria Garage & Electrical Co., and the business carried on at 27 Fleet Street, Coventry, as the Stour Cycle & Motor Depôt. The subscribers are:—E. J. Swift, D. Thompson, A. Turner. Private company. The first directors are E. J. Swift (managing director), D. Thompson, and A. Turner. Registered Office, 68 John Street, Coventry.

New Transmission Lines from Niagara.—According to the *Electrical World*, the Hydro-Electric Power Commission of Ontario has let the contract for the erection of 293 miles of transmission lines. The lines will radiate from Niagara Falls in two directions—westward to St. Thomas, and eastward to Toronto. They are to be completed by December 1st, 1909. The towers, 3,176 in number, are to be 66 ft. high, 7,340 tons of steel being required for their construction. 1,014,209 lbs. of aluminium cable will be used. The contractor undertakes, upon due notice, not only to double the mileage at the contract rate, but also to furnish at the contract prices from 50 to 125 tons additional of aluminium cable for the construction of low-tension lines. This is to provide for any extensions that may be desired from municipalities on the high-tension lines to neighbouring towns and villages.

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MISCELLANEOUS CITY NOTES

BRITISH INSULATED & HELSBY CABLES.—A dividend on the ordinary shares at the rate of 8 per cent. per annum, less tax, for the half-year ended June 30th is announced.

CANADIAN GENERAL ELECTRIC CO.—A dividend of 1¾ per cent. is declared upon the common stock for the quarter to September 30th, being at the rate of 7 per cent. per annum.

MEXICAN LIGHT & POWER CO.—A working arrangement has been come to between the Mexican Light & Power Co. and the Mexico Tramways Co., which will amount practically to an amalgamation. The *Stock Exchange Gazette* states that the Tramways Co. will become the dominating partner in the alliance, shareholders in the Light & Power Co. being guaranteed a minimum dividend of 4 per cent., with rights to further participation when the united earnings of the two undertakings exceed a certain figure.

RIO DE JANEIRO LIGHT, HEAT & POWER CO.—The *Financial News* states that the receipts of the Rio Janeiro Light & Power Co. for the thirty-third week of the year amounted to 693,999f., an increase of 42,664f. as compared with the corresponding period of the previous year. The gross receipts for the current year show an increase of 2,328,817f. The takings of the Rio Janeiro Tramways form about 50 per cent. of the total revenues of the Rio Janeiro Light & Power Co., and these receipts have fallen off considerably since the month of May, owing to the important electrification work, which has paralysed traffic on portions of the road. However, it is expected that towards the end of September some 25 kilometres of the line, situated in the heart of the city, where traffic is thickest, will be completely transformed for working by electricity and ready again for service, which the directors hope will soon make up the losses. Moreover, towards the end of the year 35 kilos. will be ready. Altogether within the next year the tramway system, of which 80 kilos. is now electrified, will have 250 kilos. running with electric power supplied by the company. The company is now working with five units of 8,700 h.p. each, and the sixth unit will be ready in a few days. The takings from this service are developing every day. While in May last the receipts from this part of the undertaking amounted to 242,000f., in June they had increased to 282,000f., and in July the figure reached 352,000f. The directors are quite sanguine that it will gradually reach about 1,000,000f. a month, when the whole plant has been installed, such is the demand for electric power in Rio Janeiro.

SAO PAULO TRAMWAY, LIGHT & POWER CO.—A quarterly dividend of 2¼ per cent. has been declared.

SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER CO.—The register of the debenture stock holders, and transfer register, will be closed from September 17th to 30th inclusive, for the preparation of warrants for interest for the half-year ending September 30th, 1908, payable on October 1st.

The Venner Time Switch.—The Board of Trade have approved of the pattern and construction of the Venner time switch, type B, and of the mode of fixing it described in the specification and instructions sent out with the meter.

Submarine Signalling by Electric Bells.—According to the *Times*, the Submarine Signal Company have in hand the equipment for an electrical submarine bell for installation at Tarrifa. It will be worked by a dynamo in the lighthouse at Tarrifa, with a cable extending a quarter of a mile off the shore into 20 fathoms of water, the action of the hammer being controlled by electric magnets inside the bell casing. Similar electric bells which have been fitted on the Canadian coast have given entire satisfaction. The code of signals for the bell at Tarrifa is awaiting the approval of the Spanish Minister of Marine.

Telegraph Traffic.—At the present moment there are no less than eight cables waiting to be repaired; the latest interruption is that of the cable between Paramaribo and Cayenne, belonging to the French Cable Company.—The Las Palmas-Arecife cable has been down since May last, and those between Djedda and Souakim and Assab and Massowah since July.—The Kwardang-Merado connection was restored on the 8th inst., but the cable between Kotonou and Lagos is not yet working.—The cable between Cadiz and Teneriffe has also not yet been repaired. The scheme of the Spanish Government to lay another cable between these two points seems at present no nearer realisation.—The Colony of British Honduras is negotiating with the Mexican Government with a view of bettering telegraphic communication with the outside world. As yet this Colony is not joined to the Imperial telegraph system, although a cable between that Colony and Jamaica has long been discussed.

MUNICIPAL TRAMWAYS ASSOCIATION

THE programme of the annual meeting of the Municipal Tramways Association, which will be held in Nottingham on Wednesday, Thursday, and Friday, September 23rd, 24th, and 25th, has now been issued.

On Wednesday there will be a meeting of the Executive Committee at the Exchange Hall at 10 a.m., which will be followed by a reception by the Mayor, the Sheriff, and Chairman, and members of the Nottingham Tramways Committee, at 10.15 a.m. The Conference will commence in the Council Chamber of the Exchange Hall at 10.30 a.m., when Mr. J. Aldworth, the General Manager of the Nottingham Corporation Tramways, will deliver his Presidential Address. A Paper will then be read by Mr. H. E. Blain, General Manager of the West Ham Corporation Tramways Department, on "Some Through-Running Problems and Their Solutions." The Association will be entertained at luncheon at the Victoria Station Hotel by the Nottingham Tramways Committee, and at 3 p.m. there will be an inspection of the Trent Bridge car-repairing works and the St. Ann's Well Road generating station. There will be a reception in the Art Museum, Nottingham Castle, at 7.30 p.m., by the Mayor, Sheriff, Chairman and vice-chairman of the Tramways Committee.

The following Papers will be read on Thursday, September 24th :—(1) "The Treatment of Corporation Employees Incapable of Performing Ordinary Duty," by Mr. Alderman H. Linsley (Salford). (2) "The Application of Technical Science to the Construction, Maintenance, and Operation of Tramways," by Messrs. R. G. Cunliffe and J. G. Cunliffe (Manchester Corporation Tramways). (3) "Ticket Check," by Mr. L. Mackinnon (Glasgow Tramways). At 7 p.m. the Association Dinner will be held at the Victoria Station Hotel.

On the morning of Friday, September 25th, there will be a meeting of the Managers' section at 10 a.m., followed by the business meeting of the Association in the Council Chamber of the Exchange Hall at 10.30 a.m.

APPOINTMENTS AND PERSONAL NOTES

Mr. D. Campbell has been appointed Chief Superintendent of Telegraphs at Glasgow.

Mr. J. A. Hoffe, Chief of the Electric Signalling Branch of the Cape Government Railways, who recently retired on pension, has returned to England.

Councillor J. Smith, chairman of the Colne Electricity Committee, has been asked to accept the Mayoralty.

NEW PUBLICATIONS

"Science Abstracts." August. Section A. Physics: Section B. Electrical Engineering. (London: E. & F. N. Spon.) 1s. 6d. each.

"Cranes: Their Construction, Mechanical Equipment, and Working." By Anton Böttcher. Translated and Supplemented with English, American, and Continental Practice by A. Tolhausen. (London: Archibald Constable & Co.) 42s.

Institution of Mining Engineers.—It has been decided to transfer the headquarters of the Institution from Newcastle to London.

Proposed Memorial to Lord Kelvin in Belfast.—In connection with the project to erect a memorial in Belfast to Lord Kelvin, the meeting of the Executive Committee was held in the City Hall, Sir W. Crawford, J.P., being in the chair. Many members of the British Association were present, including Prof. S. Dill, Prof. J. Symington, Right Hon. T. Sinclair, Messrs. J. R. Fisher, R. T. Martin, and John Sinclair Apologies were received for non-attendance from several others interested in the movement, and it was reported that the sum of £1,852 has been received in subscriptions up to date A sub-committee, consisting of the Earl of Shaftesbury, Rev. President Hamilton, Sir Otto Jaffé, Right Hon. T. Sinclair, and Mr. R. T. Martin, was formed to arrange with an eminent sculptor with reference to the proposed statue, and to report to a subsequent meeting of the Executive Committee.

Hertford Light Railways.—The Board of Trade have confirmed an order made by the Light Railways Commissioners authorising the construction of light railways in the Urban District of Watford.

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PRESSURE REGULATION ON THREE-WIRE SYSTEMS

AMONG the Patent Specifications published at the Patent Office on Thursday last is one numbered 15,846 of 1907, and granted to W. Fennell and W. P. Perry, relating to methods

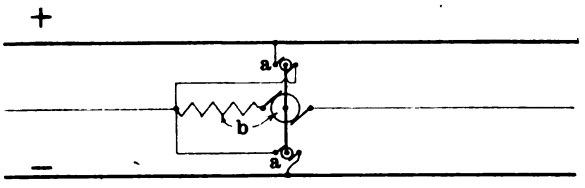

Fig. 1.

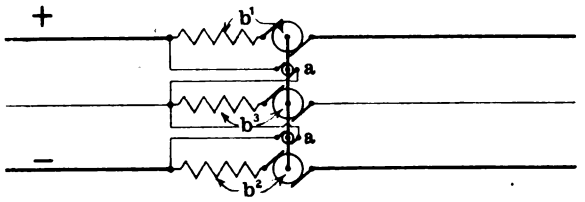

Fig. 2.

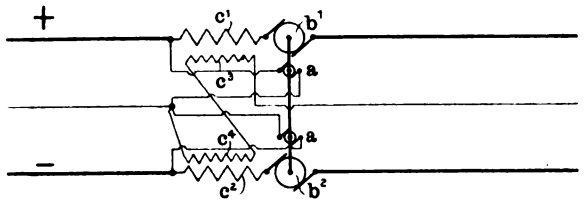

Fig. 3.

of regulating the pressure on three-wire systems. The method ordinarily employed in generating stations is to connect a balancer across the station bus-bars, but even if the fields are cross-connected, trouble is sometimes experienced in dealing with heavy out-of-balance currents, owing to the drop of pressure on the middle wire.

The present patent describes methods of connecting boosters, which are driven by the balancers, to compensate for this drop. The fields of these boosters are either connected in series with the middle wire, or with the outers. In the diagrams above the balancer fields are omitted for the sake of simplicity.

Fig. 1 is the simplest arrangement. In the neutral wire a series-wound booster is connected, mechanically driven by a balancer a, which raises or lowers the voltage of the middle wire bus-bar by an amount equal to the drop in voltage in the middle wire.

Fig. 2 shows a modified arrangement, with boosters, b^1 and b^2 in the outer feeders, as well as a booster b^3 on the neutral wire.

Fig. 3 illustrates another manner of achieving the same object without boosting the neutral wire, applicable when boosters are already applied to the positive and negative feeders. Additional coils, c^3 c^4, are placed on the boosters of the positive and negative wires. These coils are connected in series with the neutral wire; c^1 indicates the ordinary field coils of the booster b^1, and c^2 the field coils of the booster b^2. A fourth alternative is also suggested, in which the field coils c^1 and c^2 are omitted, for cases in which it is not desired to boost specially for drop of pressure in the outers.

It appears probable that these arrangements will compensate for larger out-of-balance currents, and also deal with rapid fluctuations of load more effectively than the ordinary balancer, but it is evident that it introduces an additional complication and expense.

Northampton Polytechnic Institute.—The recent provision of increased accommodation, obtained by the occupation of the British Horological Institute, not having been found sufficient for the growing requirements of this institute, an additional building is now being erected in the courtyard, and it is hoped that the greater part of it will be available immediately after Christmas. The new building will contain a lecture room larger than any of the existing lecture rooms, and also increased class-room accommodation. It also provides for the enlargement of the mechanical engineering workshops and the mechanical laboratory, and includes new power laboratories.—The prospectus of the Institute for the season 1908-9, which has just been issued, contains full particulars of the educational courses which can be taken at the Institute, and the various evening classes held there. There are day and evening courses in engineering (mechanical and electrical), in technical optics and artistic crafts, and in horology. In addition there are evening courses in technical chemistry and domestic economy. The classes of the day courses commence on Monday, October 5th, and those of the evening courses on Monday, September 28th. Enrolments for the latter commence on Monday, 14th inst. Full details of the syllabuses and the equipment are given in the prospectus. In the evening classes the electrical engineering department announces a full sessional course of lectures in wireless telegraphy and telephony, by Dr. J. Erskine Murray, the pioneer course held last May in this subject having proved to be very successful. There are also special advanced lectures on Heavy Electrical Engineering by Mr. H. M. Hobart.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Sept. 3rd, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

11,183. **Speed Control of Polyphase Motors for Marine Propulsion.** H. A. MAVOR, W. B. HIRD, and MAVOR & COULSON, LTD. A number of synchronous motors are mounted on a common shaft. The motors have different numbers of poles, but each motor is supplied with current from a separate generator at such a frequency that all rotate at the same speed. For example, four generators, having respectively frequencies of 20, 30, 40, and 60 cycles may be used with four motors mounted on a common shaft, and with 24, 16, 12, and 8 poles respectively. If these generators and motors are connected severally in the above order, all the motors will rotate at 300 r.p.m. This connection will be for normal speed and maximum power. If the 20 and 40-cycle generators are connected to the 24 and 12-pole motors respectively, a speed of 200 r.p.m. at half power will be obtained. By thus variously grouping the machines, speeds both above and below the normal full power speed can be produced. The system is suitable for land or marine propulsion. Three claims, four figures.

15,846. **Pressure Regulation on Three-wire Distribution Systems.** W. FENNELL and W. P. PERRY. The insertion of a booster, mechanically coupled to the balancer, in the neutral wire of a three-wire system, to compensate for the drop in the neutral. A short article on this arrangement, with figures, is given above.

18,165. **Automatic Telephone Exchange.** SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*). Improvements on that automatic telephone exchange system in which any given subscriber is selected by first setting one or more group selectors, according to the magnitude of the exchange, and then setting the selector which finds the individual subscriber. Each subscriber is provided with a preliminary selector, situated at the exchange, which is brought into operation by the subscriber by the act of lifting the receiver. This selector connects the subscriber with one of the group selectors. For operating the group selectors, the subscriber is provided with a current interrupter which enables him to break the circuit through his telephone instrument, and to earth either or both of the speaking lines. Should a called subscriber be engaged when the individual selector has been operated to make connection with him, a test line from his instrument will be found by the selector to be earthed, whereupon a releasing current will flow to return the selectors to their normal position. The present invention provides for circuits for locking the selectors when these have been operated by the subscriber; and further for disconnecting the speaking lines which have been connected by the selector operated by the calling subscriber, when the called subscriber is engaged. Twelve claims, two figures.

18,548. **Manufacture of the Active Plates of Alkaline Accumulators.** W. FENNELL and W. P. PERRY. The preparation of the active plates of an alkaline cell, having iron, nickel, cobalt, or copper as the active metal. The metal plate is alloyed to a certain depth below the surface, the proportion of the foreign metal gradually decreasing as the depth increases. The foreign

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metal is then dissolved out, leaving a plate with a surface sufficiently molecularly porous to be formed up into peroxide. The unalloyed metal forms the support for the active portion. The alloying may be performed by heating the metal plate in contact with another metal in a finely powdered condition. Three claims, six figures.

18,582. **Protection of Alternating-Current Distribution Systems.** BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitäts Ges.*) A method of automatically isolating a section of a distribution system on the occurrence of a fault in that section. Reverse-current relays are connected to both ends of the section, and the contacts of these two relays are connected in series in an auxiliary circuit. The latter circuit comprises a single wire connecting the two relays, two auxiliary relays for operating the main section-isolating switches, and an earth return. When current is flowing in the section, one of the main relays is closed, and the other is open, and, as the contacts are in series, the auxiliary circuit is open. If the current for any reason flows in the opposite direction, both relays operate, one closing and one opening, and thus there is still an open auxiliary circuit. Should a fault occur in the section, current will flow from each end towards the fault, and consequently both relays will close, thereby completing the auxiliary circuit. The auxiliary relays will then operate, and open the section isolating switches. Four claims, five figures.

18,688. **Supports for Metal Filaments.** T. W. LOWDEN. A resilient support consisting of a spiral spring of glass, inserted between the lamp base and the supporting pillar, for the purpose of preventing the transmission of shock or vibration from the lamp body to the filament. Three claims, one figure.

20,867. **Commutation of Single-phase Motors.** ALLGEMEINE ELEKTRICITÄTS GES. In continuous-current interpole machines it is possible to omit half the number of interpoles, or all except two in the case of a simple wave-winding, but this is not practicable owing to the high self-induction of the short-circuited coils when in the zones without interpoles. According to the present invention, a certain number of the interpoles or auxiliary windings of a single-phase commutator motor are omitted, and the unneutralised rotor cross field which then exists in the commutation zone is utilised to induce an E.M.F. in the short-circuited coils to neutralise the short-circuit E.M.F. The auxiliary windings are either short-circuited through a regulating resistance, or are supplied with a potential proportional to the stator potential, and are arranged to be connected only at or about the synchronous speed. Six claims, two figures.

22,405. **Multiple Unit Control System.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). In multiple unit control systems in which the current for the controller circuit is derived from the main power circuit, the variations in the pressure of the system may interfere with the operation of the contactors, and render their action uncertain. According to the present invention, a resistance is inserted in series with the control circuit. A relay automatically short-circuits the resistance when the pressure drops below a certain value, and inserts it again when the pressure rises. Three claims, one figure.

22,481. **Speed Limiting Device for Series Motors.** ALLGEMEINE ELEKTRICITÄTS GES. The starting devices employed in connection with series motors subjected to widely varying loads have had to be designed so as to be available, either for starting the motor at full load, or at very light load; and consequently the resistance employed for starting the motor at low speed on light load had to be short-circuited when the motor was started under full load. In this way no means were provided for preventing the armature from speeding up after it had started. The present invention renders the safety of the motor independent of the operator, and provides for the automatic switching in of the series resistances corresponding to the different loads. The value of the series resistance is regulated by means of an electromagnetically operated switch, which is energised from the armature brushes, its operation being thus directly dependent on the speed of the armature. An auxiliary device for preventing the intermittent working of this controlling switch is provided. Four claims, four figures.

23,418. **Small Transformers for Metal Filament Lamps.** H. W. TURNER. The small "adapter" type of double winding transformer, which was fully described in ELECTRICAL ENGINEERING, Vol. III., p. 698. It is stated that enamelled wire is used for both windings; and the construction of the "turn-down" device is described. Three claims, seven figures.

24,589. **Arc Extinguishing Fuses.** F. POOLEY AND W. R. MACDONALD. Tubular fuses of the usual composition of lead, tin, and antimony, but containing a core of arc extinguishing or smothering mixture consisting of 60 per cent. bone ash, 30 per cent. carbonate of lime, 8 per cent. borax, and 2 per cent. charcoal. Two claims.

24,808. **Multiple Circuit Wave Winding for Single-Phase Commutator Motors.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) It has been usual to employ only one set of brushes of each polarity in alternating-current commutator motors, with multiple-circuit wave windings, as with a fractional winding pitch, and more than two sets of brushes, internal closed circuits consisting of as many coils as there are poles produced. These cause excessive heating and sparking. According to this invention a winding pitch exactly equal to the polar pitch is employed, and by this means short-circuiting of a number of coils together is avoided. The brushes of like polarity are connected together through portions of the compensating windings, which offer a high impedance to circulating currents. Three claims, three figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

14,059, GROB. System for electrically lighting and heating vehicles.
16,429, BURBEY & KERSLEY. Rails for tramways.
18,937, RYALL. Cases for thermal electric contact-making devices.
19,085, MARCONI'S WIRELESS TELEGRAPH CO. & MITCHELL. Tremblers for sparking apparatus.
19,174, BURLEIGH. Dynamo electric machines.
20,261, LUTZ. Make and break devices for magneto-ignition in internal-combustion engines.
20,491, HEYMANN. Electrode for secondary batteries.
21,017, SANDERS & DEAN. Apparatus for regulating the ignition in internal-combustion engines.
21,273, VANDERVELL & HOFFMAN. Magneto-electric machines for ignition purposes.
22,283, CÔTE & PIERRON. Electric furnace for the extraction of zinc from its ores.
22,523, MEEK. Magnetic separators.
22,736, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Air brake systems.
24,213, FELTEN & GUILLEAUME LAHMEYERWERKE ACT.-GES. Manufacture of steel.
24,217, CONSTANTINESCU. Single rail railways.
24,690, STIMSON. Burglar alarms.
24,852, SIDWELL. Brakes for tramcars.
26,055, HAGMÜLLER. Magnetic separation of iron particles from chaff.
27,375, GUENET. Tremblers for induction coils.
27,543, GIMINGHAM. Springs for use in filament lamps.
27,556, RÖCHLING & SCHOENAWA. Manufacture of steel.

1908 Patents

33, MAUNDER, THOMPSON, & MITCHELL. Tramway braking apparatus.
1,721, ALLEN. Railway and tramway points and switches.
2,127, MILLS (*Signal and Control Company*). Electrically operated whistles.
2,307, DE BOUILLANNE. Apparatus for sterilising water by ozone.
4,273, COWPER-COLES. Electrolytic manufacture of metallic foil.
4,274, O'KEENAN. Method of compensating friction of brushes in motor meters.
6,721, VEEVERS & BUTTERWORTH. Electric tramway points.
8,800, RACOT, RENAUD, & LANOÉ. Railway signalling apparatus.
9,502, ALLGEMEINE ELEKTRICITÄTS GES. Arc lamps.
10,211, POLLOCK & WERD. Insulators for telegraph wires.
11,511, SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*). Electrical contacts.
12,265, KOCH. Transmitters for signalling systems.
12,678, GAGLIO & VILLANI. Cut-out.
13,088, SIEMENS BROS. & CO. (*Siemens & Halske Akt. Ges.*). Disc meters.
14,579, NICHOLSON. Electrically worked horn.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

8,277, SCHELLER. Production of high frequency oscillations.
9,789, DE SAINTE-CLAIRE. Variable-speed gear for electric automobiles.
14,513, TIMAR & VON DREGER. Motor starter.
14,825, SOC. ANON. MONTBARBON. High tension ignition apparatus.
16,900, TAYOUX, CHAUCHY, & FRAYSSE. Magneto electric machine.
16,986, SOC. ANON. WESTINGHOUSE & BRUN. Direct current electric motors.

Expiring Patents

The following patent expires during the current week, after a life of fourteen years.

17,529 of September 14th, 1894. **Telephonic Apparatus.** F. H. W. HIGGINS. A case of slate or other rigid non-metallic material for a telephone receiver, which will not respond to the vibrations of the diaphragm. Also a diaphragm, built up of two thicknesses of iron cemented together with shellac, and with a radial slit extending from the centre to the circumference. The bobbin of the receiver is wound in two parts in opposite directions. This specification also describes means for ventilating silent telephone closets by covered passages lined with velvet.

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ELECTRICAL ENGINEERING

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SUMMARY

The London premises of Messrs. W. H. Smith & Sons, the large newsagents and booksellers, afford an interesting example of the applications of electric lighting and of the electrical operation of printing machinery. We describe in this issue the lighting and power arrangements of the five large buildings in London, including the new one in Kingsway. The latter has an interesting automatic pumping plant. At the printing works in Fetter Lane there are about sixty motors, most of which drive printing machines. There are various types of starters and regulators in use; the automatic control of some of the larger machines is of particular interest. The lighting of the new building is entirely by tantalum lamps, of which also many are used in the old buildings. (Page 419.)

A new form of apparatus for obtaining the magnetisation curves of samples of iron by the ballistic galvanometer method has been designed by Prof. Gisbert Kapp. The two samples are connected by two short yoke-pieces with conically-bored holes to receive the ends of the sample rods. The errors due to the reluctance of the yoke and the joints are thus reduced to a minimum. (Page 420.)

An experiment in electric cooking is now being made at one of the Fleming's Restaurants in Oxford Street, and a careful record is being kept of the consumption of the various grills, hot-plates, and egg-poachers. We are able to give the figures for the first week's working, which are very favourable. Great satisfaction has been expressed with the results from all points of view. Current for the apparatus is obtained at power rates from the Marylebone Borough Council's mains. An improved form of grill is an interesting feature of the installation. (Page 421.)

In his report to the Victorian Railway Commissioners on the electrification of the suburban railways of Melbourne, Mr. Merz recommends a preliminary electrical equipment of some 29 route miles of track, which is considerably more than was originally proposed. An increase of 71 per cent. in the train-mileage, with an increase of only 23 per cent. in the ton-mileage, is expected. The system recommended is an 800-volt protected third-rail continuous-current system, with converter sub-stations supplied with three-phase alternating current from a steam turbine power station at Yarraville with a capacity of 35,000 electrical horse-power. (Page 422.)

Hitherto the water power in New Zealand has been the vested property of the State. A Bill is to be introduced in the New Zealand Parliament this session which will permit water power to be employed for private enterprise under certain restrictions. A correspondent reviews the situation, and emphasises the

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opening for British electrical engineering firms. (Page 423.)

SOME particulars are given of the proposal of the Ontario Government to furnish electric power from Niagara Falls to the municipalities of that province within a radius of 150 miles. (Page 424.)

A DETERMINED attack on electric tramways was made by Mr. F. DOUGLAS FOX in a Paper read at the British Association meeting in Dublin. It was based on an analysis of 71 municipal tramways accounts, and its object was to show that there is a wide field for the electric trolley omnibus system with which he is connected. He gave the average total costs, including capital charges, of 71 municipal tramways as 9·96d. per car-mile, and the average revenue 10·52d. per car-mile. For the petrol 'bus the figure for total costs, including capital charges, was given as 11·7d. per car-mile; for the "Electrobus," 10·25d.; and for the trackless trolley car from 7d. to 9d. In the discussion very little attention was paid to these calculations, and no municipal tramway engineer or manager spoke. Mr. SHEARDOWN (Dublin United Tramways, Ltd.) suggested that the cost of the overhead line construction for tramways might conceivably be much reduced by using short brackets close to the poles and by developing the flexibility of the trolley arm. (Page 425.)

A PAPER by Messrs. J. BROWN and M. F. FITZGERALD described some experiments on rotating discs, to investigate whether certain approximate formulæ given in works on steam turbines were sufficiently accurate for practical purposes. The authors found that these formulæ cannot be trusted in every case for actual design. (Page 430.)

SIR JAMES DEWAR, F.R.S., has measured the amount of helium evolved from radium, and has obtained a figure agreeing very closely with Rutherford's theoretical value. Other Papers on electrical science and allied subjects read before the British Association were on the inductance of two parallel wires carrying alternating currents at high frequency, by Dr. J. W. NICHOLSON; on the measurement of large inductances containing iron, by Sir OLIVER LODGE and Mr. BENJAMIN DAVIES; "The Extension of Optical Ideas to General Electromagnetic Fields," by Dr. E. T. WHITTAKER, the Irish Astronomer Royal. A discussion on the inactive gases of the atmosphere was started by Sir WILLIAM RAMSAY, F.R.S. Mr. H. J. S. SAND described a process of rapid electro-analytical separation of metals. The much-debated subject of secondary radiation was further discussed. PROF. RUTHERFORD described determinations of the light on a scintillating zinc sulphide screen; suggestions were made as to the boiling point of radium emanation; measurements by Mr. H. H. POOLE of the rate of evolution of heat by pitchblende were recorded; and Mr. T. ROYDS described further experiments he had made on the constitution of the electric spark. Mr. L. C. BERNACCHI, who was with the *Discovery* Expedition, presented a report which contained his determination of the probable position of the South Pole. A report on the Falmouth Observatory readings was presented by the Committee. A Paper by Dr. GLAZEBROOK on the pentane photometric standard of the National Physical Laboratory entered into the question of the correction for the humidity of the air, and suggested that the standard humidity should be changed. Mr. COWPER-COLES contributed a Paper on the manufacture of metallic reflectors. (Pages 430–433.)

PARTICULARS are given of the recent strike upon the Sydney tramways, which was caused by the dismissal of a conductor. The strike, which only lasted three days, was brought to a close by the refusal of the railway employees to join the tramway men. A similar strike took place upon the Auckland (N.Z.) electric tramway system for a similar cause, but here the matter went to arbitration, which resulted in the reinstatement of the dismissed conductor. (Page 433.)

A PAPER dealing with the comparative value of electric and steam traction on main-line railways, was presented by M. PAVLITZKY to the Fourth Russian Electrotechnical Congress. The author considers that the ultimate limit to the economical capacity of a railway is prescribed by the power and other qualities of the locomotive, and that a general comparison between the peculiarities of steam and electric locomotives defines the character and extent of the improvements which are attainable by the substitution of electric for steam traction. The superiority of the electric locomotive over the steam locomotive as regards power and efficiency is dealt with at length in the Paper, and the conclusion is arrived at that a much smaller capital expenditure in locomotives is needed for a given traffic capacity on a new line when electric traction is adopted. The author finally points out that, where main lines are congested and worked beyond their economical capacity, electric traction promises improvement, financial as well as technical, sufficient to justify the capital expenditure. (Page 435.)

UNDER "Electrometallurgy and Electrochemistry" we give a brief report of the discussion upon the Ionic theory, opened by Prof. ARMSTRONG, and continued by Sir OLIVER LODGE and Sir WILLIAM RAMSAY, at the meeting of the British Association at Dublin. Two Papers were read at the same meeting on the rapid electro-deposition of metals for analytical purposes. An abstract of an article on the electro-deposition of nickel contains some valuable information with regard to the conditions necessary to obtain a reguline adherent and tough deposit of nickel. (Page 435.)

THE report of the Pacific Cable Board for the year to March 31st, 1908, shows a deficiency on the year's working of £77,544 18s., which has to be met by the several Governments associated in the enterprise. There has been a falling off in the gross traffic receipts of £2,852, whilst the expenditure has increased by £4,082. (Page 436.)

THE National Society of Telephone Employés has issued a statement to the effect that nearly a thousand of the National Telephone Co.'s employés have been dismissed during the past six months owing to a limitation in the new constructional work which the company has carried out, and that a discharge of from 5,000 to 6,000 men is anticipated between now and 1911. The Society has also stated that the company is refusing orders for telephones by the hundred, which, however, is contradicted by Mr. Franklin, the President of the National Telephone Co. We have endeavoured, without success, to ascertain from the National Society of Telephone Employés the number of men of each trade and from each district that have been discharged, but from information which we have received from them, it appears that a large proportion are occupied with overhead construction, for the Society is unable to suggest any other reason for the men not finding re-employment by the Post Office. The Post Office, however, assert that the number of dismissals is not more than usual at the end of construction work, the employment on which is always of an irregular nature, and that the Department is finding employment now for the temporary men who have been discharged. (Pages 437 and 446.)

AMONG the specifications published by the Patent Office on Thursday last is one by H. GROB for a train-lighting system, in which two storage batteries are employed; one of these is being charged while the other is assisting in exciting the dynamo and lighting the lamps. Different methods of obtaining the higher charging pressure are described. A specification by E. A. GIMINGHAM relates to the manufacture of quartz or glass tension springs for supporting metals filaments, and another by SIEMENS BROTHERS & Co. describes a

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new form of platinum contact, for which only a small amount of platinum is necessary. A method of sterilising water by ozone is the subject of a patent by A. DE BOUILLANNE, and C. J. O'KEENAN has one for a device whereby the perturbations due to brush-friction in motor-meters are said to be eliminated. THE GRÖNDAL KJELLIN CO., LTD., have applied for the amendment of a specification relating to electric furnaces. A patent granted to THE PHONOPHORE CO., LTD., and E. W. SMITH for telephone calling apparatus and a switch-hook in connection with it expires during the current week. (Page 439.)

A SCHEME of competitive street lighting is now being carried out between the Bradford Electricity and Gas Departments.—After meeting all liabilities and a contribution to the rates, there is a balance of £978 upon the Chesterfield tramways undertaking for the year to March 31st, 1908.—A resolution has been carried by the Dublin Corporation, requesting the accountant to inquire into and report upon the general financial position of the electrical undertaking, regard being had to Mr. Hammond's original estimates, and to the salaries of all the employees.—The compensation claims in connection with the Pye Nest tramway accident at Halifax amount to £11,000 towards which the insurance Company will contribute £1,000.—The Hythe Town Council has refused to allow the National Electric Construction Co. to change the system of traction upon the tramways between Folkestone, Sandgate, and Hythe to overhead instead of the surface contact.—Upon the Kirkcaldy electricity undertaking there was a profit of £137 last year, and a net balance of £123 upon the tramways undertaking.—The Sheffield Corporation has voted the sum of £10,000 from the tramway funds for various relief works.—The Midland Electric Corporation for Power Distribution has notified the Wednesbury Council that it will not supply electricity in the district any further. There was threatened competition by the Council, who are erecting a separate generating station. —A recommendation by Mr. G. Wilkinson, the Electrical Engineer to the Harrogate Council, that a charge of 2s. 9d. per quarter per 30-watt lamp be made in the case of tenements, has been passed by the Council, but the Town Clerk has declared the proposed system of changing to be illegal. (Page 441.)

TENDERS may be looked for shortly in connection with Mr. Merz's scheme of converting the steam railways of Victoria to electric traction.—Local Government Board inquiries have been held at Burslem (£12,000), Bury (£72,000), Darwen (£4,300), and Wimbledon in connection with electricity extensions. The Neath Town Council is applying for a loan of £18,000 for electrical purposes. (Page 443.)

THE accounts of the United Electric Car Co., for the year to June 30th, show a profit of £12,187, including £5,095 brought forward from last year. After paying the preference dividends a balance of £6,187 is carried forward.—There is a net profit of £36,198 shown by the accounts of the Direct West India Cable Co. for the year ended June 30th.—The directors of the Newcastle and District Electric Co. have decided not to pay an interim dividend for the half-year just ended. A dividend of 4 per cent. per annum is announced upon the ordinary shares of the Bromley (Kent) Electric Light and Power Co. (Page 445.)

SOME curious papers have been read before the British Association, but that emanating from Mr. F. DOUGLAS FOX on "General Urban and Inter-Urban Transportation and Railless Electric Traction," stands almost by itself in its combination of features. It is nothing new that a Paper may have something of an advertising character about it, but the feature of Mr. Fox's advertisement for the goods of his company is a general vagueness as to their detail, cost, and working results, which would be remarkable in a prospectus. Figures he gives, in great abundance, but they are figures from the statistics of tramways—figures selected and treated with the object of showing that, on the whole, British tramways are commercial failures or socialistic devices for carrying the working-man at the partial cost of the ratepayers. This "crabbing" of the electric tramway was entirely gratuitous and superfluous for the purpose of describing "Railless Electric Traction." We have nothing to say against the electric trolley omnibus, *per se*, it is an interesting cross between the tramway car and the motor 'bus which may have a certain field of usefulness, but the very slow progress made by the system—eleven lines in seven years, according to Mr. Fox—suggests that its field is a rather circumscribed one. The question at issue as between the electric tramway and the electric railless system is, at bottom, a very simple one, viz.:—under what conditions does it pay to provide the most perfect road surface attainable for the purpose of reducing the working expenses of public service vehicles? A tramway is nothing more than an improved road surface, about eight inches wide for each track. The answer is very well known, and has been known in substance ever since horsed tramways came into competition with horsed omnibuses. The saving in working expenses is mainly under two heads: power expenditure and maintenance of vehicles. Against these have to be put the maintenance and renewals of the rails. If the balance leaves a sum sufficient to pay the capital charges on the track construction, the tramway is justified. The determining factor is the service to be provided for, and given a correct set of figures for the costs of construction and working in any particular case, it is not difficult to show that, for some particular frequency of service, the tramway will be the more economical undertaking. But there is a further point which Mr. Fox ignores, though he remarks upon the figures which illustrate it as "an anomaly." A tramway has a greater earning power, upon a similar route, than an omnibus service. The greater seating capacity of the tramcar enables it to take the passengers offering in the "rush hours" which the omnibus must leave behind, or must run extra car miles to carry. Tramway men know, by experience, that in most districts a route earns more money at 9d. or 10d. per car mile than at 1s. per car mile. The same thing would be true with a 'bus service, no doubt, but as the working expenses are higher, the 'bus cannot give so frequent a service as the tramcar remuneratively.

We have not analysed Mr. Fox's voluminous array of figures in detail, but certain inaccuracies in them, where we happen to have the correct figures at hand, inspire no great confidence in the bulk. For example, he states that the London tramway accounts show a deficiency of £25,000. No year is mentioned, but Mr. Fox will find that no payments from the rates have ever been necessary to balance the London tramway accounts, and that the "deficiencies" which have been talked about in various quarters are purely "paper" deficiencies. Again, he states that the average fare per passenger in London is not published. The last report published gives this figure as 1·04d. on the horse, and 1·06d. on

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the electric lines. And the population of Maidstone is twice or thrice stated as 13,000, whereas it happens to be over 33,000. Another slight error that indicates that Mr. Fox's statistical conclusions may not be absolutely reliable is that he has included Belfast and Bexley in the sixteen Corporations having separate tramway stations for tramways and lighting, whereas both lines are supplied from combined stations. Passing on from inaccuracies of detail to broader questions, it is to be noted that Mr. Fox does not mention how he has treated the rates paid upon the tramway tracks. These are, in the ordinary course, reckoned as part of the working expenses, and we presume that Mr. Fox has included them, but they are, in effect, a special tax levied upon the tramway passengers, and upon no other users of the highway, so that, in discussing the finances of municipal tramways at least, credit must be given for these payments. Secondly, a large part of the expenditure on permanent way repairs is made in respect to the paving, which is not used or worn by the tramway traffic, and this is another contribution to the public funds from the tramway traffic, not levied upon other users of the highway, to be taken into account in any comprehensive analysis. Thus it is not true to say that the public travels partly at the expense of the ratepayer, but rather that the tramway passenger is specially taxed for the benefit of the ratepayer, and the benefit of other road-users. We are well aware that tramways, municipally and company owned, in this country are not so remunerative as they should be, considering the benefits they confer upon the public, but this is partly because the profits are misdirected, and not visible as such, although they exist. We shall welcome the electric trolley omnibus here, but we predict that its profitable field of action is through sparsely populated suburban and interurban districts, and that it will in many cases be only the pioneer of the electric tramway. We regret that its advocacy has been disfigured by Mr. Fox's very special pleading, which is likely to be utilised by the anti-tramway interests always with us.

MR. MERZ'S report to the Victorian Railway Commissioners on the electrification of the Melbourne suburban railways shows commendable confidence in the improved traffic results to be expected from the change. Mr. Merz's inside knowledge of the working of the electrified lines in the Newcastle district has, no doubt, assisted him in his forecast. The Melbourne lines are evidently working near the limits of their capacity with steam traction, and a large expenditure in new rolling stock, and doubtless in station and other accommodation, is immediately needed if steam is retained. In these circumstances it is not surprising that Mr. Merz recommends electrification. In the details of the scheme, so far as published, there is no great deviation from general "third rail" practice, excepting that the pressure of 800 volts is recommended, which is a considerable innovation in the direction advocated by Mr. HOBART and certain American engineers. The increase of pressure permits of material savings in the distribution system on the D. C. side, without going beyond reasonably safe stresses on the insulators and motor windings. The recommendations to generate all the power at a single station might have been anticipated from Mr. Merz, but the supply of 121 route miles from one station is a fairly bold proposal. Given this and third-rail distribution of direct current, sub-stations with rotary converters are necessarily part of the system. Mr. Merz no doubt considered the alternative of single-phase working with due care before deciding on the scheme recommended, and as his report appears to deal exclusively with the suburban lines, it may be supposed that the future possible electrification of the main lines, and the desirability of having a uniform system, has not been taken into account. Probably electrification of the main lines is a contingency too remote to justify any considerable sacrifice in the work which is immediately urgent. Details of the technical part of the report with maps of the lines would be very interesting, and we hope they will be made public in due course.

THE enthusiast who believes in the future of electric cooking will read with interest the short article which we publish this week on an application of it on an industrial scale in a London restaurant. It redounds to the credit of the Managing Director of Fleming's Restaurants and the Electrical Engineer to the Marylebone Borough Council that this experiment has been initiated, not merely as an advertisement, but as a true investigation as to the possible advantages and economies that may be arrived at with this means of cooking. So far, the results have been most encouraging, and further experience as to the durability of the apparatus, and the cost and the time lost in maintenance and repairs, will be awaited with interest. Hitherto, the most serious defect in the greater part of electric cooking apparatus, after its high first cost, has been the difficulty of executing what should be small repairs and renewals, and we trust that this matter is being given due attention by the manufacturers. It will be seen that one of the innovations described effectively removes the slur cast on electricity—and still applicable to gas cooking—that it was extremely difficult to grill a chop or steak perfectly by this means, and that the so-called toast would be more correctly described as roasted or stewed bread. The new grills for this purpose actually grill without burning, and they toast by heat which is radiated from a red surface, instead of being imparted by conduction from a dull one. The thoroughly practical nature of the experiment is indicated by the figures of energy consumption obtained from separate meters connected to the various appliances.

The New Garage of the Electric Landaulet Co.—A new garage for electric automobiles has been opened recently by the Electric Landaulet Co., Ltd., to supplement their large garage at Chelsea. There is accommodation in the new garage for about 25 electric cars, and a special shed is reserved for petrol cars. It is very conveniently situated in Salisbury Mews, opposite the Great Central Hotel, Marylebone. Power is taken from the mains of the Marylebone Borough Council, and as the supply is continuous current, the cells are charged direct without the intervention of any converting plant. The difficulty of the high voltage is surmounted as follows:—The three-core concentric service cable, with 480 volts across the outers, is brought in to the main board, and the supply is there divided into two 240-volt circuits. Each of these circuits consists of five pairs of panels, each pair consisting of two 120-volt panels connected in series. There is a meter, a demand indicator, a double-pole fuse, and a double-pole switch for each of these 240-volt circuits. Each panel contains an ammeter, fuse, and series resistance. As there are twenty panels altogether, 20 cars can be charged simultaneously, but as it is often necessary to charge one only, a few spare batteries are always connected up, and one of these can be charged with the single car. If a car is needed in a hurry, one of these spare batteries is substituted for the spent battery, and a hand-trolley is provided for this purpose.

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ELECTRIC LIGHT AND POWER AT THE PREMISES OF MESSRS. W. H. SMITH & SONS

THE London premises of Messrs. W. H. Smith & Sons, the large stationers and booksellers, comprise no less than five large buildings and many small branch shops, and there is, besides, the binding-works at Letchworth. In the present article we intend to describe the lighting and power arrangements at the four London buildings, in particular at the new building at Kingsway, which is devoted to the stationery and advertising departments, and at the printing works in Fetter Lane. In order to avoid confusion, it will be best to deal with each building separately.

Kingsway Building.

Lighting Arrangements.—The Kingsway building is quite new, and is devoted to the stationery and advertising departments. Current is obtained from the service mains at a pressure of 2 × 100 volts three wire and the lighting is carried out almost entirely with tantalum lamps, of which there are about 500, some 100-volt and some 50-volt lamps. The wiring is done in wood casing in the ground and upper floors; particular care has been taken to harmonise this casing with the general decoration of the rooms in the case of the ground floor, which is used as a shop. In the basement the wiring is in exposed iron conduit. The service cables are brought in to a switchboard with separate lighting and power panels, and the cables from this board to the distributing boards, lift, and other motors, &c., are carried in iron troughing suspended by iron brackets from the ceiling. This troughing, which is self-fastening, was supplied by Messrs. Gibbons Bros., Ltd., of Dudley. The method by which the sections of troughing are joined together can be seen from Fig. 1. The distributing boards on the various floors are worthy of notice. These have the usual hinged glass fronts, but the box itself is also hinged to the supporting board on the wall. This renders the back connections easily accessible, as there is a space between the box and the board for the coiled-up ends of the cables. Besides the fuses there is a switch on each pole of each circuit; the whole set of switches in the box are mechanically connected, and are operated by a handle outside the box. These boxes were supplied by the Edison & Swan United Electric Light Co., Ltd. There is an "intercommunication" telephone system with 25 stations. This latter and also the whole of the lighting work was installed by Messrs. Tyler & Freeman.

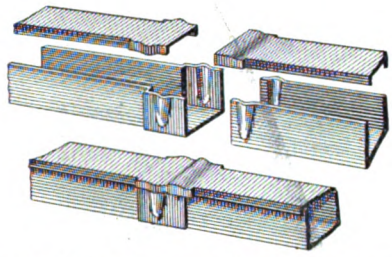

Fig. 1.—Self-Fastening Cable Trouching.

Power.—The application of electric power is represented by two lifts, one passenger and one goods lift, an electric winch for hoisting fodder to the upper floors and the three-floor stables adjacent to the Kingsway building, and the pumping plant which is described in a separate section below. Both the lifts are Pen-

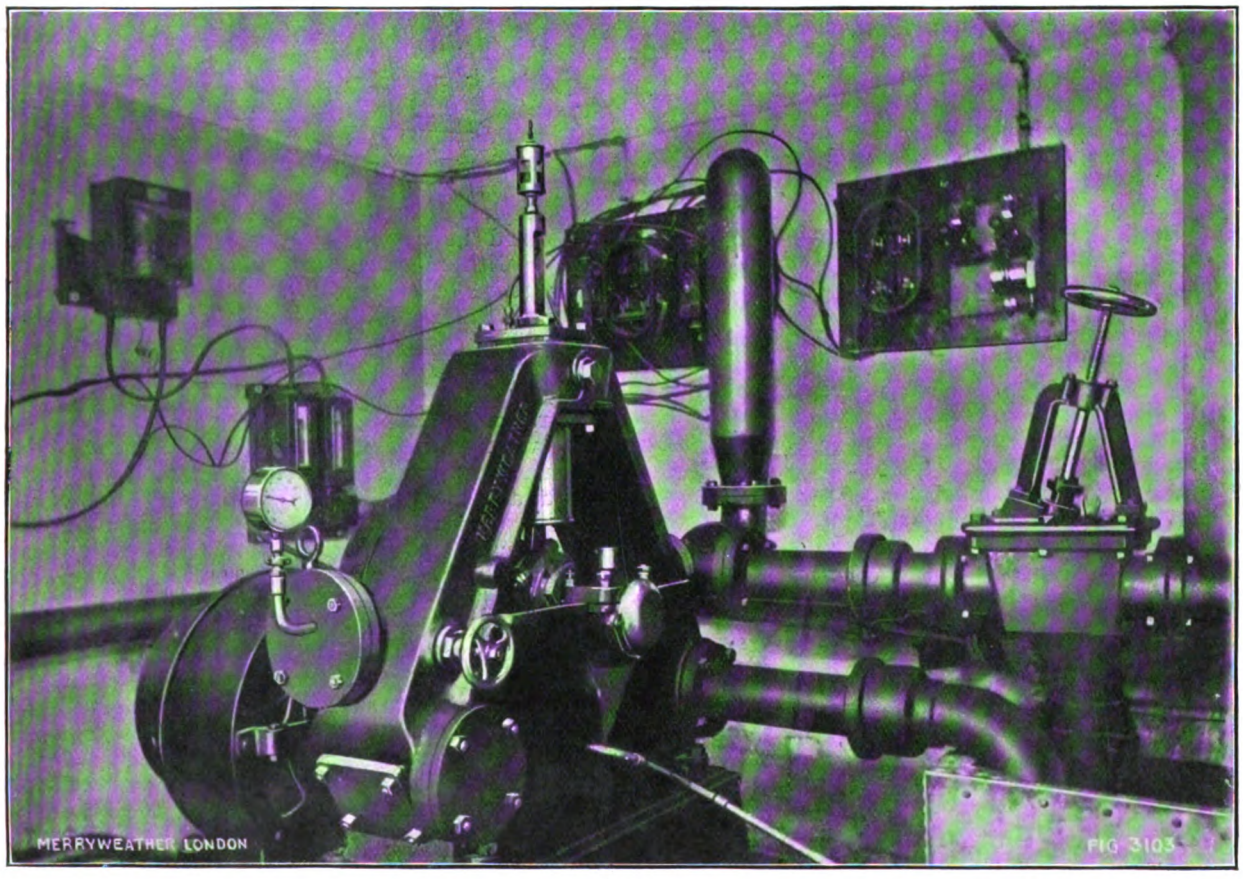

Fig. 2.—Merryweather Pump, Motor, Automatic Switchgear, Supply Tank, and Fire Main.

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rose lifts, the goods lift being provided with switch-button control. The winch is driven by a Rhodes motor.

Water Supply.—The building is nine floors high, and the tanks for the general water supply are situated in special rooms on the roof about 110 ft. from the ground. As the street pressure would only suffice to give a supply to the fifth floor, a system of automatic pumping has been installed by Messrs. Merryweather & Sons for the water service to the floors above and for the fire service. It was required that the apparatus should ensure a constant supply of water for domestic purposes and for the heating apparatus without the use of steam or other machinery requiring labour for its working and control, and it was also necessary that powerful jets for fire extinction should be available on every floor and on the roof. The system includes a powerful "Hatfield" pump driven by an electric motor, arranged to draw water from a tank in the basement supplied through an equilibrium valve, and delivering into a fire main carried to a 500-gallon tank in the roof. A branch is also fitted to supply another tank of the same capacity for domestic services and the hot water system for heating the building. Hydrants, hose, &c., are placed on each floor, and, in the event of a fire, any hydrant opened would be first supplied from the roof tank. Over this tank is a smaller tank containing a float connected to a switch, and as soon as the water level falls in this smaller tank the main current is switched on automatically, and the pump starts running to maintain the supply. The pump cannot supply the tank except through a relief valve set to open under a pressure more than sufficient to throw a jet over the roof, water from the fire main being prevented from entering the bottom of the tank by a reflux valve. While any hydrant is in use the pump continues working, and as soon as all hydrants are shut off, the pressure in the main continues to rise until the top relief valve opens, fills up the tanks, and the current is switched off by the action of the float before referred to. The supply to the domestic tank is controlled automatically in the same manner, with the exception that the switch does not come into action until the water level has fallen to within 12 in. of the bottom. Then the pump starts and runs until the tank is filled up again. This arrangement prevents the continual stopping and starting of the pump which would otherwise occur all day long.

A general view of this pumping installation is given in Fig. 2. The motor, which drives the pump through reduction gearing, can be seen on the left of the photograph. The meters are also on the left, and the two relay switches for the fire and domestic service tanks respectively are visible at the back. It will be noticed that the photograph was taken before the wiring was permanently fixed. This plant has been examined and approved of by fire and other authorities, and illustrates a way in which the high buildings which are springing up in all our large cities may be protected from fire without calling for expensive alterations in the water supply arrangements.

Printing Works: Fetter Lane.

Lighting Arrangements.—Current for lighting and power is obtained from the mains of the Charing Cross, West End & City Electric Supply Co., at 2 × 200 volts, three wire. There are two service cables from different sections of the distributing network, and a change-over switch is on the main switchboard. The board is divided up into power and lighting panels, and the back of the board is easily accessible. The cables to both power and lighting circuits are in iron tubing. There are in all about 500 lamps, most of which are carbon filament. Mann, Egerton & Co., Ltd., of Norwich, were the contractors for this installation, and also for the power installations described below.

Power.—All motors, with the exception of those below 3 h.p., are connected across the outers of the 400-volt supply system. Some two or three years ago all the machines in these works were driven from shafting by gas-engines, but now all are driven electrically, and, with a few exceptions, the shafting has been removed. There are about sixty motors in all; these range from 7 to 1 h.p. in capacity. Most of these drive printing machines, but there are a large number of cutting, folding, and stitching machines. Many of the machines are driven from shafting suspended from the ceiling or run along the floor under platforms; for instance, three cutting machines are driven by a single 5 h.p. motor. All these machines are provided with heavy flywheels. The large lithographic printing machines are belt-driven by separate motors; the motors in some cases are suspended from the ceiling of the floor below, the belting being carried through the floor. In the setting room there are six linotype machines in two groups of three; each group is driven by a single 1-h.p. motor. Various methods of starting and controlling the motors are in use.

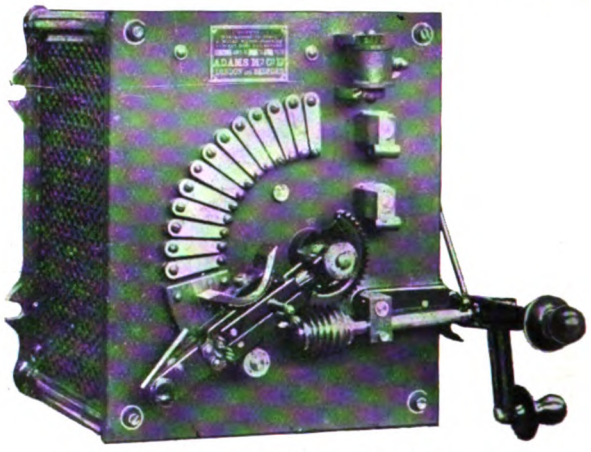

FIG. 3.—STARTER WITH WORM AND WHEEL GEAR.

The simplest of these is that in which a hand starter, as illustrated in Fig. 3, is used. This is an ordinary starter with no means for regulating the speed, but the method of preventing an operator from switching over too quickly is interesting. A handle (which is outside the cover) operates the worm and wheel gear; the worm does not normally engage the wheel, but is made to do so by depressing the lever shown in the illustration. This leaves the switch-arm free to fly back when the no-voltage release operates. Some of the machines require a certain amount of speed regulation, and these are fitted with special compound controllers. These control the speed between normal speed and 50 per cent. of normal speed by inserting resistance in the armature circuit, and between normal speed and 25 per cent. above normal by inserting resistance in the shunt field circuit. To enable the switch-arm to be left in any position, and at the same time to fly back to the off-position on the operation of the no-voltage release, the following device is fitted:—The armature of the no-voltage release holds a pin up into a notch at the base of the switch-arm; for every position of the arm there is a notch, and so long as the armature is held down, the arm is fixed. Should the armature be released, however, the pin leaves the notch, and the arm flies back. The field resistance contacts are reached by the switch-arm only after all the series resistance is cut out, and it is impossible to start the motor with a weak field as when a separate field regulator is used.

A large number of the printing machines are provided with automatic control apparatus. This con-

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sists of an automatic self-starter, a solenoid main switch, and a tumbler switch on the machine itself. For motors of less than 3 h.p. the solenoid main switch is not required, however. The working of this automatic control is as follows:—The tumbler switch on

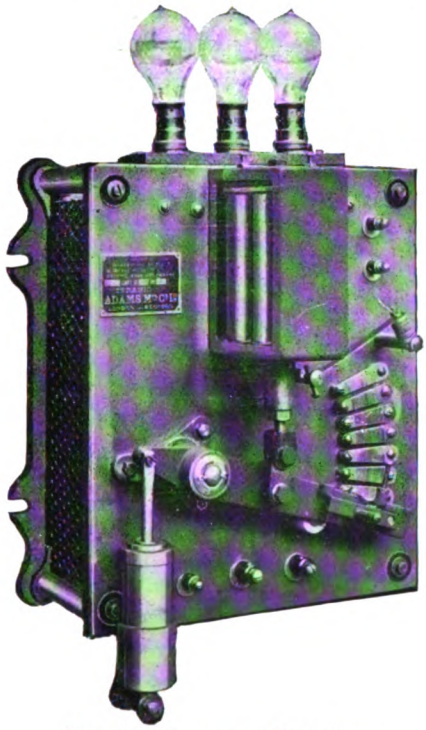

Fig. 4.—Automatic Starter.

the machine is turned on; this closes the circuit through the solenoids of the main switch and the starter. For damping the movement of the starter arm, as can be seen from Fig. 4, an oil dash-pot is provided. When the arm has risen so far that all the resistance is cut out, one of the lamps shown in Fig. 4 is automatically inserted in series with the solenoid, so as to cut down the current to the value necessary to hold up the plunger, and thus prevent undue heating of the solenoid. On turning off the tumbler switch to stop the machine, the main solenoid switch, which is illus-

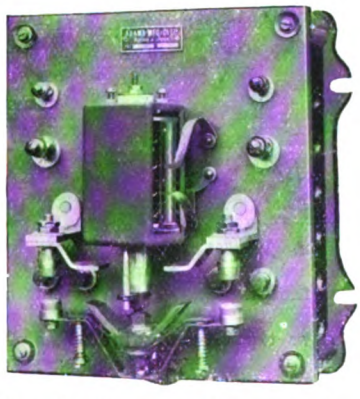

Fig. 5.—Solenoid Main Switch.

trated in Fig. 5, is released. This, as can be seen, is provided with a carbon break and magnetic blow-out. When first starting the machines, and while "inching," the main circuit must of necessity be made and broken several times in succession. A modification of this system of control has been fitted to one of the machines, and has proved so successful that the other machines will soon also be fitted. As the starting and stopping is effected by means of an ordinary tumbler switch on the machine, if the main fuse blows, or for any reason the main switch is opened, the machine stops, but would start again on closing the main circuit, as the operator would probably forget to throw over the tumbler switch, and thus break the control circuit. Mr. Oliver Holt, the electrical engineer in charge at these works, remedied this, however, by substituting for the tumbler switch a small switch with a no-voltage release, the coil of which is in series with the motor shunt field circuit as usual. A small button at the side of the switch-box permits of this coil being short-circuited, which allows the switch to open and break the control circuit, thus stopping the machine. This modified control switch has been in operation for more than a year, and has given every satisfaction.

Besides the above-mentioned printing and other machines there are two lifts worked by a single 5-h.p. motor. As these lifts were originally driven by a fast and loose pulley arrangement from the power shafting, it was found most convenient to retain the former arrangement and run the shafting for the two lifts with a single motor. This motor is provided with an automatic control system similar to that in use for the printing machines. In order that the lift man may know that the motor is up to speed before he starts the lift by shifting the belts, two lamps are put on every floor. One of these lamps is in series with the solenoid of the main switch, and the other is in series with the starter solenoid, but is put in circuit only when the starter arm is on the full voltage position as explained above. All the starters and regulators which have been mentioned are of the Adams Manufacturing Co.'s make.

Goldsmith Street Building.

This building is the home of what is known as the Requisite Department, and contains 23 motors with an aggregate power of somewhat over 90 h.p. These motors drive folding, cutting, and small printing machines, all of which were formerly driven by one gas-engine. The lighting arrangements of this building were carried out by Messrs. Tyler & Freeman, and include an installation of about two hundred 200-volt carbon-filament lamps. A Smith & Stevens 12-h.p. goods lift is installed here.

Works Department.

The Works Department is situated in a large building in Water Lane, Strand. In the carpenter's shop here there are various tools, belt-driven from separate motors. A variable-speed circular saw is driven by a 7-h.p. motor with shunt field regulator. Most of the machines have "Brookhirst" starters with a worm and wheel gear resembling that of the Adams Manufacturing Co. described in a previous section. These starters are provided with emergency stops, by pressing which the no-voltage release coil is shorted and the machine stopped. All are totally enclosed in iron cases with glass fronts, the handle and emergency stop only being accessible. There is nothing remarkable about the lighting arrangements in this building. About 200 lamps are installed, mostly carbon filament. In this department there is a Smith & Stevens slow-speed goods lift worked by a 2-h.p. motor. A chaff-cutter in the stables is also electrically driven, a totally enclosed 6-h.p. motor being employed for this purpose.

Library Department.

The building in which the library books are stored, and which is adjacent to the Water Lane building, has been recently re-wired, and about 280 tantalum lamps are used here. The lighting of the passages between the bookshelves is carried out with pendant lamps and cord operated trigger switches adjacent to the ceiling roses. On each floor is a master switch. For raising the books to the upper floors a Waygood lift is pro-

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vided. On the top floor is a 3-h.p. electric winch for loading and unloading goods.

News Department.

The News Department is situated in the original building in the Strand. The lighting of the ground floor is by nine small enclosed arc lamps supplied by the Westminster Engineering Co. The upper floors are illuminated with tantalum lamps, of which about 350 are employed. To bring up the parcels from the basement to the ground floor there is a 3-h.p. elevator, constructed in the form of an endless canvas belt with cross-battens of wood. There is also a Waygood push-button lift for books, and a large Fryer goods lift.

In the preparation of this article we have to acknowledge the courtesy and assistance of Messrs. W. H. Smith & Sons and their staff, and also of Messrs. O'Gorman and Cozens Hardy, the consulting electrical engineers.

NEW APPARATUS FOR THE MAGNETIC TESTING OF IRON

A NEW form of apparatus for obtaining the magnetisation curves and the magnetic constants of samples of iron and steel is described by Prof. Gisbert Kapp, in a recent issue of the *Elektrotechnische Zeitschrift*.

All those types of magnetic testing apparatus in which the sample of iron is introduced in the form of a rod or bar, suffer

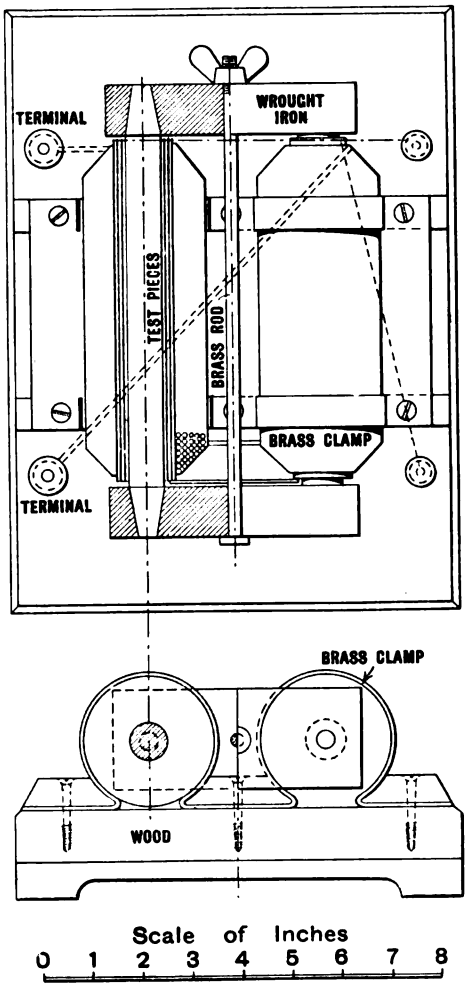

FIG. 1.—APPARATUS DESIGNED BY PROF. KAPP FOR THE MAGNETIC TESTING OF SAMPLES OF IRON.

from two important sources of error: the first lies in the fact that there is generally a bad magnetic joint between the rod and the yoke, and the second in the fact that the ampere turns necessary for the yoke cannot be allowed for exactly. With the classical apparatus of Dr. Hopkinson, these errors may be considerable. In that pattern, two rods are arranged axially, and butt together in the middle; the magnetic resistance of this joint, as also of that at the openings in the yoke through which the rods are introduced, is very uncertain in value, and not always so small as to be negligible. The yoke itself also is long, and a certain number of ampere-turns are required to force the flux through it. In order to reduce the importance of these errors, some workers in this field have constructed apparatus in which the two rods of iron to be tested are arranged side by side, and connected by short yokes of comparatively large section at both extremities. The apparatus, designed by Prof. Kapp, and illustrated in Fig. 1, is of this pattern.

The two yoke pieces are separate, and are provided with conical holes to take the ends of the test pieces. In order to get good magnetic joints between the yokes and the rods, the two yokes are drawn together by means of the central screw, as shown in the drawing. It has been found quite unnecessary to tighten the screw, however. On each rod is a wound bobbin consisting of two coils: an exciting coil of thick wire, and a testing coil of fine wire. The testing is carried out in the usual way, with the aid of a ballistic galvanometer or a Grassot's fluxometer. A small correction is necessary on account of the air-space between

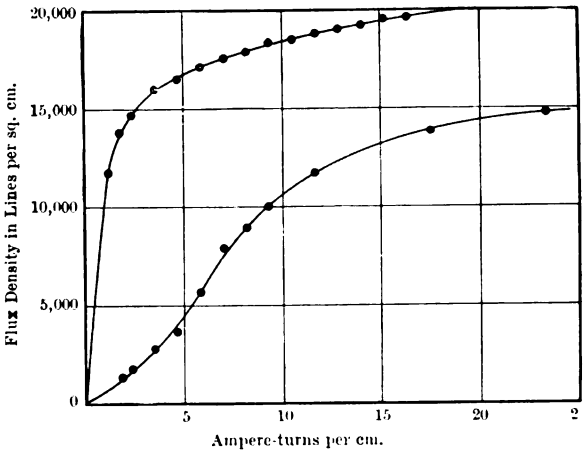

FIG. 2.—MAGNETISATION CURVES TAKEN WITH PROF. KAPP'S APPARATUS.

the rod and the testing coil. In the apparatus described, the flux in this ring space amounts to $45 \times C$, where C represents the exciting current. The number of ampere-turns required for the yoke pieces works out at 1/3000 of the value of the total flux, as shown by the galvanometer. If this latter is represented by Φ_1 and the actual flux in the rod by Φ; then:—

$$\Phi = \Phi_1 - 45\ C,$$

and the flux-density in the sample will be:—

$$B = \frac{\Phi}{\text{section of rod}}$$

The ampere-turns acting, as the total number of turns is 840, will be equal to—

$$(840 \times C) - \frac{\Phi_1}{3{,}000}$$

and the ampere-turns per centimetre or per inch can then be obtained by dividing by the total length of the rods. In Fig. 2 are given two magnetisation curves taken by means of this apparatus on two samples of wrought iron.

As can be seen, the points lie well on the curves. Slight variations are to be expected when the flux-density is below 5,000 lines per sq. cm., as the influence of previous magnetisations on the yoke is then felt. However, the most important part of the curve is that corresponding to densities over 10,000 lines per sq. cm.

New Danish Duties on Electrical Goods.—The new Danish Tariff Law, which is to come into operation on January 1st next, has been translated by order of the British Parliament. The following table shows the duties on electrical goods under the existing tariff and the new tariff:—Electric machines and parts (dynamos and electromotors): Existing tariff, 10 per cent. ad valorem; new tariff, 7½ per cent. ad valorem. Engine packing and insulating materials: Existing tariff, 10 per cent. ad valorem; new tariff, 5s 7½d. per cwt. Wire for electrical purposes and cables, and all kinds of wire having paper, textile, or other material spun round, woven in, or twisted round it: Existing tariff, 2s. 4½d. per cwt.; new tariff, 7½ per cent. ad valorem.

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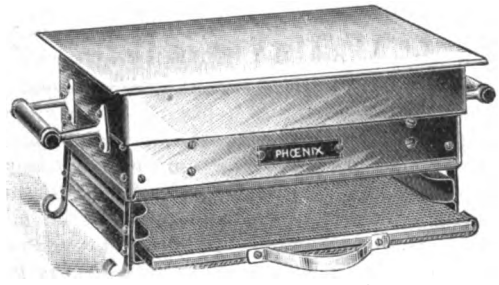
ELECTRIC COOKING AT A LONDON RESTAURANT

AN experiment of some considerable interest to electrical engineers is now being carried on at one of the Oxford Street branches of James Fleming's Restaurants, Ltd. In one window of the premises at 68 Oxford Street there is a display of electric cooking, and all the chops, steaks, poached eggs, &c., for this restaurant are cooked by electricity. As Mr. Fleming, the managing director, has informed us, this experiment is being made, in the first place, to determine the practicability of electric cooking on a large scale as regards convenience, economy, cleanliness, and success from the epicurean's point of view: the display is quite a secondary matter.

Power is taken from the mains of the Marylebone Borough Council, the electricity department of which has not only done the necessary wiring free of charge, but has lent meters for registering separately the consumption of each piece of apparatus.

The apparatus at present in use consists of an oven, a large grill measuring 15 in. by 10 in., and consuming 1,800 watts when hot, an egg-poacher, 6¼ in. diam., consuming 600 watts when hot, a toaster, and a 6¼ in. hot-plate. All these were supplied by the Phœnix Electric Heating Co., Ltd. The most interesting piece of apparatus is the large grill, which is illustrated below, and is constructed as follows:—Under the nickel-plated cover is a pad of asbestos wool some two inches thick, beneath which is a metal reflector. A grid of spirally-wound resistance-wire is supported from



NEW PATTERN OF ELECTRIC GRILL.

the latter on small porcelain buttons, and the heat is reflected down on to the chop or steak placed on a grid below. The wire is red-hot under normal conditions, and keeps remarkably clean in use, as, contrary to the usual grill-room grill, the heat is directed on the meat from above, and the fat drips downwards, and not on to the fire or its equivalent. In order to economise at "light loads," the resistance wire is divided into two sections, either or both of which can be switched on. The grid for carrying the chops or steaks, as can be seen from the illustration, can be put in at various levels. The whole stands in a tray for catching the surplus fat. The first form of grill used was that in which the chop was laid on a heated corrugated iron grid, but this type had several disadvantages, the most important of which was that a film of fat remained on the grill, and continued to burn during the operation of cooking. In the new pattern, with the heating grid above the chop, this trouble is eliminated, and the food is well and cleanly cooked. The toaster resembles the grill in general design. The bread is thus not in contact with the heating element as is the case with gas-heated toasters and some electric ones, and another important point is that the toaster is open all round, which, although allowing heat to escape, and, therefore, to the prejudice of efficiency, prevents the bread from being "stewed," and the toast is real toast.

A five-gallon copper boiler will also be used for keeping water at the boiling point. This consumes 1,000 watts, and will only be employed for keeping the water at its boiling temperature, and not actually for boiling it. Mr. Fleming has sent us the following report on the results for the eight days commencing Wednesday, September 2nd, and ending Thursday, 10th, inclusive, with the exception of Sunday, September 6th. During that time the plant was in use almost continuously from 12 noon till 9 p.m. daily. The average daily consumption of the oven which has been in use only for keeping the plates hot, was 8¾ units, of the egg-poacher 5⅛ units, of the grill for chops and steaks 13½ units, and of the small grill for toasting bread and the boiling plate use for poaching eggs, &c. (which are both connected to the one meter), 11¾ units. The total consumption was 313 units, making an average daily consumption of 39⅛ units, which, at 1⅛ pence per unit, makes a daily cost of 3s. 8d. for current, or about 9d. per day, or 1d. per hour for each grill, boiling plate, and oven in use. For the egg-poacher, small grill, or boiling plate, the cost, however, is only about ¾d. per hour. For the large grill, which is capable of cooking twelve chops or steaks at one time, the cost per hour is slightly over 1½d. This grill in the eight days referred to was made to cook 678 chops and steaks at a cost for current of 3/16 of 1d. per chop or steak.

The average cost of 1⅛d. per unit is derived as follows:—The Marylebone power rates are 2d. per unit for the first 125 hours per quarter of the maximum demand, and 1d. for the remaining units, and under the conditions of the present case this works out at about 1⅛d. per unit. It must be remembered that in the case under consideration one of the chief advantages of electric cooking—namely, that cooking can be done at a moment's notice, without the necessity of maintaining a fire—does not come into the question, as cooking is being done nearly continuously from noon to 9 p.m.

As is well known, grilling on a gas stove is nearly always unsatisfactory, owing to the inevitable taint from the gas. On the other hand, Mr. Fleming informs us that electrically cooked chops and steaks have been pronounced by some epicures to be even better than those cooked on a coal or coke fire. No trouble has been experienced with the apparatus, and it is worthy of notice that, in spite of the fact that no ventilating hoods have been provided, there is no unduly strong odour of cooking.

The Marylebone Electricity Department has also installed a small equipment at the "Green Man," Euston Road, some apparatus will be shortly put on trial at one of Slater's branches, and negotiations with several other dining rooms are in progress.

Electrification of the Baden Railways.—In last week's issue we inserted a note to the effect that the Baden State Railway authorities had decided to introduce electric traction on the main line sections, Basle-Schopfheim-Zell and Schopfheim-Säckingen. We have obtained the following further particulars from the *Elektrotechnischer Anzeiger*. A water-power station is to be erected at Augst-Wyhlen, on the Rhein, and from there the power will be transmitted in the form of three-phase alternating current to Basle. At Basle transformation to single-phase at 10,000 volts, 15 cycles will take place. The Siemens-Schuckert Werke have obtained the contract for the sub-station, the feeder system and the overhead equipment of the section Basle-Schopfheim, and ten 1,000-h.p. locomotives. The overhead equipment of the section Schopfheim-Säckingen will be supplied by the Allgemeine Elektricitäts Ges. Brown, Boveri & Co. will supply two further locomotives, and the transmission line from the power station to Basle will be erected by the Felten-Guilleaume-Lahmeyerwerke.

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THE ELECTRIFICATION OF THE VICTORIAN RAILWAYS

IN our issue of August 27th last we gave some particulars of the proposed electrification of the suburban railways of Melbourne, and mentioned that the report of the consulting electrical engineer, Mr. Merz, to the Victorian Railway Commissioners would soon be ready. An official summary of this report has now been issued, and was published in the last issue of the *Railway Gazette*.

The report deals with two main questions: First, is electrification financially justifiable? and secondly, which is the most suitable system in the case under consideration?

After referring to the exceptional importance of the suburban business in the case of Melbourne as compared with other great cities, the principal features of electric working generally, and the advantages which it offers both to the travelling public and to the management, are dealt with at length. It is shown that electrification allows for a more frequent service throughout the day, and the running of trains at regular intervals, as well as greater punctuality and safety in working. Fires from locomotive sparks, and smoke, steam, and dust, would be practically abolished, while the lighting and heating of the carriages would be much improved. In addition to this, journeys would be shortened by 15 to 30 per cent. Following on this are elaborate technical investigations and calculations both as to the first cost and the working cost of the Melbourne system with electric traction as compared with steam, and a list is then given of the improvements in the time-table which can be brought about. As showing the improved services which electric traction offers, the journey from Flinders Street to Sandringham takes 38½ minutes with steam, and would take 31 with electric traction; to Williamstown, 37 minutes with steam, 31 with electric; to Camberwell, 21 minutes with steam, 17 with electric; and other journeys in proportion. Instead of 70 trains a day to Essendon, there would be 88 with electric; instead of 40 to Williamstown, there would be 75 with electric; instead of 28 to Sandringham, there would be 73 with electric; and other routes with corresponding improvements.

The main conclusion is that on account of the great advantages to the public, and the improvement in financial results to be expected from electrification, the installation of electric traction on the suburban railways is desirable on grounds of finance and of public convenience, and it should be carried out in the following stages:

I. The Port Melbourne, St. Kilda, Sandringham, and Broad Meadows branches. Route length, 29 miles.

II. Stage I., and, in addition, the Camberwell and Williamstown branches. Route length, 65 miles.

III. The complete scheme including, in addition to Stage II., the Sunshine, Coburg, Preston, Heidelberg, Dandenong, and Mordialloc branches. Route length, 124 miles.

Mr. Merz considers it would not be convenient to try and convert more than the lines in Stage I. at first, nor financially advisable to convert less than the lines in Stage I.

The following is the summary of conclusions appended to the report:—

CAPITAL OUTLAY.

(1) The total capital outlay for the conversion of the whole suburban system will be £2.227,050. It is recommended that a portion only of the system be converted at present.

(2) In considering these figures, the expenditure necessary if steam traction be retained must also be taken into account. This expenditure, on rolling stock only, amounts to £408,358.

COST OF ELECTRIC WORKING.

(3) The expenses per train-mile with electric traction would be 11·0d., as against 18·9d. with steam. With the former, however, there would be a greater train-mileage.

(4) The total operating expenses with electric traction for the whole suburban service would be £27,267 per annum less than with steam.

FINANCIAL RESULT.

(5) The total annual expenditure for the whole service, including 4 per cent. on the new capital outlay, would be £44,791 more than with steam; against this must be put the additional revenue due to the improved service.

(6) The surplus, after paying interest on new capital for the complete scheme, would, with electric traction, be £40,251 greater than was obtained in 1906 with steam.

IMPROVED SERVICE.

(7) If electric traction be adopted, an improved schedule speed and frequency of service becomes possible with the existing tracks and termini.

(8) An increase of 20 per cent. over the present schedule speed and an increase of 71 per cent. in the train-mileage, are financially justifiable, and are covered by the expenses referred to above.

ROLLING STOCK.

(9) The adoption, instead of locomotives, of the "multiple-unit" system of train operation is recommended, giving this increase of 71 per cent. in the train-mileage, with an increase of only 23 per cent. in the ton-mileage.

(10) Cross-compartment coaches should be adopted, and the existing bogie stock be altered and used for the electric service.

(11) The total stock required would be 496 coaches with electric working, as compared with 546 coaches and 110 locomotives with steam, the reduction in the number of coaches being due to the higher schedule speed.

ELECTRICAL SYSTEM.

(12) A direct current 800 volt system would be the cheapest and best system for this particular case.

(13) The direct current should be distributed to the trains from sub-stations by means of a protected conductor rail.

(14) The sub-stations should be supplied with three-phase high-tension current from the power station by means of underground cables in the central areas, and by overhead lines in the less populous districts.

POWER STATION.

(15) The energy required should be generated in a central power station situated at Yarraville, designed to handle the load of 35,000 electrical horse-power.

(16) This power station should be designed to burn either black or brown coal, and the power plant consist of water tube boilers and steam turbines.

(17) The Spencer Street and Elsternwick Stations should be shut down, and the St. Kilda tramway and the existing lighting system be supplied in bulk from Yarraville.

(18) The Yarraville Power Station should be also used for the lighting of the railway stations and the driving of the Newport and North Melbourne workshops.

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Initial Scheme.

(19) If electric traction be decided on, the scheme proceeded with in the first instance should consist of the Port Melbourne and St. Kilda and the Brighton and Essendon branches, involving, with power plant, an initial expenditure of £801,880.

(20) After paying interest on this sum, the surplus from these lines would, with electric traction, be £21,358 greater than was obtained in 1906 with steam traction.

(21) If steam be retained on these lines, £141,019 will have to be spent on rolling stock for them alone.

(22) The conversion of these lines should be so arranged that the electric zone might be extended to the other suburban lines at a future date, with a minimum of alteration and expense.

Other Operating Changes.

(23) Such questions as systems of train despatching, automatic signalling, new block sections, special provisions for race traffic, &c., would be best deferred until part, at least, of the system is being worked electrically.

PROSPECTIVE ELECTRIC POWER DEVELOPMENT IN NEW ZEALAND

(From a Correspondent)

WE have been accustomed in the past to underestimate the importance of New Zealand. It has had, it is true, the struggles of a young colony, but of late years its progress has been by leaps and bounds. Wealth and population have alike increased, and the total value of exports and imports last year attained a value of about £32,000,000. Moreover, this prosperity is based on a comparatively small area of development. The interior of the land has never been thoroughly prospected for mineral wealth, and there are vast tracts of land that have not yet been explored by the white man. As a matter of fact, we have before us at the present day a dominion in the making, and in practically the same position as was Canada before its wonderful grain-raising resources were opened up.

One very important feature which affects the development of New Zealand is the fact that it is a most Socialistic State. All royalties in the working of coal, gold, flax, and other natural products of the north and south islands are vested in the Government, and particular attention should be directed to the fact that the water supplies of the dominion have hitherto been conserved as a national asset. This is a factor which deserves very careful attention, and the main object of this article is to show that the water power of the colony, of which, on an estimate of experts, there is no less than four million horse-power available, constitutes the key to the future.

It should first of all be pointed out that there is a very strong pro-British feeling in the colony. This is shown in the general tenour of political speeches and newspaper articles of every shade of legislative opinion, and is carried out in a very practical manner in the business relations existing between us and our colony. This is indicated by the almost complete monopoly which we possess of the imports into the dominion, six-sevenths of the whole import trade being in the hands of England and her colonies, notwithstanding the fact that foreign countries have direct representation in the country by means of Consuls who are largely trade representatives, whereas England still conducts its official representation on the obsolete lines which have so often been protested against. This preference for the Old Country is very fortunate for us, inasmuch as foreign countries have already realised that in the water power of New Zealand lies one of the greatest opportunities of the twentieth century. The dominion Government has already been approached by an Italian syndicate on the question, while American experts have presented reports on the water facilities of New Zealand to their associations. Where Italy and America are alive it is only to be expected that the pushful German is also on the move to obtain possession. The only question seems to be whether England will stand aside until the best of the prizes have gone.

The position, briefly stated, is this. The new colonies of New Zealand have not at present reached sufficient strength and maturity to develop their own resources successfully unless assisted by outside capital. To "harness" the waterfalls of the country, and to provide suitable industrial outlets for the electrical energy so produced, would require an estimated amount of £10,000,000 sterling, and the obtaining of a loan for this sum is far too heavy a burden to be borne by the Government. The other alternative is to lease the water powers of the country to private capitalists, but at present the legislation of the colony is not able to permit this. Lately, however, a great move forward has taken place. At the opening of the New Zealand Parliament on June 29th of the present year the Premier's speech referred, almost in its opening phrases, to the rich national endowment of water power, and stated:—

"The expediency has been impressed on my advisers of permitting portions of the water power to be employed for private enterprise under strict and proper safeguards in the public interest. Proposals to this end will be shortly laid before you in the form of enabling legislation."

It is extremely probable that some measure to this effect will shortly be passed, inasmuch as support is being given to the proposal by newspapers of every shade of political opinion. The way in which the wisdom of discussion is endorsed by the Press may be shown by the following sentences from a leader in the New Zealand *Daily Telegraph*:—

It has been announced in Parliament by a responsible Minister, speaking from figures and under instruction provided by Government experts, that utilisation of our water power for one purpose alone, that of the manufacture of nitrates from the atmosphere, would enable the Dominion to do an annual trade exceeding in value the whole of our wool output. It is hardly necessary to allow for exaggeration here. What German capital and German enterprise are doing in Sweden and Norway at this moment is quite sufficient to show that New Zealand, given the necessary capital for harnessing our water power, could control prices in the world's market for nitrates."

The water power of New Zealand, if turned into electrical energy, will regenerate the country. To take a single instance, the wool industry is to the dominion what the coal and shipping trades are to us. It constitutes more than half its total exports, but the natural outcome of the wool industry is hampered in a desperate manner because coal is practically inaccessible for manufacturing purposes. The woollen articles used there have to stand the cost of freight over to England as raw material, and freight back again as manufactured goods. Moreover, a fluctuating duty has to be paid on these imports, having an average value of about 30 per cent. *ad valorem*, this being required under the present conditions to prevent competition with home-manufactured wool.

With electrical power at hand, New Zealand could,

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by manufacturing on the spot, become the Bradford of the East, and speedily build up a big shipping trade to the Far East in woollens. Although New Zealand coal is amongst the best steam coals in the world, it must be remembered that the carboniferous district is principally located in the south island, and that the cost of carriage is not unimportant, so that there would be a considerable saving by utilising water power together with electrical transmission and distribution. The difficulty of obtaining coal in the northern parts of New Zealand is amply illustrated by the fact that it is the practice of ships from our own country to take a cargo out to Sydney in South Australia, ship a cargo of coal as ballast from Sydney to New Zealand, a distance of 1,500 to 1,600 miles, and then to bring back a general cargo from New Zealand to Sydney. Moreover, the cost of the distribution of electric power would be far less than here, as overhead lines could be used, and the difficulties would be less.

A few sentences will indicate what the application of electric power distribution might do for New Zealand. The production of nitrates and the development of woollen manufactures have already been mentioned. There is an immense saw mill industry, scattered over a wide area, and lending itself most admirably to the facilities for cheap power afforded by electrical transmission. On the east coast there is a deposit of "iron sand" about 180 miles long, aggregating millions of tons, containing a large ferric percentage which experiments have proved capable of producing iron equal to the best Swedish. This industry is at present untouched, owing to the inadequacy of present methods of smelting the ore, and if electricity can be rendered available, there is no doubt that a second Middlesbrough will be the result. There is already a large demand in New Zealand for agricultural implements which could thus be manufactured on the spot. The railways require cheap electrical power in place of dear coal.

All, or nearly all, the railways are State-owned, the small lengths of private lines, some two or three hundred miles, being steadily acquired by the State as opportunity serves. The harbours and practically all the public works belong to the new Zealand Government or to local authorities. All these undertakings could use electric power with advantage. Neither the Government nor the local authorities can afford to lay down a supply of electricity themselves, so that in this one item alone there is a tremendous field for private enterprise.

Power is also required for the large frozen meat industry, while the butter and cheese trade of New Zealand must inevitably develop on the Danish system in which large depôts will be founded in which the milk will be converted into butter by means of electrically operated centrifuges. The coal mines themselves will be operated electrically, following the example of Germany and England, while the tramway systems of New Zealand, which are a profitable market for electrical power, are at present only in their infancy.

GOVERNMENT COMPETITION WITH CANADIAN POWER COMPANIES

WITH regard to the proposition of the Provincial Government of Ontario to furnish electric power from Niagara Falls to the municipalities of that province, within a radius of 150 miles, the American Consul at Hamilton writes to the following effect in a report upon this subject :—

The Government Commission, composed of two members of the Cabinet of the Ontario Government, has charge of this matter, and has given it careful study and attention. The Commission has in its service expert electrical engineers, who have spent a year or more in estimating the possible cost to the municipalities as their share for the construction of the power line from Niagara Falls to the several points of delivery. This cost is to be shared *pro rata* between the municipalities entering into the scheme. It is proposed to furnish the electric energy to the municipalities at the price for which the Government contracts it from the supplying company at the Falls, to which is to be added the necessary expenses for maintaining the line and keeping it in working order. An extra charge is to be added for the construction of the line, which will continue to be a fixed charge for thirty years. At the end of that period the transmission line becomes the joint property of the municipalities, who will thereafter pay all necessary costs for upkeep and management, as well as for the electric power furnished, the Government retiring from further control in the matter. Although no definite figures of cost have been given, the expectation of the Government Commission is that it will be so low that the expense to manufacturers will be less than that of steam power, there being no coal supply in Ontario.

Hamilton is the first important point at which power would be furnished by the Government, and the lowest estimate per horse-power, delivered here, is $17·80 per annum. The cost would increase to other municipalities in proportion to distance from the source of supply and the expense of construction and upkeep of the transmission line. The Government contract proposes to bind the municipalities for a period of thirty years not to contract with any private company or corporation for a supply of electric power. In the city of Hamilton there is a company which began in a small way many years ago to furnish electricity derived from its steam plants for street lighting and for the street railway system. Less than ten years ago this company utilised the water power at Decew Falls, 34 miles from Hamilton, constructing a power house, machinery, buildings, and a pole line to this city for the transmission of electrical energy. Contracts were made with the manufacturing establishments to furnish them power at a price far below the cost of steam power, and now there are very few factories, and those only small affairs, that are not run by electricity. Natural gas, with which this city is supplied, furnishes a cheap power to small users.

The city of Hamilton is now proposing to instal electric power to operate the waterworks system and the sewage disposal plants instead of steam, and to that end a by-law was passed by the City Council on July 17th authorising a contract to be made with the local company for power at the rate of $16 per horse-power-year. An effort was made by the advocates of the Government power system to contract with the Government, but as the Government could not yet make even an approximate offer at what price electric energy would be furnished, the City Council accepted the proposition of the local company. As the contract for street lighting will shortly expire, this question was also settled by by-law. The city has been paying $80 a year per lamp for all-night service during the entire year for 460 lamps. Under the new contract the city will be supplied with light at $47.50 per lamp of 2,000 candle-power, and the number of lamps will be largely increased.

These contracts are made binding for periods of five years, the city having the power of renewal at the end of each five years for twenty years by giving the company due notice. The city can abrogate the contract at the end of any five years, while the company may be held for the full period. In the contracts the city has provided for ample protection to the private users of incandescent lighting and to the manufacturers, so that the company cannot take advantage of them and raise their rates. It is probable that the City Council could not have made such favourable contracts had it not been for the prospective construction of the Government transmission line from Niagara Falls.

Hamilton is substantially a manufacturing city, having now nearly 300 large manufacturing establishments, largely built up during the past eight years as the result of cheap power. They are mainly controlled by American capital, induced to locate here by reason of cheap power, and are managed by American experts. About $35,000,000 capital is employed, furnishing labour to over 10,000 men and women in the factories. The bonded debt of the local power company is held by capitalists in the United States. The City Council and the company are negotiating for a rebuilding and equipping of the street-car lines, increasing the mileage, and the purchase of new cars. To enable the company to undertake the cost at this time the city has agreed to guarantee the bonds of the company to the amount of $500,000. The contract is that the company shall provide 50 new cars of up-to-date construction, one-half of that number to be double trucks.

Meat Curing by Electricity.—The Acting British Consul-General at Chicago (Mr. T. Erskine) reports that a process of curing meat by electricity has been perfected which has proved successful enough to induce the formation of a company to put it on the market. The building of a model plant to demonstrate the new process was recently begun in Cleveland. The promoters of the process say that it does not change the method of soaking, but hastens the penetration of the meat by salt; bacon, for example, which under the old process takes twenty days to cure, can, it is claimed, be cured by the new method in two or three days. In addition to saving much time, the process is said to be extremely sanitary.

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THE BRITISH ASSOCIATION MEETING

An Attack on Electric Tramways

IN our last issue we reported the first Papers and discussions at the meeting of the British Association for the Advancement of Science, held in Dublin from September 2nd to September 9th. Of the remaining Papers, one only was of direct interest to the electrical engineer—namely, an essay on "General Urban and Inter-Urban Transportation and Railless Electric Traction," by Mr. F. Douglas Fox, who is connected with the company now endeavouring to introduce into this country a system of electric trolley traction in which electric motor omnibuses running on roads take current from an overhead trolley wire. The Paper, of which we give an abstract below, advanced arguments to prove that this system was more economical than other forms of mechanical traction, but did not go deeply into the engineering side of the subject, nor did it explain why this system, which has been before the public for many years, has only been adopted in a few isolated instances. The Paper, in fact, consisted in the main of a general analysis of municipal electric tramway accounts, upon which the author based a determined attack on electric tramway traction in general, and municipal tramways in particular.

MR. F. DOUGLAS FOX commenced his Paper with a general survey of the present methods of mechanical traction.

The cost of construction of electric tramways, he said, has been steadily mounting up, and even in its most economical form the cost of the permanent way exceeds that of some railways. The mechanical omnibus, he contended, can be installed for less than half the cost of a tramway; its working expenses are somewhat higher; but, the author argued, when interest on capital is combined with working expenses and both together are reduced to cost per car-mile, there is not much margin between the tramway and the petrol 'bus. If, however, the mechanical omnibus were no more than on a commercial parity with the tramway, it would, if there were still a clear field and no favour, be preferable on account of the lower capital expenditure.

Mr. Fox continued: This country has, however, committed itself heavily to the tramway system, having embarked capital in it to the extent of about 35 millions of municipal indebtedness, 10 millions of companies' obligations, and 20 millions of preference and ordinary stock. In other words, the cream of urban traffic has already gone to the tramway. The motor-omnibus cannot now displace its rival, but must look for its field with some exceptions either to the smaller towns or to suburban extensions of city tramways, or to foreign countries. Since the denser and more remunerative traffic is already dealt with, the motor omnibus should, in order to succeed in Great Britain, be able to pay with a lower revenue than the average of the tramways.

As to the technical features, on the one hand, a railway is an unnatural adjunct to a city street. On its own right of way it is unexceptionable, but in the midst of a public thoroughfare it interferes with a dense, heterogeneous traffic, during construction, operation, and repair. On the other hand, the tramcar as at present designed is superior to the motor omnibus in comfort and capacity. The latter can handle an enormous traffic, it can travel quite as fast as is consistent with safety, and in point of comfort has been recently greatly improved. It is, however, limited as to its capacity from respect for the road surface, to one-third the weight permissible on the tramway.

Capital has up to the present time only been embarked in the mechanical omnibus to any large extent in that form where the petrol or steam motor is used. In London alone some 3½ millions of capital have been invested, which, at the market quotations, would appear to have a present value of about one million. There can be little doubt that the motor omnibus was bound to come, but it seems to have come too quickly. There is no restriction to public carriers on highways such as there is to railway companies, and mutually destructive and competitive undertakings in the form of omnibus lines can be carried on to any extent. When capital poured into motor omnibus companies, the existing horse omnibus companies were driven into adopting them also, to the prejudice of their commercial standing. The 3½ millions of capital above mentioned do not include that of many companies which have disappeared.

In the 71 of the 75 corporation-owned tramways, statistics of which are given in the Paper, the working expenses vary from about 4½d. to 8½d. per car-mile. The capital charges of interest, sinking fund, and depreciation vary from 2d. to 5½d. per car-mile. The averages of these data are 6·34d. and 3·62d. respectively. These two figures added represent an average minimum remunerative revenue of 9·96d. The actual average revenue obtained is 10·52d. per car-mile. Thus the average net profit barely exceeds ½d. per car-mile.

In the petrol omnibus the working expenses and depreciation together are estimated at 10·86d. per car-mile. Adding to this interest and sinking fund at 6 per cent. of the invested capital, the minimum remunerative revenue is estimated at 11·7d. per car-mile, and this is based on a somewhat sanguine view of the costs of maintenance. The variation is great, and under certain conditions the figure might be well over 1s. per car-mile. In the tramway list considered, there are only 10 out of the 71 cases in which the traffic receipts reach 11·7d. per car-mile. On the other hand, directly an omnibus line is able to earn a profit at all, each ½d. per car-mile, when reduced to percentage on its much smaller capital, means three times as much profit as it does on the tramway.

The electric omnibus with accumulators (popularly known in London as the "Electrobus") is estimated as capable of meeting its expenses and depreciation at 9·5d. per car-mile, and adding to this a 6 per cent. allowance for interest and sinking fund, the minimum remunerative revenue becomes 10·25d. per car-mile. In the tramway list there are 35 of the 71 in which the traffic receipts reach this figure.

The electric omnibus with overhead wires, the trackless trolley system, is estimated as a possible paying concern with a revenue of from 7d. to 9d., according to class of construction. In the tramway list there are 65 which have a revenue of over 7d. and 50 of over 9d. per car-mile.

As an example of the wide field of public highways which await occupation by improved methods of mechanical transportation, the author said that in India alone, there are 150,000 miles of good roads, upon which both passenger and goods traffic could be handled upon a prodigious scale.

To estimate the working expenses and fixed charges of petrol omnibuses, Mr. Fox made use of the estimates given in a Paper read by Mr. W. G. Hardy before the Society of Road Traction Engineers in December of last year, and published in the January number of the *Tramway World*. This estimate is admittedly based on experience with a comparatively small number of mechanically propelled vehicles.

The details of Mr. Hardy's estimate are as follows:—

MOTOR-OMNIBUS ESTIMATE.

Number of cars in stock	20	
Number of cars in service	13	
Total capital expenditure	£25.000	
Car-mileage per annum	425,880	
Receipts per car-mile	12	pence
Total Receipts	£21,294	
Working expenses per car-mile	9·449d.	
Depreciation per car-mile	1·407d.	
Working expenses and depreciation per car-mile	10·856	pence
Total operating expenses	£16,772 3s. 4d.	
Depreciation, 15 per cent.	£2,497 10s. 4d.	

The details of the operating expenses reduced to car-mileage are as follows:—

Petrol, carbide, grease, and oil	1·600	pence
Rubber tyres	2·000	,,
Drivers and conductors	1·801	,,
Ticket checks	0·163	,,
Attendance on 'buses	0·528	,,
Attendance at garage	0·132	,,
Repairs to chassis (including engines)	0·602	,,
,, ,, ,, Materials	1·000	,,
,, ,, ,, Bodies	0·113	,,
,, ,, ,, Buildings and tools	0·088	,,
Lighting and power	0·059	,,
Sundries	0·161	,,
Rents, rates, taxes, and insurance	0·564	,,
Salaries and Management	0·638	,,
Total	9·449	pence
The depreciation taken at 15 per cent. per annum works out at per car-mile	1·407	pence

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The minimum cost of working of a fleet of this size is therefore, according to Mr. Hardy, 10·856d. per car-mile, leaving, out of a revenue of 1s. per car-mile, 1·144d., or on 425,880 car-miles a profit of about £2,000 per annum, or 8 per cent. on the capital.

The following estimate of the costs on a tramway of equal capacity, and with a length of track, frequency of service, and average speed corresponding with a traffic density such as would yield receipts as high as 1s. per car-mile is next given. Instead of Mr. Hardy's speed limit of 7½ miles an hour, however, which the author considers is too high for such conditions of general traffic where a revenue of 1s. per car-mile could be earned, a headway of five minutes has been taken, and an average speed as near to 7 miles per hour as will correspond with 13 cars and a length of route of 3·75 miles, double track. The capital expenditure per mile and the working expenses per car-mile have been taken at the average of the 71 corporation-owned tramways already referred to. The depreciation has been taken at £400 per annum per mile of single track.

COMPARATIVE TRAMWAY ESTIMATE.

Number of cars in stock	20
Number of cars in service	13
Length of track (double line)	3·75 miles
Capital expenditure	£88,000
Time interval between cars	5 min.
Average speed	6·93 m.p.h.
Receipts per car-mile	12d.
Working expenses per car-mile	6·34d.
Depreciation	1·69d.
Total receipts	£21,294
Working expenses plus depreciation	£14,250
Gross profit	£7,044
= 8 per cent. on the capital.	

Thus, the Paper continued, the commercial results of the motor omnibus line and the tramway work out at an equal rate of profit on the investment, the amount of capital in the case of the motor omnibus line being less than one-third of that of the tramway. As regards the estimated receipts taken in both cases at 1s. per car-mile, this is quite a possible revenue in London streets, but by no means an ordinary one in comparison with general tramway statistics. Out of the 71 cases considered, there are only 6 in which the receipts reach this figure. It has been assumed, moreover, in the comparison that the business done by the motor omnibus is equal to that done by the tramcar, although the latter is of much greater capacity. This is an anomaly which is supported by fact in London, but cannot be regarded as of universal application. Although comparative estimates of such diverse systems of transportation are difficult to make, the preceding comparison at least shows that the petrol omnibus has not as yet proved itself a more economical method of transportation than the tramway. The Paper then dealt with the "Electrobus" :

The "Electrobus," which has now been running for the best part of a year in London, is probably a more formidable rival than the petrol 'bus, not only to the horse omnibus but also to the tramway. The results of six months' running were examined by Sir Douglas Fox and Partners, in conjunction with Mr. T. Graham Gribble. Certain points of importance which have all previously been the subject of much controversy were in this examination fully established :—

1. That the vehicle, which (when fully loaded, with its complement of passengers) weighs 7½ tons, can do 40 miles without any distress of the batteries.

2. That the current consumption upon London streets, after allowing for all losses, does not exceed that of the average tramcar.

3. That the wear and tear of the chassis, including motor, is moderate as compared with that of the petrol 'bus.

4. That steep gradients, such as that of Ludgate Hill, are easily overcome with a full load on, and with no apparent distress of the battery.

The batteries were the property of and were maintained by two well-known accumulator companies on a mileage contract of 2d., and the representatives of these companies stated that they were very satisfied with their contracts. One of these gentlemen also stated that at this figure a life of six months was sufficient to pay for the batteries, some of which had already run that time and were still in good condition. The operation of the line, up to the time when the tests were made, had been more or less experimental, but sufficient data were available for making an estimate of the cost of operating a service of 100 'buses under similar conditions of duty. A business of considerable magnitude is obviously necessary in order to cover the cost of superintendence and skilled labour at the charging station, but, assuming a garage of 100 'buses, with a total performance of 2,400,000 car-miles per annum, there appears from the probable net cost of the batteries, and their apparent life, to be good grounds for regarding the mileage contract of 2d. as well within the powers of the battery company to continue indefinitely.

The general conclusion of the studies and tests made was that such a fleet of 100 electric omnibuses could be operated at an expenditure of 9½d. per car-mile, including maintenance and depreciation. The capital expenditure may be assumed at £125,000, upon which 6 per cent. for interest and sinking fund would come to 0·75d. per car-mile, thus making the minimum remunerative revenue for such an installation 10·25d. per car-mile.

With regard to current consumption, as against the loss in charging and discharging batteries should be set the favourable feature of the possibility of charging at night time when the demand on the central station is at its lightest, and consequently current has been offered to the Electrobus Company by a municipal central station at a very low figure. The many attractive features of the electric omnibus as compared with the petrol omnibus must dispose everyone interested in urban transportation to wish for it all the support, moral and financial, necessary for its development and perfection.

The principal improvement still to be looked for is the extension of the capacity of the battery without additional weight, and to the performance of a full day's work with one charge. It can now do 40 miles regularly with one charge. The Electrobus has performed the journey from London to Brighton, of 50 miles, without any distress.

However much the electric omnibus, driven from accumulators, may yet be improved, the cost of the batteries added to that of the rubber tyres, will in all probability limit its use to those circumstances where a fairly good revenue is to be obtained. The possibility is still a remote one of battery power being reduced in cost, and of some cheap substitute for rubber being found as together to reduce these items of working expense to a level with the cost of operating cars upon rails.

After this introduction the author gave the following account of one of the electric trolley omnibus routes on the Continent.

On the Continent of Europe, numerous installations of electric road traction are in operation for the transportation of both goods and passengers, in which the driving current is obtained from aerial conductors, and taken by a swivelling contact boom, having sufficient lateral freedom to enable the car to deviate in either direction sufficiently to pass other vehicles. These installations date from the year 1901, and each year sees not only fresh lines opened, but also installations of greater importance are being undertaken. Seven of these lines are in operation in Germany, one in France, and three in Italy. The Italian Government is said to have in contemplation the utilisation of the public highways for this mode of transportation upon an extended scale.

One of the latest of the projects, now well on the way to completion, is that of Mülhausen in Alsace. The city, of 100,000 inhabitants, is already supplied with a tramway system, but it was found necessary to connect the suburbs with these tramways and also with one another. It was also desired to obtain better access to the Public Gardens during the summer months. The traffic was, however, estimated to be too light to render a tramway profitable. The line to the Public Gardens has gradients as steep as 1 in 12; the zone line is comparatively flat. The estimates were to include a fixed charge of 4 per cent. interest upon capital. The Corporation appointed a commission to report first as to whether any means of communication could be made remunerative, and secondly, as to what means to adopt.

The complete scheme was to be for 6¾ miles of route, on which 550,000 car-miles were to be made per annum. The commission reported on three alternative proposals :—

1. For a very cheaply constructed tramway, for which plans and specifications were prepared by their own engineer.

2. For a service of motor omnibuses operated by benzine engines, for which several tenders were made by manufacturers of these vehicles.

3. For a "railless traction" line of electric omnibuses with aerial conductors.

The conclusions of the committee were, that the last proposal was the only method having prospects of commercial success, and the installation was therefore contracted for, and is now under partial operation.

The digest of the estimates is as follows :—

	Tramway.	Benzine Omnibuses.	Electric Trolley Omnibuses.
Total cost	£62,530	£23,581	£25,050
Do. per mile of route ...	£9,260	£3,500	£3,700
Expenses per car-mile including repairs, renewals, depreciation, and 4 per cent. interest... ...	7·730d.	9·45d.	5·13d.

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The benzine omnibuses and the electric vehicles were of about the same capacity; the tramcars would have given considerably more accommodation.

The prices of labour for both construction and operation are lower in Germany than in England. The tariff is correspondingly low.

The Mülhausen line is interesting, not only from being the longest yet undertaken upon this system, but also from the severity of the gradients. The corporation decided that the Public Gardens line should precede the zone route, and that the brake tests should be such that the braking of either axle independently should be sufficient to hold the car on the steepest gradient, and also to bring it to a standstill in the shortest possible time. Also, that these tests should be carried out in winter. The road is of macadam saturated with tar by a new German process, which attains a smoothness almost equal to that of asphalte, and much resembles "tarmac."

The car is steered and driven on the front axle, the wheels of which are rubber tyred, the rear axle having steel tyres; both axles are supplied with mechanical brakes, and the front axle with an electric brake. The car accelerates and maintains speed on the gradient of 1 in 12 without any trouble; the single forward brake gear is sufficient for holding the car, but the braking of the tyred wheels on the rear axle has required modification. During a recent visit paid to this installation by Mr. Bertram Douglas Fox, chief electrical assistant to the author's firm, the car was put through all the tests required by the authorities, and the performances were satisfactory. This section of the line is now opened for traffic. On some of the lines in Germany, goods transportation is being carried on upon the same lines as a passenger business without any inconvenience, the former being handled by trains of cars hauled by a double-ender electric locomotive, the cars being provided with a coupling and steering device which compels them to follow the exact course taken by the locomotive.

At the figures of working expense estimated by the Mülhausen committee, the author contends that such a system could pay its way in this country with the smallest revenue earned by any tramway in England, even allowing for the higher rate of wages here than in Germany.

This was the only electric trolley omnibus system described in the Paper, and no actual costs were given of lines actually running.

The author next proceeded, by an analysis of the accounts of the 71 municipal tramways already referred to, "to show the degree to which this great system of urban transportation has overstepped the limits of commercial soundness," and "by the selection of typical cases to show the principles which should govern the design of a transportation system from a commercial point of view." We give this part of the Paper below in a slightly abbreviated form :—

1. *The Rentability of the Tramway System.*

The capital expenditure on the 71 installations has been		£27,213,674
The gross income in 1907 was		6,361,860
The operating expenses		3,833,370
Leaving net income		2,528,160
The deductions made were :—		
Interest	801,906	
Sinking fund	641,074	
Income tax	39,012	
Depreciation	528,733	
Sundries	176,753	
		2,187,478
Net surplus		+ 340,682

The gross surplus was contributed by 36 towns, which was disposed of as follows :—

Carried forward	56,854
Reserve	52,932
Reduction of rates	335,194
	£444,980

Deficits were shown by 20 towns, the remainder coming out even.

In the following table the deductions from income, &c., are reduced to percentages of income and of capital expenditure :—

	Percentage	
	Net Income.	Capital Expenditure.
Interest	31·90	2·945
Sinking Fund	25·55	2·355
Income Tax	1·55	0·143
Depreciation	20·60	1·945
Sundries	7·00	0·650
Total	86·60	8·038

The surplus from the 36 towns was disposed of as follows :—

	Percentage	
	Net Income.	Capital Expenditure.
Carried forward	2·25	0·209
Reserve	2·10	0·95
Reduction of rates	13·27	1·230

The entire surplus available from the aggregate of the undertakings is thus seen to be about 1½ per cent. on the cost of construction. On 30 of the tramways, representing over 500 miles of single track, no allowance for depreciation is made. If this is reckoned at £400 per mile, or £200,000 per annum, the surplus would be reduced to about 0·75 per cent. on the capital expenditure. The total amount set aside for depreciation by those towns which make any appropriation under this heading averages £336 per mile of single track. If the whole of the 2,071 miles included in the list were provided for at £400 per mile, there would be a deficit in place of a surplus.

A surplus of a bare 1½ per cent. on such a system of tramways as that of Great Britain cannot be claimed as a lucrative result. It may be contended that the system as a whole would have been equally unremunerative if it had been built up and run by private companies. Without discussing so wide a question, it is plain that this form of municipal exploitation is greatly on the increase and enters into the programme of politicians of socialistic tendency. More than twenty years ago the suggestion of free urban transportation was put forward in the Colonies. The London County Council is engaged in a collossal municipalisation scheme, in which the experiment of a maximum capital expenditure is combined with a minimum passenger fare, and at the present rate of progress, it cannot be many years before the general public will be compelled to take something more than an academic interest in it.

Occasionally some journalist raises a warning note, but the whole subject arouses as little concern in the persons most concerned as does the National Debt. Whether municipal indebtedness is to be reduced or not does not trouble the average ratepayer. The working classes need cheap travel. Whether the means adopted will relieve or increase the rates affects them far less than the question of the facilities themselves, and the working classes elect the town council. It is only when the increase of rates reaches the point of driving the manufacturer, possibly their own employer, to a cheaper district, that it begins to touch their personal interests. If corporations want to borrow and the working classes support them, the Board of Trade will sanction the loan, even when the rates are already as high as can be tolerated.

At a town council meeting a short while since, when the tramway project was under discussion, the chairman said, with a fine satire, that its commercial prospects were a "Limerick," to which the ratepayers must apply the last line. The authorisation was, however, applied for and duly granted.

As to the present outlook, it may be asked whether there is any probability of the tramway system clearing off its debt. If we take the system in its entirety we can see no possible chance. From the Board of Trade returns lately issued we see that the loan capital has risen in the last 30 years from 4 to 64 millions. Amortisation has, of course, gone on, but the borrowers keep on borrowing more than they pay off. If, on the other hand, we take the seven largest and best paying tramways, in which it would appear as if construction had approached its limit, we find that at the present rate of amortisation the debt would be cleared in about 26 years, and these tramways would then have about a million pounds of surplus at their disposal. They could either apply it to reduce the average passenger fare of a 1d. to ½d., or they could reduce rates by an amount equal to about 5s. per head of population served. Probably, however, long before then, they will have decided to replace the overhead system by an electrical conduit or in some other way will have enlarged instead of reduced their loan capital.

2. *Rentability as Compared with Size.*—Although as a rule big tramways pay and small ones do not, there are remarkable exceptions of both kinds. Fourteen cities of populations varying

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from 100,000 to 232,000 either show a deficit or no surplus. The aggregate amount of deficit being £7,225.

On the other hand, the smallest town boasting an electric tramway—Maidstone, with 13,000 inhabitants—shows a surplus. Ayr, a town of 33,000, pays fixed charges, puts aside a depreciation fund, and carries over a surplus of £1,000.

The following table illustrates this point:—

Population.	Number of Tramways.	Number providing depreciation fund.	Number showing surplus.	Number showing deficit.	Number with even balance.
up to 20,000	2	0	1	1	0
20 to 40,000	7	4	4	3	0
40 to 60,000	9	3	0	8	1
60 to 80,000	6	3	2	1	3
80 to 100,000	4	2	2	0	2
100 to 150,000	12	3	3	2	7
150 to 200,000	8	5	3	1	4
200 to 300,000	6	5	6	0	0
300 to 500,000	5	5	5	0	0
500 to 1,000,000	3	2	3	0	0

It will be noticed that prosperity is at its lowest ebb in the case of tramways serving from 40 to 60,000 and only becomes invariable in the case of those serving over 200,000. In tramways serving 40 to 60,000 there is a sudden increase of proportion of double track mileage. It would seem, therefore, that at this point of population tramway construction has been too heavily saddled with the cost of double track. It is not to be inferred that all the tramways which show no depreciation fund, or even which show a deficit, are permanent failures from a commercial standpoint. Some of them are of recent date, and may have a good future before them. On the other hand, it would appear from the foregoing table that about half the tramways provide no depreciation fund, and about one-quarter come out with a deficit.

3. *Capital Expenditure per Mile.*—The total capital expenditure, in the 55 tramways having combined generating stations, ranges from £10,630 to £37,210 per mile of route, and from £7,516 to £20,728 per mile of single track, the two extreme cases being Halifax and West Ham respectively.

In the 16 towns having separate generating stations for lighting and tramway purposes, the cost ranges from £17,750 to £46,300 per mile of route and from £10,888 to £23,514 per mile of single track, the two extreme cases being Preston and Portsmouth respectively.

The cause of this great variation is mainly in the cost of permanent way and widenings, and expenses incidental to obtaining authorisation. The rolling stock, overhead equipment and generating stations are fairly uniform in cost. With regard to permanent way, however, in the first place there is generally a horse-car track to be bought up, and a new track laid down, which involves numerous and often heavy incidental expenses. Some towns are overburdened with length of permanent way needed to reach the population, others with peculiarly heavy cost of the permanent way itself. At Halifax, for instance, 37 miles of route were needed to serve 178,000 population, or about twice the average proportion; the cost per mile of track is comparatively low, the average number of rides quite normal, and the receipts per car-mile exceptionally high, but the undertaking appears to be handicapped by its length. At Wigan, the ratio of length to population is four times the average, and the cost of track per mile nearly twice the average; in such circumstances the immense deficit of over £16,600 is not to be wondered at.

Comparing the capital expenditure of British with that of American and Continental tramways we find that the British undertakings are as much burdened by excessive first cost as is the railway system. An estimate is given in Mr. Ashe's book which he regards as a fair average of the cost of an American tramway, and which works out at about £6,300 per mile of route, or about one-third that of the average, and not much more than one-half the lowest figure in British tramways. The estimate made by the town council of Mülhausen, Germany, previously referred to, for a tramway was also between one-half and one-third of the average of British tramways. In America, a lower first cost is combined with a higher tariff. The question of first cost should obviously be studied in connection with the possible tariff, as to which more is said later.

4. *Route-Length Factor.*—This factor is the length in miles of route per 1,000 of population. Its normal length depends upon the extent to which the population is scattered or condensed, and whether the routes are parallel or radial. The factors given in the table are only approximate averages for British tramways, in an element of design which is necessarily extremely variable. They apply only to the more usual form of towns and their suburbs, but not to inter-urban lines or towns with detached suburbs. In these cases the factor is higher. As a general rule, the factor is in inverse proportion to the size of the town, because, as the population increases, it becomes denser, principally on account of the increased value of land.

In the tramways considered, this factor ranges from 0·033 to 0·4. Only one case having over 0·2 mile per 1,000 is remunerative. On the other hand, the low ratios are not either as a rule remunerative. Lincoln, for instance, with 52,500 people and a factor of 0·033, comes out with a deficit. The riding habit factor is only 27, thus the tramway can only by a flower of speech be said to "serve" its population.

The average of the 55 towns in the first list is 0·107, and in the second list 0·098 mile of route for 1,000 population.

APPROXIMATE ROUTE-LENGTH FACTORS FOR URBAN TRAMWAYS IN ENGLAND.

Population.	Route Factor.	Population.	Route Factor.
20,000 ...	0·180 to 0·220	120,000 ...	0·113 to 0·139
40,000 ...	0·162 to 0·198	140,000 ...	0·105 to 0·129
60,000 ...	0·147 to 0·179	160,000 ...	0·099 to 0·121
80,000 ...	0·134 to 0·170	180,000 ...	0·094 to 0·115
100,000 ...	0·123 to 0·150	200,000 ...	0·090 to 0·110

As a mere memoriser, and subject to amendment according to circumstances, the factor may be taken as ranging from 0·2 in the smallest to 0·1 in the largest town.

In America the riding habit being much greater, the towns are also better served.

5. *Density of Traffic or Riding Habit.*—Very approximately, the density of the traffic, expressed in average journeys per head of population per annum, varies with the size of the city. When the route mileage is proportioned to the population, the variation of riding habit becomes still more closely proportional to the size of the city than in the statistics. In the 71 cases cited, the riding habit varies from 27 at Lincoln, a town of 55,000, to 213 at Glasgow with 1,000,000. Lincoln, however, has only 0·033 per mile per 1,000 people, and as they do not live in sky-scraper buildings they cannot be said to be served.

Maidstone again, already referred to, with a population of only 13,000 people carries it 91 times per annum, forming a very favourable exception in high density of travel with small population. Kirkcaldy, Southport, and Wigan are also remarkable cases of the same kind.

It may be thought a hazardous thing to give any rule for estimating the density of travel in a city where results vary as greatly as they do. It is, however, less hazardous to form some kind of rule based upon study of statistics, than to make a mere guess, as is too often done. The following table is only intended as a rough approximation, subject to more accurate estimation from the study of the particular case, and provided the system is of dimensions, and so laid out, as to be truly described as "serving" the population:—

Population.	Riding Habit.	Population.	Riding Habit.
20,000 ...	50	120,000 ...	89
40,000 ...	65	140,000 ...	93
60,000 ...	74	160,000 ...	95
80,000 ...	81	180,000 ...	97½
100,000 ...	86	200,000 ...	100

and for each 100,000 more, add 12½ rides per head per annum.

The curve corresponding with the above figures will, in the main, agree with the statistics of British corporation-owned tramways, and will generally be found rather under than over the actual riding habit.

6. *Income per Car Mile.*—In the cases analysed, the income per car mile ranges from 5·8d. to 13·9d. The average of all is about 10½d. per car mile. Low receipts may be caused by a too frequent time interval between cars, by too low a tariff, by too low a speed, or other ground of unpopularity in the cars themselves.

In America, the income per car mile of 18 electric railways given in a table by Mr. Ashe ranges from 4·61d. to 14·25d. per car mile, the lowest income where no deficit is made being 4·65d.

7. *Working Expenses per Car Mile.*—In the British tramways analysed, the variation is from 4·6d. to 8·59d., the average being 6·25d. High costs are generally found with a high route length factor. Probably the upkeep of track is chiefly responsible, but administration expenses borne by a light business in proportion to size are also contributory. The lowest working expenses are those of Kilmarnock, which is, however, not thereby saved from a deficit. The riding habit factor is here fairly high as compared with the route-length factor, and the tariff is normal. With this size of town, something abnormal is required, either in the riding habit or the tariff to make the undertaking pay.

8. *Interest and Sinking Fund per Car Mile.*—In the British tramways these figures range from 1·93d. to 5·30d., very approxi-

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mately in direct proportion to the capital expenditure per mile. The average of the whole is about 3·6d. Probably about half this burden is due to permanent way.

9. *Average Fare Charged per Mile.*—This ranges in the British tramways from 0·36d. to 1·0d., and the great variation does not appear to correspond with variation in cost of construction and operation. In the case of electric lighting companies, the cost to the consumer is always made to vary with the cost of production, but in traction companies there are many curious anomalies. The Parliamentary fare on railways is 1d. per mile, and there is no reason why a tramway should be victimised by a tariff of about one-third of that amount. In some cases it is possible to operate a tramway on a much lower tariff than 1d. per mile, which is, of course, then recommendable, as, for instance, at Hull, where, with a tariff of 0·36d. per mile, the Corporation is able to put aside a fairly good depreciation fund, and to carry over a surplus amounting to 4 per cent. of the capital expenditure. Maidstone, on the other hand, the smallest remunerative tramway of the United Kingdom, levies the standard tariff of 1d. per mile, and could not have earned a profit at a lower tariff. It has, however, more than double the normal riding habit factor.

When one comes to the long list of tramways which declare a deficit, and compares it with the fares charged per mile, the results are startling. Probably London, with its deficit of over £25,000 per annum would be the most surprising of any. Unfortunately, in the statistics, London does not give its average passenger fare. There can be no doubt, however, that it is extremely low. Taking the other 19 tramways, which together have a deficit of £48,000 per annum, we find that with three exceptions these tramways levy a fare under 1d. per mile, carrying passengers at rates varying from 57 per cent. under normal fare and upwards. The financial result, supposing these tramways all levied a fare of 1d. per mile instead of their present fare, would represent a surplus of about £70,000 in place of a deficit. It will at once be replied that the travelling public would not submit to a fare of 1d. per mile in these cases. Naturally they would not. When once the passenger has been allowed to travel partly at the expense of the ratepayer, he will not surrender his privilege. It is practically impossible to raise fares when once they have been established at an unremunerative figure. This does not, however, contradict the fact that, combining actual deficit with possible surplus, a sum of over £100,000 per annum is given away to the general travelling public in place of finding its way to the coffers of the undertakings.

If municipalisation of tramways is subject to ordinary business principles, the practice of letting the public travel partly at the expense of the ratepayer is to be condemned as vicious. If, on the other hand, commercial principles are not to be held to govern this form of exploitation, consistency should demand that the full programme of the Socialistic propaganda should fix the goal of municipalisation as that of free urban transportation. There is at present a lack of programme.

10. *Power Consumption, Cost per Car Mile, and Cost per Unit of Power.*—The variations in the statistics are very much greater than would appear natural to the diversity of local conditions. As to power consumption per car mile, this varies from 0·88 unit in the case of Keighley to 2·08 units at Burnley. This variation is more normal than that of the cost, and depends upon the weight of cars, density of traffic, and gradients to be overcome. The maximum gradients in the two above-mentioned towns are 1 in 25 and 1 in 9·8 respectively.

The cost per B.O.T. unit varies from 0·32d. at Leeds to 2·14d. at Lowestoft. The variation depends on the kind of engines used, the cost of fuel, and the output of the plant. The output in the two cases cited above are 13 million and 350,000 units respectively. It should not, however, be taken as a necessary drawback of a small installation that the power cost should be anything like as high as it often is. Even with steam plants, there are cases of comparatively small installations where the cost per unit is under 1d.

The internal combustion engine has been proved to be capable, when judiciously installed, and efficiently managed, of placing the small power station almost on a level as to fuel cost with the large station. Gas engines with suction or producer gas as fuel have under certain conditions been proved extremely economical. Unfortunately, however, there are many cases of very unfavourable results which are all easily to be accounted for either from bad design or management, but which have much interfered with the progress of this form of generator. There certainly ought, however, to be no tramway needing to pay 2d. per unit for power.

With regard to the total cost per car mile for power, this varies from 0·37d. at Glasgow to 3·032d. at Burnley. From various causes, therefore, many of them quite avoidable, it costs eight times as much to drive a car in one place in England than in another. Certainly a surprising fact, even when all allowances are made.

11. *Average Speed per Hour.*—The gain in speed through the introduction of mechanical traction in great thoroughfares is not as much as the passenger imagines.

During the tests made with the London Electrobus, speed curves were obtained of several omnibuses plying on the same route, between Liverpool Street and Victoria. The variations were considerable with the same class of vehicle, but the average of a number of tests was as follows :—

	Average speed between termini. Miles per hour.	Highest average speed between any two cross streets. Miles per hour.
Horse Omnibus	5·30	8·75
Electric Omnibus	6·25	10·00
Petrol Omnibus	6·50	11·00

The police regulations limit the maximum speed to 12 miles per hour. Taking the above averages, a passenger travelling half a mile would save about a minute as between the horse 'bus and the electric, or about a quarter of a minute as between the electric and the petrol 'bus, but the latter saving is mostly a matter of chance.

The statistics of average speed per hour of tramways are misleading. They sometimes mean schedule speed and sometimes the actual average, that is to say, the total car miles per annum divided by the total car hours per annum. Thus the minimum is Northampton, 5·6 miles per hour, which is the true average, while the maximum is 10 miles per hour at Hull. This latter, however, is only the schedule speed, the true average being 7·1 miles per hour. Northampton might, as far as speed is concerned, continue to operate by horse traction.

The London County Council also under "Average speed" appears to give the schedule speed of 8½ miles per hour, whereas it works out at 7 miles per hour.

ANALYSIS OF 55 TRAMWAY INSTALLATIONS HAVING COMBINED GENERATING STATIONS FOR TRACTION AND LIGHTING PURPOSES.

Population served	7,045,285
Length of route (miles)	756·88
Length of single track (miles)	1332·25
Route-length factor; miles route per 1,000 population	0·1074
Capital expenditure	£15,052,619
Ditto per mile of route	£19,900
Ditto per mile of single track	£11,300
Income	£3,681,866
Ditto per mile of route	£4,865
Ditto per mile of single track	£2,762
Operating expenses	£2,360,774
Interest, sinking fund, and depreciation	£1,199,095
Net surplus or deficit	+£151,831
Application to relief of rates	£169,191
Passengers carried per annum	791,015,891
Riding habit = average journeys per head per annum	112
Average fare charged per mile	
Car-miles made per annum	82,168,927
Receipts per car-mile	10·76d.
Expenses per car-mile	6·90d.
Interest, sinking fund, and de preciation per car-mile	3·50d.
No. of cars in daily use	2805·57
,, ,, stock	3,508
,, ,, use per mile of route	3·7
,, ,, stock per mile of route	4·6

ANALYSIS OF 16 TRAMWAY INSTALLATIONS HAVING SEPARATE GENERATING STATIONS FOR TRAMWAYS AND LIGHTING.

Population served	4,119,152
Length of route (miles)	403·55
Length of single track (miles)	739
Route-length factor	0·098
Capital expenditure	£12,161,055
,, ,, per mile of route	£30,400
,, ,, per mile single track	£16,450
Income	£2,679,994
Ditto per mile of route	£6,650
Ditto per mile of single track	£3,630
Operating expenses	£1,472,926
Interest, sinking fund, depreciation, &c.	£988,583
Net surplus or deficit	+£235,468
Application to relief of rates	£166,003
Passengers carried per annum	625,413,614
Riding habit	152
Average fare charged per mile	
Car miles made per annum	62,832,281
Receipts per car-mile	10·25d.
Expenses per car-mile	5·63d.
Interest, sinking fund, &c., per car-mile	3·78d.
No. of cars in use daily	1671·76
,, ,, stock	2,520
,, ,, use per mile of route	4·15
,, ,, stock per mile of route	6·25

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DISCUSSION.

Mr. P. S. SHEARDOWN (Dublin United Tramways, Ltd.) said that "railless traction" would seem to offer a possibility at cheap capital cost of opening up suburban or country traffic in connection with existing tramway systems. It was remarkable, he said, how little the application of electricity to tramway systems had added to the route mileage throughout the United Kingdom. This was due to the fact that, owing to the heavy capital expenditure, the standard method of construction did not pay except in a fairly densely populated district, where circumstances compelled people to move from one locality to another. In the first part, dealing with the comparison of the operation of the standard form of electric tramways with the petrol and electric accumulator omnibus, the conclusion the author arrived at seemed to be that a case might be made out for the latter form of traction, provided receipts could be guaranteed at 1s. per mile, which it was well known was almost impossible to obtain, except in areas of very dense population. The financial position of the petrol motor-'bus generally seemed to be a disastrous one, and although the author appeared to make out a better case for the electrobus, it must be realised that his estimates were formed on a very small service of these vehicles. The electrobus being undoubtedly more in favour with the general public, it resulted in its taking better receipts per car-mile, but this advantage would disappear as more of them were put on the streets. It must also be remembered that the surface of the London streets was remarkably smooth compared with that of provincial towns and suburban roads. Running on a smooth surface naturally reduced the traction effort required; it also saved wear on tyres and saved the deterioration in the accumulator due to excessive vibration, so that the figures obtained in London with both petrol and electric omnibuses could really only be applied to London, as the conditions elsewhere varied considerably. With regard to the figures given by the author, showing that on the whole the large amount of money sunk in electric tramways had proved to be an unprofitable investment, it must be remembered that most of these figures related to municipal tramways which, it was now generally recognised, were not run with the sole object of making profits, vote-catching being apparently much more what was sought after. Mr. Sheardown expressed his regret that more details had not been given with respect to "railless traction," but undoubtedly, although not yet tried in this country, he said, it would appear to have the elements of advantage for feeling around for further traffic with the smallest possible capital outlay, provided that a supply of electricity could be obtained without building a power station, and that facilities were given for carrying current at high pressure on the poles. In this connection it would appear as if the single-phase traction motor might be suitable for adoption, owing to the much greater facility with which alternating current could be distributed without loss. In ascertaining whether a traffic would be remunerative, it would probably pay for the first few years to put up with a fairly heavy cost for energy per car-mile due to transmission loss, &c., which could be subsequently rectified by investing additional capital when the possibility of the line with regard to traffic had been ascertained. He was of the opinion that a very much cheaper form of overhead construction might be employed than that which was standard in towns at the present time, as if the wire could be carried on short brackets close to the poles by developing the flexibility of the trolley arm, the weight of the poles and the cost of erecting them could be very materially reduced, and bare copper wire was an article which could be always turned into money. The great saving with regard to capital expenditure was that the costly permanent way was not required, for it must be realised that a tramway company not only provided an iron road to take up the wear of its own traffic, but also a substantial road which was kept up at the tramways' expense, but was used and worn out by the ordinary road traffic. The third portion of the author's paper, the speaker continued, was full of interesting statistics, which, owing to the fact that nearly all the possible tramway systems had been electrified, could not be made very much practical use of. Certain remarks made by the author would seem to indicate that an authorised electric tramway system ran practically without competition, but although this apparently often was so, it was not so in practice, as it was always in competition with the natural means of locomotion given to man. On the surface it would always appear that an increased revenue per car-mile could be obtained by running fewer cars, but this meant reducing the interval between the service, with the result that people only going short distances walked instead of waiting for the car. In the same way, if one reduced the distance people were carried for a given sum, no benefit would ensue, as people would walk the distance that had been taken off the original fare, or, in other cases, were offended, and walked the whole distance.

Mr. P. C. COWAN (Engineer, Irish Local Government Board) asked whether the figure of 5·13d. per car-mile, as mentioned in the case of railless traction, included the cost of repair to the road. This, he said, was the turning-point on which this system of railless traction seemed to hinge. What would be the wear on the road with this system as compared with the ordinary road traffic, and who was going to pay for the upkeep of the road? He further mentioned that there was an admirable road from the terminus of the Dublin tramway system at Donnybrook to Bray with a first-class surface on which the enterprising Dublin Tramway Co. might make some interesting experiments.

Mr. RYDER thought the system was very suitable for the development of traffic in many parts of Ireland, but he thought that the first experiment should be made on level roads. He did not quite agree with Mr. Sheardown's remarks that the wear on rubber tyres on the London roads would likely to be less than the wear which would take place on rougher paving; he thought that the continual stopping and starting in the crowded London traffic must be very severe on the tyres.

Professor WIMPRESS said the Paper was most interesting, although the last part was more suitable for the section of the Association dealing with statistics. It was very difficult to obtain practical results in many cases from statistics. In the case of Lincoln mentioned, he thought that the reason of non-success there was the fact that the old part of the town was built on what was practically the side of a hill, and it was very difficult to connect it with the rest of the town.

Mr. LONG also referred to the matter of what was likely to be the additional road wear with the railless form of traction. He said that he had seen some such form of traction working round the London Exhibition, and the havoc it caused to the roads there was deplorable.

Mr. FOX, in reply, stated that he thought the answer to the question that had been raised of the wear to the road was that the weight per axle could be kept low and need not exceed a ton and a quarter per axle. This was possible, due to the fact of the electric motors and gear weighing much less than the machinery required for a petrol or accumulator 'bus. In reply to Mr. Cowan's question whether 5·13d. included the cost of road repair, he said that £100 per mile per annum had been put aside and was included in this figure. With reference to Mr. Long's remarks *re* railless traction in the White City, what he referred to was a Renard train which was running round the Exhibition. This, with regard to weight, was very different to what he contemplated, and moreover it must be remembered that the paths in the Exhibition had been very quickly made, and must only be regarded as temporary.

Steam Turbine Design.

THE following is an abstract of a Paper on "Experiments on Rotating Discs," contributed by Messrs. J. BROWN, F.R.S., and MAURICE F. FITZGERALD :—

The authors begin by referring to the difficulty of the mathematical analysis of the elastic deformation, under centrifugal stress, of rapidly revolving discs, particularly when formed with a central hole, surrounded by a thick boss, gradually reduced outwards to a thin edge by an arbitrary curve, and mention the investigations of Mr. Chree and Mr. F. Purser of the cases of cylinders and ellipsoids. The authors' experiments are described as made for the purpose of finding out whether approximate formulæ, such as have been given for cases in practice in such works as that of Stodola on steam turbines, are sufficiently nearly correct for practical purposes. Two discs, made of red rubber weighing 72 lb. per cubic foot, were tested. The discs were both 12 in. external diameter. One was solid, ½ in. thick at edge, 2 in. at the centre, its surfaces being two flat cones. The other was ⅝ in. thick at edge, in its centre was a hole 1½ in. diameter, surrounded by a boss, with flat ends 2½ in. diameter, and 3 in. thick, the surfaces between the edges of the boss and disc being shaped to hollow hyperbolic curves. The discs were suspended from the end of the shaft of a small motor, placed with its axis vertical, and circles drawn on the faces, previously painted white, while spinning. Photographs being taken of the discs while spinning and when at rest, the strains at different radii were found by comparison of the photographs, and plotted as curves, shown by lantern slides. The results were compared with those of approximate formulæ. In the case of the solid disc the difference between the speeds causing a given strain as calculated and as observed, amounts to about 20 per cent. and may, considering the imperfect elasticity of india-rubber, be considered a fair enough approximation; but in the case of the other disc, though the formula gives a tolerably fair idea of the shape of the curve of strains, its error as to the actual magnitude of the speed causing a given strain is so great, being near 400 per cent., as to lead to the conclusion that the formula could not be trusted for practical purposes.

Physics and Chemistry.

Helium and Radium.— SIR JAMES DEWAR'S Paper on "The Amount of Helium Evolved from Radium," attracted considerable attention. He announced that he had discovered that Crookes' radiometer could be used as a very sensitive pressure gauge. He connected a radiometer with a bulb filled with charcoal, and immersed in liquid air. The great exhaustion

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thereby produced sufficed to stop the radiometer even when illuminated by an arc lamp. On attaching a tube containing dry perchlorate of potash, and evolving pure oxygen from it, it was found that the radiometer begins to work at one 50-millionth of an atmosphere, equivalent to the vapour pressure of mercury at −23° C. The Macleod gauge only reads down to double that pressure. He applied the new method to determine the amount of helium evolved from 70 milligrammes of radium bromide, and found the amount to be 0·37 cubic millimetres per gramme of radium per diem, which strikingly agrees with Rutherford's theoretical value of 0·3 cubic m.m. He asked Mr. Strutt if he still thought all helium was evolved by diffusion from rocks. The HON. R. J. STRUTT maintained that the earth would not be capable of retaining helium in its atmosphere, and that only an underground source could account for the amount of helium present in the atmosphere. In reply, SIR JAMES DEWAR mentioned that Bryan had shown that gases of the atomic weight of helium are heavy enough to be retained by the earth.

The Inductance of Two Parallel Wires.—The following is a Paper on this subject, contributed by Dr. J. W. NICHOLSON :—When direct and return currents flow in two wires of great length, and the alternation is not rapid, the effective self-induction L per unit length of the system may be calculated readily by simple integration.

If the wires have radii (a, b) and permeabilities (μ, ν), and if c be the distance between their axes,

$$L = 2\log\frac{c^2}{ab} + \frac{1}{2}(\mu + \nu)$$

But this formula is generally of little practical use when the frequency of alternation is several thousands per second. Such frequencies are of constant use in practical work, where pairs of long wire leads are continually employed, whose self-induction must be small. A knowledge of the effective self-induction of such leads is therefore very desirable. The general case presents considerable mathematical difficulty, but the solutions given below appear to include most cases of practical utility.

The mode of proof depends chiefly upon a transformation of a series of Bessel functions of type K_n finite at infinity, to another series similarly related with respect to a new origin. The disturbances caused by one wire in the vector potential due to the other may be summed to a high order of accuracy. From a knowledge of the vector potential, the total current in each wire, and thus the self-induction, may be deduced.

The result for wires not too close together is

$$L = 2\log\frac{c^2}{ab} + \frac{2\mu}{x}\cdot\frac{\mathrm{ber}\,x\,\mathrm{ber}'\,x + \mathrm{bei}\,x\,\mathrm{bei}'\,x}{(\mathrm{ber}'\,x)^2 + (\mathrm{bei}'\,x)^2} + \frac{2\nu}{y}\cdot\frac{\mathrm{ber}\,y\,\mathrm{ber}'\,y + \mathrm{bei}\,y\,\mathrm{bei}'\,y}{(\mathrm{ber}'\,y)^2 + (\mathrm{bei}'\,y)^2},$$

where (μ, ν) are the permeabilities of the wires, (σ, σ') their resistivities.

$$x = 2a\sqrt{\frac{\pi\mu n}{\sigma}},\quad y = 2b\sqrt{\frac{\pi\nu n}{\sigma'}}$$

and ber x, bei x are the functions introduced by Lord Kelvin, and afterwards tabulated. Their main properties are well known to mathematical electricians.

Measurement of Large Inductances containing Iron.—Sir OLIVER LODGE, F.R.S., and Mr. BENJAMIN DAVIES' Paper on this subject was identical with one which has already been published in the *Journal* of the Institution of Electrical Engineers. The following is a brief abstract :—We have had occasion lately to measure large inductances, up to and above 100 henries, with core consisting of subdivided iron in a nearly close circuit, as used for certain telegraphic purposes with very weak currents. Since the inductance may vary rapidly with strength of current, it is necessary in any measurement to imitate the conditions of practice, and to determine the inductance as a function of current under those conditions. To this end we have designed a maximum-amplitude galvanometer, consisting of a well-damped coil moving *dead beat* in a strong magnetic field, and attached to a mirror so that the amplitude of its excursion can be observed. It can subsequently be calibrated by means of a steady current giving the same deflexion. The inductance to be measured is connected up in series with this galvanometer, and with a specially designed alternator of small power and known frequency $p/2\pi$, giving a sinuous or simply harmonic current. A switch allows the inductance to be suddenly replaced by a non-inductive adjustable resistance R′; and when under these conditions the same oscillation is produced in both cases, then the self-induction is equal to that equivalent resistance divided by the frequency constant; or $L = R'/p$. The strength of the current involved in this measurement is known by imitating the deflexion with a known steady current; and the main measurement consists simply in observing the deflexion caused by the sine-alternator, at a measured frequency, either with the inductance, or with the adjustable non-inductive resistance, indiscriminately. It is to be understood that the ohmic resistance of the wire wound on the self-induction is low. If not, a correction must be applied for that, which is easily done, since $\sqrt{(R^2 + p^2L^2)} = R'$.

The following empirical expression is found able to give the self-induction of a nearly closed magnetic circuit excited only by very weak currents, since for such currents it is found to be practically constant.

$$L = \frac{kn^a}{(G+g)^b}$$

where n is the number of turns, G the width of the air-gap in millimetres, and the other quantities are constants to be determined by experiment: though a will naturally be nearly 2. In an actual case of a nearly closed magnetic circuit the following values were found :—

$a = 1{\cdot}99$; $b = 0{\cdot}47$;
$k = 18$ henries; and $g = 0{\cdot}1$ millimetre.

The result of this method of measurement applied to inductance coils of this type shows : (1) that measurements based on a determination of the square root of mean square of current would serve fairly well for low magnetising forces; (2) that the self-inductance of such coils is for weak currents nearly independent of frequency, or say for all frequencies up to about 20 per second, when the magnetising force does not exceed 0·04 c. g. s.; (3) that the self-inductance of a nearly closed magnetic circuit is a definite and dependable function of the width of the air-gap for moderate currents and frequencies.

On the Extension of Optical Ideas to General Electromagnetic Fields.—Dr. E. T. WHITTAKER's Paper with this title showed that the resolution of a beam of light into two components polarised in planes at right angles to each other, leads to an expression of the state of the luminiferous ether in terms of two potential functions, one of which corresponds to each of the polarised beams. It was then shown that the state of the ether can be expressed in terms of these two potential functions, not only in the case in which the disturbance consists simply of luminous or electromagnetic waves, but also in the more complicated cases when electrostatic charges and voltaic currents are present in the field. It thus appears that the ether is a medium with two essential qualities, which are both scalar (like the pressure and temperature of a gas); and the various vectors in terms of which the electromagnetic field is usually specified (*e.g.*, the electric force and magnetic induction), are merely derived from the variation of these two qualities in space and time.

The Inactive Gases of the Atmosphere.—Sir WILLIAM RAMSAY, F.R.S., gave evidence to show that there was no gas lighter than helium in the atmosphere, unless we suppose that that lighter gas can penetrate glass, as helium does, to a slight extent. Professor RUTHERFORD attacked Sir W. Ramsay's method of producing neon by the action of radium emanation upon water. He said that even 1/15th of a c.c. of air would show the neon spectrum. To this Sir W. Ramsay replied that every care had been taken to keep air out of the apparatus. Professor W. N. HARTLEY doubted that lithium was as rare as Sir Wm. Ramsay thought, in comparison with sodium and potassium. Lithium was found in limestones, in dust, in the Bessemer flame, in ordinary pipeclay, tobacco pipes, and a great variety of siliceous minerals, such as the Dublin granites; in Donegal kyanite, which contains 98 per cent. of aluminium silicate; and in asbestos. It was found in dust which fell from the clouds, in volcanic dust, in soot, in flue-dust from chemical works, and in that from copper smelting and refining works. Sir JAMES DEWAR read a communication from Dr. Kamerlingh Onnes on the liquefaction of helium.

The Rapid Electro-analytical Separation of Metals.—Mr. HENRY J. S. SAND gave a demonstration of a process of electro-analysis, in which the principle of very vigorous stirring of the electrolyte has been combined with that of keeping the potential of the cathode under control by means of an auxiliary electrode. It has thus been possible very largely to extend the scope of electro-analytical methods. The following metals have hitherto been studied. First the metals of the silver and copper groups and zinc, *i.e.*, silver, mercury, copper, bismuth, lead, cadmium, and zinc. These metals have all been deposited singly, separated from each other and also separated when all present in the same solution. In the last-named case the quantity of each metal taken varied between 0·10 and 0·15 gramme, and the time for the deposition of each between about ten and fifteen minutes. Secondly, new methods have been elaborated for the determination and separation from each other of antimony and tin. A considerable number of determinations have been carried out in which the metals taken in varying ratios weighed together approximately one gramme. The time for the deposition of the antimony was usually about twenty minutes, that for the tin about eighty minutes. Lastly, the possibility has been examined of securing a purely electro-analytical method for the analysis of an alloy consisting of copper, antimony, lead, and tin, and all the separations required for such an analysis have at the present time been carried out.

Secondary Radiation.—Prof. J. A. MACCLELLAND read a Paper on "Secondary Radiation," dealing with its various types. In the case of the secondary radiation due to β-particles, care must be taken to distinguish between β-particles reflected or "scattered" in the direction of reflection, and truly secondary β-rays liberated by a kind of trigger action upon the atoms of the metal. The latter proceeded impartially in all directions. As regards the secondary radiation of β-particles due to γ-rays,

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it is found that the number of β-particles liberated per atom of the exposed substance varies as to atomic weight. This law applies, at all events, until the higher atomic weights are reached, when the number increases more rapidly, owing probably to the greater instability of the atoms. The work of Bragg and Hackett makes it probable that γ-rays are not ether pulses, but doublets made up of opposite ions, or opposite electrons. In the matter of γ-rays liberated by γ-rays, and the secondary rays liberated by ultra-violet light, there was still much obscurity.

Prof. E. RUTHERFORD gave credit to Prof. MacClelland for having discovered the relation between atomic weight and secondary radiation. He asked whether Prof. MacClelland would describe a particle as "scattered" when it returned upon its own path, and what criterion he relied upon to distinguish primary from secondary radiation. (Prof. MACCLELLAND: Yes. The criterion is chiefly to velocity.) The Hon. R. J. STRUTT confessed himself as being somewhat bewildered by the complexity of secondary radiation. He could not readily conceive how the velocity of secondary rays could be greater than that of the primary. Prof. MACLENNAN said the ionisation method, which was mostly used in these experiments, was a kind of omnibus method, and did not give very precise indications concerning velocity. The magnetic field should be more extensively used for this purpose. In reply, Prof. MACCLELLAND said he hoped the work indicated by Prof. MacLennan would soon be undertaken. The velocity of secondary radiation was less, not greater, than that of the primary. It was evidently due to some "trigger" action within the atom.

The Scintillations of Zinc Sulphide.—Prof. E. RUTHERFORD read a Paper describing his determination of the luminous efficiency of these scintillations. The α-particles, or helium atoms, which produced the effect in the spinthariscope, did so by dissociating the molecules of the ZnS. The recombination of these probably produced the light. He had compared the light on a zinc sulphide screen with a 2-c.p. lamp, and found the screen to have about 0·01 c.p. Knowing the number of α-particles per second and their speed, their total energy could be calculated. On the other hand, the mechanical equivalent of the light emitted was also calculable from Stephan's law. The calculation was very rough, but it indicated a very high efficiency of the light, as high, perhaps, as 80 per cent. In reply to a question, Prof. Rutherford said the spectrum of the scintillations was continuous, and mostly in the blue.

The Boiling Point of Radium Emanation.—Discussing a Paper by T. Royds on the grating spectrum of the radium emanation, Sir JAMES DEWAR said that the boiling point of the emanation could be arrived at by two different methods. By the periodic system, a boiling point of 244° C. abs. (−26° C.) was indicated. By Trouton's law of molecular latent heat, they obtained the value 250° C. abs., showing a fair agreement. Prof. RUTHERFORD said the boiling point must be much lower, as he found the emanation evaporating right down to the temperature of liquid air. Prof. TROUTON said that might be due to slight differences of temperature in various parts of the apparatus.

Rate of Evolution of Heat by Pitchblende.—Mr. HORACE H. POOLE described a determination of this made in the following manner:—A spherical vacuum jacketed vessel with a narrow neck is filled with powdered and carefully dried pitchblende. The neck is filled with cotton-wool and rendered water-tight with sheet rubber, and the whole is buried in ice. The difference of temperature between the layer of pitchblende in contact with the bottom of the vessel and the ice is measured by a sensitive thermo-couple. After about a fortnight this temperature becomes steady, when the heat leakage across the walls of the vessel is equal to the heat generated by the pitchblende. This leakage depends solely on the vessel and on the difference of temperature between inner and outer walls, which is measured by the thermo-couple. The thermal conductance of the vessel is found by substituting water for the pitchblende and determining its rate of cooling. Hence the heat leakage is known, and, knowing the amount of pitchblende present, the heat evolution per gram is found. The thermo-couple is calibrated by placing one junction in finely broken ice and the other in a mixture of broken ice and water, which can be subjected to a known pressure. The deflection caused by the resulting small change of temperature is noted, and hence sensitiveness of couple is found. Using 560·7 grs. of pitchblende in an atmosphere of nitrogen, the temperature finally steadied at 0·0092° C. As the thermal conductance of vessel is 5·8 calories per hour per degree difference of temperature between inside and outside, this corresponds to a heat leakage of 0·053 calorie per hour. Hence heat evolution per gram of pitchblende is 0·000094 calorie per hour. This is about twice the quantity estimated from the known amount of radium present.

Constitution of the Electric Spark.—Mr. T. ROYDS described "Further Experiments on the Constitution of the Electric Spark." The results obtained by photographing on a rapidly-moving photographic film the spectrum of the ordinary oscillatory spark with small self-induction have already been communicated to the Royal Society. The method has now been applied to study the spark when the self-induction of the circuit is gradually increased. On account of the feebleness of the light in these cases it has been found necessary to remove the prisms, photographing directly the image of the slit, in order to avoid the loss of light due to dispersion by the prism. It is still possible under these conditions to differentiate by their character the streamers in the metallic vapour from those in the air. Condensers, whose capacity amounted to about one-third of a microfarad, were charged from a large Wimshurst machine, and the spark of 8 mms. length passed between metal electrodes. Self-inductances ranging in value up to 0·026 henries could be inserted in the circuit. The velocity of the photographic film was about 100 metres per second.

The commencement of the spark is marked by a sudden and almost instantaneous luminosity of the air, showing on the photographs as a narrow vertical line. The duration of the luminosity is not appreciably affected even when the period of the circuit reaches a value of about 2×10^{-4} secs. This initial air discharge does not start quite simultaneously at all parts of the spark length. It is followed by another type of streamers through the air in which the duration is comparable with the interval between the oscillations; in some cases the oscillation is divided into more than one air streamer. After the initial air discharge has passed, the light from the spark is chiefly due to the metallic vapour which is produced. The moment of vaporisation of the metal is simultaneous with the passage of the initial air discharge. The first streamer in the metallic vapour often reaches to the centre of the spark. The slope of this streamer gives the velocity with which the vapour first produced is moving along the line joining the two electrodes. The luminosity of the metallic vapour afterwards consists of streamers starting from the electrodes. At the instantaneously positive electrode the luminosity of the streamers is of longer duration than at the negative; the streamers are not so numerous nor so distinct. There is not, however, the marked difference in the intensity of the streamers at the instantaneously-positive and negative electrodes which was noticed in a previous Paper on the spark with small self-induction. It is again found, however, that at the commencement of the spark, vapour is produced at both the positive and negative electrodes. Dark spaces at the electrodes separate the oscillations of the circuit and serve to measure the period of the oscillations.

The measurements of the photographs show that the velocity of the metallic vapour first produced is smaller in the spark with self-induction than in the ordinary spark. In the case of mercury, for example, the velocity becomes 620 metres per second; the velocities found in the ordinary spark are 1,150 and 940 metres per second for two different types of spectral lines. This is more probably due to a reduced temperature rather than to the supposition that the quantity of metal vaporised is not sufficient in the former case to produce the difference of pressure required to make the velocity of diffusion attain its maximum value. The introduction of self-induction brings out the "arc" lines of the metal. The evidence now obtained that the arc lines are due to, or accompanied by, a lower temperature confirms Lockyer's supposition which forms the basis of his researches on star temperatures.

When the self-inductance of the spark is increased, it is seen that during a single oscillation several streamers start from the electrodes; they are more distinct with magnesium than with lead, bismuth, or mercury. The streamers are too numerous and close together to make useful the supposition that they are due to harmonic overtones of the fundamental period of the circuit. The streamers are found to recur at definite intervals after the commencement of each oscillation of the spark, though they are not invariably present in every oscillation; generally not more than about ten appear in a single complete oscillation. These intervals are the same in different photographs of the spark under the same conditions, but the individual streamers are not always reproduced in the same oscillation in different photographs.

Position of the South Pole.—Mr. L. C. BERNACCHI presented a contribution on the results of some physical observations taken on the National Antarctic Expedition by the *Discovery*, 1902-1904, in lat. 77° 50′ 45″ S., long. 160° 44′ 30″ E. The magnetic and other physical observations conducted on the shore close to the ship extended over a period of nearly two years. The *Discovery's* "winter quarters" were to the south-east of the south magnetic pole, the mean absolute declination being about 152° E. From the photographic records by the Eschenhagen magnetometers the general character of the regular diurnal variation of declination is clearly shown, the movement being five or six times as large as that at Kew; even during the months when the sun is continuously below the horizon, the diurnal range remains large—at least double that at Greenwich at midsummer. The seasonal change in the type of the diurnal variation is very small. In temperate climates generally the changes of declination during the day are conspicuously larger and more rapid than during the night. At the "winter quarters" there was no such marked difference. The horizontal force at the "winter quarters" was about a third of that at Kew, but the range of the diurnal inequality about 50 per cent. greater than at Kew. The type also varies very little with the seasons, and is totally different to that at temperate stations.

Vector diagrams have been made for the "winter quarters" for the whole year, and for the seasons midwinter (May to July), equinox (March, April, September, October), and midsummer

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(November-January). The differences between these diagrams and the vector diagrams for Kew and Falmouth are remarkable. There is much less asymmetry than in England, the direction of motion is anti-clockwise, and there is very little difference in type for the different seasons. The most striking peculiarity in the diurnal inequality in all the elements is the large size of the fundamental or 24-hour Fourier "wave" as compared to the harmonics of shorter period. In order to determine the position of the south magnetic pole by means of all the declination observations taken at the "winter quarters," sledge journeys, and at sea, the results have been plotted (by Captain L. W. P. Chetwynd, R.N.) and the direction of the magnetic meridian as indicated by the observations extended towards the magnetic pole. These lines of direction intersect within a space triangular in form. The radius of the circle inscribed in the triangle measures about thirty-eight geographical miles, and the centre of the circle indicates the probable position of the pole, and is in lat. 72° 50′ S., long. 156° 20′ E. All the inclination results were plotted on a chart and lines of equal inclination drawn, from which the probable position of the pole is indicated to be in lat. 72° 52′ S., long. 156° 30′ E. The agreement between this position and that determined by the declination results is remarkable, and may be considered as corroboration of the results.

A report on the magnetic observations at the Falmouth Observatory was presented by the Committee, consisting of Sir W. H. Preece (*Chairman*), Dr. R. T. Glazebrook (*Secretary*), Prof. W. G. Adams, Dr. Chree, Captain Creak, Mr. W. L. Fox, Sir A. W. Rücker, and Prof. Schuster. The mean values of the magnetic elements for the year 1907 were:—Declination, 18° 0′4 W. Horizontal force, 0·18799 C.G.S. Vertical force, 0·43330 C.G.S. Inclination, 66° 32′·7 N. The observatory at Eskdalemuir has only commenced work during the current year, so that comparative results are not yet available, while the disturbances due to electric traction in the neighbourhood of London have a natural tendency to increase.

The Photometric Standard of the National Physical Laboratory.—Dr. R. T. GLAZEBROOK, F.R.S. (Director of the National Physical Laboratory), contributed a Paper upon this standard. It had been shown by Mr. Paterson in 1904 that the relation between the candle power of the 10 c.p. Vernon Harcourt Pentane Standard at the laboratory and the humidity of the air is given by the equation, Candle-power $=10+0{\cdot}066(10-e)$, where e is the amount of moisture present measured in litres per cubic metre of air, so that the standard condition is when 10 litres of moisture are present and the lamp has its nominal value 10 c.p. In Mr. Paterson's experiments the quantity e was measured (in nearly all cases) by an ordinary wet and dry bulb thermometer, and the observations reduced by the usual formula.

At the Reichsanstalt an Assmann ventilating hygrometer is employed for the purpose, and the International Commission on Photometry recommended at Zürich the use of some ventilating hygrometer. This has led to a comparison of the two kinds of hygrometer in the still air of the photometer room, with the result that it has been shown that the ordinary wet and dry bulb instrument gives results some 20 per cent. higher than the Assmann. The standard humidity, then, in the previous experiments, when measured by the Assmann, was 8 litres (not 10) per cubic metre, and Mr. Paterson's formula becomes: Candle-power $=10+0{\cdot}066(8-e)$.

The present Paper discussed the question whether, since a change has to be made, it is desirable to retain the standard humidity at 10 litres, measured by the Assmann, and in consequence to change the light value, at any given humidity, of the National Physical Laboratory standard lamp by about 1·3 per cent., or whether it is preferable to retain the light value and change the standard humidity. The latter alternative is recommended. In this the gas referees concur. The changes which are involved, in consequence, in the value of the ratio of the Pentane candle to the Hefner candle, and to the Bougie decimals are considered, and it is shown that, adopting as the basis of comparison the results arrived at by the Commission at Zürich, and altering the standard value of the Pentane candle to 8 litres humidity, the Pentane candle and the Bougie decimale become practically equal, and each is equal to nine-tenths of the Hefner.

The practical consequences of this were first pointed out to the author in a letter from the Bureau of Standards of America, and he hopes that they will be thought sufficient to lead the International Gas Commission to consider the question of the change at their next session.

Manufacture of Parabolic Reflectors.—Mr. SHERARD COWPER-COLES described his method for the production of true metallic surfaces for parabolic reflectors, in which the mirrors are deposited electrolytically on a carefully ground glass mould. The preparation of this mould is a long and costly operation, but when once prepared the reflecting surface can be reproduced in metal any number of times at a fraction of the cost, thus enabling mirrors of a true parabolic curve to be manufactured at a very cheap rate. The mould is coated with a thin film of silver on the convex side by a chemical process, and mounted in a metallic ring, which makes contact with the silver film, and is then suspended with the convex side downwards on a spindle, placed above an electrolytic cell for depositing copper. The spindle is rotated at 5 to 10 revolutions per minute, whilst the copper is being deposited on the silver coating until a sufficient thickness has been obtained to give the necessary rigidity. The glass mould and copper deposit is then placed in warm water and gradually heated until the expansion of the copper causes it to leave the glass mould. The mirror thus produced has a surface as highly polished as the glass, and of exactly the same curvature. A silver-faced mirror thus produced would tarnish and be scratched too readily for practical purposes, so it has to be faced with some harder untarnishable metal or alloy. The metals usually employed for this purpose are platinum, palladium, or an alloy of silver and cadmium, which are deposited in a bright form. The process was also described in ELECTRICAL ENGINEERING, Vol. III., p. 550, in which some additional information will be found.

Reference is made to other Papers on electrochemical subjects under "Electrometallurgy and Electrochemistry," on p. 435.

TRAMWAY STRIKES IN AUSTRALIA AND NEW ZEALAND

IN the course of an article published on Friday from the *Times* Australian correspondent upon labour troubles in Australia, the following particulars are given of the recent tramway strike in Sydney:—Sydney's tramways are a Government enterprise under the control of the Railway Commissioners. The system is overhead electric; the drivers are mainly married men, the conductors more usually young bachelors, often sons of country farmers who prefer a less arduous life in the city. Both classes had grievances. The drivers complained that they must run their open-fronted cars through all weathers, and that none but the strongest could get through a winter without the doctor's help. The conductors were irritated beyond measure at a system which tested their honesty by sending plain-clothes detectives as ordinary passengers, and comparing in the central office the tickets they obtained with the record of those the conductors ought to have issued—this being supposed to detect cases in which a conductor might dishonestly reissue a used ticket and pocket the fare. Theoretically the system is a fair one, however much prejudice may be created against it by calling it espionage. In practice it has many defects; and not long ago a conductor who had been dismissed for reissuing used tickets was lucky enough to obtain convincing evidence of his honesty, and was reinstated accordingly. This threw grave doubt on the efficacy of the system in actual practice; and when a second conductor (Croucher by name), with an admittedly admirable record for good conduct during many years' employment, was dismissed on a similar charge, on the evidence of two young constables who had quite recently abandoned farm labour to join the police, there was great and sustained indignation throughout the tramway service. Mass meetings demanded Croucher's reinstatement and the abolition of the system. The new Chief Commissioner was sympathetic. He retried Croucher's case, but upheld the dismissal (one cannot but remark in passing that, when the evidence was published in full, it did seem as if Croucher might well have been given the benefit of the doubt). He admitted the weaknesses of the espionage system, inviting suggestions for its reform, promised that no more dismissals should occur meanwhile. But "Croucher" had become the tramwaymen's Shibboleth; his final dismissal was the signal for a strike. Of a sudden Sydney found itself forced into using legs that had almost atrophied. For two days—two fine days—the situation was accepted almost jocularly; and then came the rain. The rain is not over yet—but the strike is. The reason, the *Times'* correspondent states, is that the railway employees refused to join the movement.

A similar difference of opinion took place early in the summer between the employees of the Auckland Electric Tramways Co. and the company itself, a strike being ordered by the Auckland Electric Tramways Industrial Union of Workers. The reason in this case was the dismissal of a conductor, without any reason being assigned. There was an absolute deadlock, both sides refusing to give way. The matter therefore went to the arbitration of a special Conciliation Board, which has now issued its award, entirely in favour of the men. The recommendations of the Board are:—(1) That Conductor Herdson be reinstated in his position. (2) That the general manager shall give a written guarantee that in future any employee being dismissed from the service shall be given a valid reason for his dismissal. (3) That any employee being sent to the head office for an alleged fault shall see all reports made against him, and have the right to call evidence on his behalf. (4) That any inspector proved guilty of making mis-statements of false reports against employees shall be instantly dismissed. (5) Seeing that Mr. Lysaght's (the traffic manager) questionable methods were the real cause of the strike of November, 1906, and that the recent harassing of motormen and conductors by ticket inspectors has been in obedience to his instructions, he shall be removed from direct contact with the men. (6) The Board directs that the foregoing recommendations shall take effect from the first day of September, 1908, and shall continue in force until the 31st day of August, 1910. The result is viewed with some consternation by employers in New Zealand, and may be taken as an indication of the growing power of the Labour Party there.

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ELECTRIC VERSUS STEAM TRACTION AND RAILWAY PROGRESS

IN a recent issue of the *Bulletin de l'Institut Electrotechnique Montefiore*, was published an essay presented by M. Pavlitzky to the Fourth Russian Electrotechnical Congress, held at Kieff, dealing very fully with the comparative value of electric and steam traction on main line railways, under modern conditions. M. Pavlitzky postulates that:—"The principal aim of modern railway practice is to diminish the cost of transport per ton mile, and at the same time to increase the carrying capacity. Only electric traction permits the attainment of that aim, thanks to its unlimited power, and to its facile adaptation to the variable conditions, and the increasing necessities of traffic." He follows up this proposition with the remark: "We must note that the discussion of the economics of electric traction should be made independently of the existing organisation and working of existing railways."

Pointing out that the conditions under which it is generally admitted that electric traction is superior to steam traction are those presented by short lines requiring a frequent service and a considerable number of trains, and where running times must be reduced to a minimum, the author proceeds to recount the usual objections to the wider application of electric traction, most of which he considers are fully met by the general admission of railway and electrical engineers that it is purely a commercial question, resolving itself into a justification of the heavy capital expenditure required. This justification requires a complete study of the whole extent and consequences of electrical working as contrasted with those of steam working, and especially the recognition of the most important and essential quality of electric traction, viz., its power of increasing the carrying capacity of a railway, and reducing the cost per ton mile of the traffic on it.

The propositions to be proved may be stated thus:—(1) To show that the characteristics of the electric locomotive meet the requirements of railway managements; and (2) to examine the general and special conditions applying to the movement of heavy trains, which must be satisfied by the electric locomotive.

The modern requirements and tendencies of railway working are best shown by the recent developments in the United States, which possesses more than a third of the total railway mileage of the world, and where the rate of development has been 50 per cent. greater than in Europe, with, as yet, no signs of falling off. But in both Europe and America the tendency is to increase the power of the steam locomotive, with the object of getting from it the greatest possible number of ton miles. To this end the locomotive must be powerful, require little attention, and infrequent repairs or stoppages. These requirements are conflicting, because power depends upon steaming capacity, and increased steaming capacity necessarily entails more labour, more repairs, and more stoppages. Contrasting the different methods by which European and American engineers have sought to give the steam locomotive the power and other qualities needed to deal with the increased intensity of traffic, it is evident to the author that the limit to the capacity of the steam locomotive is already in sight, and that to provide for the necessary continuous development of railway traffic it is essential that the substitution of electric traction should be considered.

The tendency to increase the speed and weight of trains, and to utilise the track and rolling stock to the greatest advantage, shows itself in all branches of railway construction, and it appears that the limits of steam traction are already in view, and are closely approached on some of the important main lines, both in America and Europe. We may add that the financial results of railway operation in the United Kingdom, at least, indicate that existing methods do not satisfactorily meet modern conditions, and that railway managements, when they have found the limits of the advantages of amalgamations and similar nostrums now fashionable, will have to turn their attention to more fundamental improvements. Our author infers that the development of traffic requirements in the directions of higher speed, greater utilisation of the track, heavier paying loads, and cheaper transport will persist, and that as steam traction has reached its limit, it must give way to something superior. The alternative is to suppose that railway transport has reached finality, and that no improvement is possible.

As the ultimate limit to the economical capacity of a railway is prescribed by the power and other qualities of the locomotive, a general comparison between the peculiarities of steam and electric locomotives defines the character and extent of the improvements which are potentially attainable by the substitution of electric for steam traction.

This sentence gives the key of the author's argument, and, as applied to railways upon which the density of traffic is already great, or on which a greater amount of traffic cannot be economically handled by steam without great expense in the doubling or improvement of lines, the argument is difficult to refute.

He shows in considerable detail that while the power of a steam locomotive is limited, in effect, by the steaming capacity of its boiler, and that the limits are already attained, the power of an electric locomotive is only limited by that of the station supplying it, and that instead of providing many different types of locomotives to suit different services, and more or less difficult sections of line, the electric locomotive lends itself to standardisation and to the application of power as and when it is needed by the adaptation of the multiple unit system. The efficiency of the electric locomotive considered as a motor is greater than that of a steam locomotive; it utilises the whole of its weight, or even some of the live-load weight, for adhesion; it can be built with no longer rigid wheel base than that of the train vehicles; the tractive effort distributed over a larger number of wheels, and applied by a steady rotary motion, instead of one subject to the effect of reciprocating masses, is greater per ton of axle load, and applied with less severe stresses upon the track and structures than that due to a steam locomotive; the power used in propelling the locomotive itself is very little in excess of that required by a similar weight of ordinary vehicles, whilst the steam locomotive requires from two to three times the pull per ton of total weight.

Considering these advantages as to the power available and better running qualities, the author suggests that in the construction of new railways, especially in mountainous districts, considerable economy will be possible by the adoption of shorter routes, with more severe gradient and curves than are advisable on a steam line, and that existing railways on which gradients and curves limit the capacity or increase the working expenses unduly, may receive a fresh lease of life by electrification, instead of by the much more costly process of improvement of alignment and profile.

It is admitted that weight for weight the steam locomotive is cheaper than the electric locomotive, but such a basis of comparison is evidently erroneous; power for power the positions are reversed, and when the annual carrying capacity and mileage, the small cost of labour, repairs, and maintenance are taken into account, it is claimed that a much smaller capital expenditure in locomotives is needed for a given traffic capacity on a given line. The author goes so far as to suggest that to provide for a very heavy traffic the whole electrical equipment of a railway may cost less than the provision of steam locomotives, but wisely remarks that it is idle to give general figures when every case must be worked out by itself.

Coming to the crux of the question—capital cost—the author believes that in many cases of new lines the total cost of construction and equipment may be less, or at least not exceed that for steam traction. Towards this he points out that the track may cost less, that expenditure on engine sheds and shops will be less, that less rolling stock will be needed, because it will be better utilised, and that there will be many other details in which economy will be found possible. But there will be many cases in which the first cost will retard electrification, though it will not lead to its ultimate rejection. In the electrification of existing lines the capital expenditure involved is more serious, and whether for new or existing lines the question in every case is whether electric traction will offer advantages which will cover the interest and sinking fund charges upon the first cost. The author has no hesitation in giving an affirmative answer, providing that on an existing line the electrification permits of a required increase of traffic with which steam traction cannot deal. He points to the statistics obtained from, *e.g.*, the Valtellina line, as confirming his optimism in respect to working cost and increased carrying capacity, and to the considerable amount of railway electrification which has occurred, and is still in progress, as showing that responsible authorities agree with him.

The conclusions arrived at are not materially different to those which have influenced the electrification of urban and other passenger railways, where the traffic demands could not be economically met by steam traction; the fresh aspect put forward is that similar considerations call for the electrification of lines carrying heavy traffic and suffering from congestion or otherwise worked up to their economical limit. The method of arriving at this conclusion from a consideration of the fundamental properties and differences of the steam and the electric locomotives is novel, ingenious, and convincing, but, like most arguments of the kind, its application to any particular case resolves itself into a quantitative question—How much expendi-

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ture, how much increased traffic capacity, how much saving in working expenses? The hardened railway manager will also ask: How much extra traffic shall I get? even if the answers to the other questions are satisfactory, and that may be the hardest question of all to answer in a definite way. The answer available is by analogy, and the records of railway traffic supply a sufficient basis, if properly considered. Increased facilities, reduced rates, greater expedition, induce goods traffic just as surely as they do passenger traffic. Congestion of goods and mineral traffic is frequent on most of our heavy lines; there have been numerous instances during the last few years of railway companies being unable to handle the traffic offered them, and the comparatively poor dividend results reaped from the manufacturing boom of the last three years is largely accounted for by the extraordinary expenditure needed to work systems much beyond their economical capacity. A great deal of capital has been spent in providing relief lines, doubling lines, enlarging sorting yards, as well as in providing locomotives and rolling stock, which would have been better spent in increasing the effective use of the existing lines and material, had the means been at hand. It is in this direction, as our author points out, that electric traction promises improvement, financial as well as technical, sufficient to justify the capital expenditure.

ELECTROMETALLURGY AND ELECTROCHEMISTRY

THERE was not very much in connection with electrochemistry at the meeting of the British Association in Dublin. Professor Armstrong, however, introduced a discussion upon the Ionic Theory. As is his custom, he condemned it and physical chemists in general. He started by saying that the assumption of independent ions in solution had not been experimentally proved, and he did not believe that hydrochloric acid, for example, was dissociated in aqueous solution into H cations and Cl anions, but that in contra-distinction to dissociation there is an association between the water molecules and hydrochloric acid. He would therefore write hydrochloric acid in solution:—

$$H_2O\langle^{Cl}_{H},$$

and he considers that when an E.M.F. acts, be it ever so little, it is sufficient to break down this unstable molecular complex, and then the chlorine will be carried to the one pole and hydrogen to the other. He likewise affirmed that there was no proof and no probability that water itself was to a certain extent dissociated into H and OH ions. The physical chemist argues that there are a certain number of such ions even in pure water. Armstrong says, "get your water pure and it will be an absolute non-conductor." But the hydrolysis of salts is under modern theories attributed to this very dissociation. It cannot, however, be stated that his arguments, although interesting, were very convincing. In any case, the dissociation theory has proved an extremely useful ground for research, and physical chemists have undoubtedly very much enlarged our knowledge of the internal structure of things. The word "ion," however, always arouses the fury of Prof. Armstrong; as he once said, someone remarked, "let there be ions, and there were ions all over the place." We all know that all acids contain hydrogen, and very often in referring to the strength of an acid one refers to the number of hydrogen ions in a solution. But Armstrong says there are no ions, but that all acids are produced by the union of something with water, but as water contains oxygen, therefore the original name for oxygen—which means acid producer—is correct. In the discussion which followed, Sir Oliver Lodge remarked that physicists had no objection to imagining hydration of ions. They also had no particular objection to the formula for hydrochloric acid in solution which had been put upon the board, only they would rather imagine in place of one molecule of water the union of a very large number, which would then cause the hydrochloric acid to be in such a state of instability that the least E.M.F. would break down the complex and allow the current to pass in. Armstrong was getting nearer to the physical chemist than he had ever done before. Sir William Ramsay remarked that as all mention of electrons had been omitted it was hardly possible to discuss the question because chemists looked upon ions as being a collection of electrons. Prof. Armstrong considered that this only added to the confusion. Other speakers wanted to know how Prof. Armstrong explained conduction in fusion salts, but on this point discreet silence was maintained.

The only other papers of interest to electrochemists were two upon "Rapid Electro-deposition of Metals for Analytical Purposes." One was by Dr. H. S. Sand, which he illustrated by means of apparatus, showing how copper can be deposited out within the space of a very few minutes. The other one was by Dr. F. M. Perkin, and Mr. W. Hughes and Dr. Perkin showed two new forms of apparatus for the same purpose as that of Dr. Sand. In the one case a rotating cathode in the form of an elongated thimble is used, a platinum gauze cylinder acting as anode; and in the other case a spiral anode of platinum is employed, and a gauze cylinder serves as cathode. It was also shown how this apparatus could be used for depositions by means of the graded potentials when an auxiliary electrode is employed to maintain a constant potential.

The problem of the utilisation of peat in places such as Ireland, where it is found in such enormous quantities, is one of primary importance. The difficulties, however, have always been, how can the peat be used in such a manner that no large expenditure shall be required to prepare it? Of course, air-dried peat can be burned as fuel for domestic purposes, but only a small portion of it can thus be employed, and, furthermore, there are certain disadvantages in its employment for this purpose. For many years past, therefore, attempts have been made to utilise the energy stored up in peat for power purposes. The difficulty met with, however, has been the large percentage of moisture which even air-dried peat contains. "Peat and its Utilisation" was the subject of a Paper read by Capt. H. R. Sankey before the British Association. This Paper was abstracted in last week's ELECTRICAL ENGINEERING, page 393, and the discussion on it will be found on p. 396 of the same issue. A Paper was also read by Dr. Woltereck in section B. It is hoped in the near future to employ peat for the manufacture of gas for power purposes, and also for the manufacture of calcium carbide, and then to employ the calcium carbide for making cyanamide. Experiments which have been conducted with a Mond generating plant show that one metric ton of peat containing from 42 to 47 per cent. of moisture will produce 2,800 cubic meters of gas, which contains from 36 to 39 per cent. of combustible products; and the gas yielded from turf containing from 65 to 70 per cent. of moisture contains 28·6 per cent. by volume of combustible gases. Such gas can very well be employed for driving gas engines. Taking the better quality peat, it is found that 2·4 cubic meters of the gas will generate one effective horse-power; therefore, one ton would generate 1,150 h.p. Taking 1,000 h.p. as the amount actually obtained, one ton of this peat would fix from 16 to 20 kg. of atmospheric nitrogen in the form of nitric acid, or 50 kg. in the form of cyanamide. Now, over and above the gas power which can be obtained, there is an extremely useful by-product produced at the same time, namely, ammonia. The amount of ammonia obtained depends upon the quantity of nitrogen in the original peat. For example, from a sample which contained 1·05 per cent. of nitrogen, 40 kg. of ammonium sulphate were obtained by burning one ton of it in a generator. In Stockton, peat containing 2·85 per cent. of nitrogen was employed, and 110 kg. of ammonium sulphate were produced from the ton. Good dividends are being earned by some Swedish works, and if it can be done, there seems no reason why it should not be a success in Ireland.

In *Electrochemical and Electrometallurgical Industry* of September there is a useful article upon the "Electro-deposition of Nickel," by Dr. E. F. Kern and Mr. F. G. Fabian. This article is really a *résumé* of methods employed in the electroplating of nickel. The authors have investigated the methods, and have arrived at the following conclusion. The most generally employed electrolyte is a solution of nickel-ammonium sulphate, which may be neutral or slightly acidified with a feeble acid, such as boric, phosphoric, benzoic, acetic, tannic, tartaric or citric acid; it may also contain alkali salts of these acids. The addition of the acid is for the purpose of dissolving basic salts of nickel which are caused by oxidation at the anode. An excess of acid, however, causes evolution of hydrogen, which produces spongy or non-adherent deposits. Electrolytes containing nickel-ammonium phosphate are used to less extent than those containing nickel-ammonium sulphate. In exceptional cases electrolytes containing nickel chloride and nickel-potassium cyanide have been employed. The presence of boric acid in nickel electrolytes not only keeps the solution clear, but also causes the formation of a smoother and less brittle deposit than when none is present. The amount used varies between 1·5 to 30 grams of boric acid per 100 c.c. solution. Nickel deposits formed from nickel-ammonium sulphate electrolytes are harder, smoother and more durable than those obtained from chloride electrolytes. The addition of 5 to 10 grams of sodium chloride per 100 c.c. of nickel-ammonium sulphate electrolyte reduces the E.M.F., and also causes the deposit to form more reguline, more adherent, and tougher, and the anode to dissolve more uniformly. Pure nickel anodes are less readily dissolved than those which contain iron, copper, tin, &c., unless the electrolyte contains chloride. Rolled sheet anodes are less readily dissolved, and require a higher E.M.F. than cast anodes. Rough cast anodes require less E.M.F. and are more uniformly dissolved than smooth, polished cast anodes, or sheet nickel anodes. The solution which is used for recovering nickel from nickel-copper mattes or alloys is

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either dilute sulphuric acid or dilute hydrochloric acid. The copper in either solution is reduced below 1 per cent. by electrolysis, and finally completely removed chemically. The purified solution is rendered alkaline, filtered to remove precipitates, and the nickel recovered by electrolysis in suitable cells, using a lead anode for the sulphate solution, and a graphite one for the chloride solutions. There is a difference of opinion as to the cause of reguline, adherent deposits of nickel; some electrometallurgists claim that the most satisfactory deposits are from alkaline electrolytes, whereas others say that the electrolyte must be acid. The general opinion, however, is that non-adherent deposits are due to the electrolyte being too acid, the temperature of the electrolyte being too low, or else the cathode is not clean. Pulverulent deposits are due to too high a current density, too high an E.M.F., and too acid an electrolyte. Conditions which favour solid adherent deposits of nickel are slightly acid electrolyte, to prevent formation of basic salts, pure electrolyte, gas-free electrolyte, temperature between 40° and 65° C.; constant current density; low E.M.F.; efficient circulation; clean cathode; and concentrated electrolyte. The tendency of nickel deposits to curl is greatest with high-current density, said to be due to formation of nickel hydride, which is the result of greater liberation of hydrogen with high current density and high E.M.F. Messrs. Kern & Fabian consider that "the conductivity of an electrolyte varies directly as the weight of salt in solution, and the more concentrated the electrolyte the more satisfactory the deposit."

THE PACIFIC CABLE

THE Chairman of the Pacific Cable Board, in his annual report upon the accounts of that undertaking for the year to March 31st, 1908, states that the Board have to deplore the loss of their Chairman, Sir Spencer Walpole, K.C.B., who died very suddenly on July 7th, 1907. He was the first occupant of the post, having been nominated to it by the Pacific Cable Act, 1901; and the ability and zeal with which he discharged his functions were very fully appreciated by his colleagues, and earned for him their high regard. Since the close of the year, the Board have sustained another severe loss in the death of Mr. C. H. Reynolds, C.I.E., who, from the commencement of the enterprise, has served them most faithfully and efficiently in the capacity of general manager. He died on May 21st, 1908, at Lisbon, where, though already suffering severely from the malady which caused his death, he had gone to represent the Board at the International Telegraph Conference.

The financial results of the year 1907–8 are set forth in the following statement:—

RECEIPTS.

	£	s.	d.
Traffic Receipts	113,548	18	1
Less Atlantic Companies' charge for conveying date and time, and for delivering duplicate copies in London and other large centres in United Kingdom	3,911	13	0
Interest on deposits	522	17	3
Deficiency recoverable in the following proportions:—			
United Kingdom	17,322	18	4
Canada	17,322	18	4
Australia	20,787	10	0
New Zealand	6,929	3	4
	£172,522	12	4

EXPENDITURE.

	£	s.	d.
Fifth Annuity payment	77,544	18	0
Head Office (salaries and expenses)	4,345	9	1
Head Office (advertising, canvassing, engineers' fees, royalties, and cost of remitting money home)	1,596	12	7
Stations (salaries and expenses)	38,764	16	1
Ship (salaries and expenses)	16,759	12	11
Provident fund	1,511	3	8
Renewal account	32,000	0	0
	£172,522	12	4

As compared with 1906–7, there was a falling off of £2,852 15s. 2d. in the gross traffic receipts: but of this the greater part (from £1,800 to £2,000) is apparent only, not real, the accounts for 1906-7 having included the receipts at Southport for 13 months, while those for 1907-8 include only 12 months' takings. As regards the remainder of the decline, it may be observed that the message revenue of 1906-7 was enhanced by the increase of business resulting from various circumstances, viz., the earthquake at San Francisco, interruptions to the Eastern Extension Company's cables, and the general prosperity of trade; whereas during 1907-8, the cable has had to contend against adverse conditions of trade resulting from the panic in America of last summer and autumn, and other unfavourable influences. The only set off against these was an increase of traffic which resulted from a week's interruption of the Eastern Extension Company's Cocos Island cable in August last, and taking all the circumstances of the two years into account, it may be considered satisfactory that the revenue of the cable has been maintained so well as it has been.

On the expenditure side of the account there has been an increase, as compared with 1906-7, of £4,082 13s. Of this, £2,027 16s. was due to the insurance which it was decided during the year to effect on the Board's cable ship; but under the terms of the contract with the underwriters a considerable rebate is claimable for periods during which the vessel remains in harbour, and on this account, nearly one-half of the premium will probably be eventually recovered. The remainder of the increase is attributable to various causes, such as the normal growth of incremental salaries, the increase in the charges for officers going on leave now that the staff has had some years of service in the tropics, and the fact that the accounts include the cost for a whole year, instead of for nine months only, of the new offices opened in Sydney and Melbourne in 1906.

Exclusive of the annuity payment of £77,544 18s. covering interest and sinking fund on the capital advanced by the National Debt Commissioners, the expenditure on the maintenance and working of the cable during the year, including the sum of £32,000 carried to the renewal account, and the sum of £1,511 3s. 8d. contributed to the provident fund, amounted to £94,977 14s. 4d., or £15,182 8s. less than the net revenue earned by the cable. The annuity to the National Debt Commissioners absorbs this surplus, and £62,362 10s. in addition, which has to be made good by the several Governments associated in the enterprise.

The total contributions to the renewal fund, including interest, amounted on March 31st last to £198,836 12s. 11d., £12,500 of this sum being held in spare cable. The amount of £177,691 12s. 11d. is invested in home and colonial securities as shown in Statement VI., while a balance of £8,645 was in hand, and has since been invested. All interest earned on the investments is added annually to the fund, and is not treated as part of the revenue of the year.

The Board's forecast of its probable revenue and expenditure during the year 1908-9, as submitted to their Lordships on December 20th last, is as follows:—Traffic revenue, £108,000; estimated deficit, £69,566, making a total of £177,566. The expenditure is estimated as follows:—Sixth annuity, £77,545; renewal fund, £31,000; working expenses, £69,021.

The land line services in Australia and New Zealand, in connection with the cable, have been generally well maintained by the Governments concerned. The Atlantic companies have afforded uninterrupted cable communication throughout the year, and a rapid and efficient service. In Canada, the lines of the Canadian Pacific Railway, both in Vancouver Island and elsewhere, suffered considerable interruption, first from bush fires and unusual electrical disturbances in July, August, and September, and later from severe storms in November and December. In the latter month, a gale occurred in Vancouver Island which is said to have been the worst on record in that region, and caused an interruption of over 70 hours, all the wires having been thrown down. In August, moreover, the traffic, more especially that to the States, was considerably disorganised by reason of the strike of telegraph operators in Chicago, and the sympathy it excited amongst those employed by the Canadian Pacific Railway.

The health of the staff has been satisfactory throughout the year, and the service rendered by them has continued to be maintained on the high level of efficiency and zeal which has characterised it in previous years. Throughout the year the cable has worked without interruption, and no repairs have been called for. The buildings, electrical apparatus, and plant, at all stations, have been maintained in good order. No damage has occurred to the repairing vessel "Iris," and the discipline and efficiency of the ship's company have continued to be thoroughly satisfactory. The wharf and shed, which the New Zealand Government undertook to provide for her use at Auckland, were completed by January of this year, and permanent moorings for the vessel are now in course of being supplied. These works will be of much benefit to the safety of the ship, and to the comfort and convenience of her crew, and the Board feel greatly indebted to the New Zealand Government for the liberality with which they have given this valuable assistance.

The number of messages transmitted during the year was 105,189, against 97,818 for the previous year, and the number of words, 1,250,345, against 1,128,662. Both these figures represent the highest point yet reached by the Board.

In addition, a very considerable Intercolonial traffic is carried between Australia, New Zealand, and the Fijis, keeping the Southern sections of the cable fully occupied during business hours.

The Paris Strike.—In connection with the strike of the employees at the electricity works a short time back (ELECTRICAL ENGINEERING, August 13th, p. 238), M. Pataud (Secretary of the Electricians' Union) has been sued by three music-hall artistes for damages on the ground that they were unable to give their performances. A nominal fine of 8fr. in each case was ordered.

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THE NATIONAL TELEPHONE EMPLOYÉS' GRIEVANCES

THE National Society of Telephone Employés issued the following statement to the *Daily Telegraph* and other papers on Monday:—

A very grave crisis has arisen in the telephone world, owing to the action of the National Telephone Company (Ltd.), in dismissing thousands of their employés on the ground of reduction of staff.

As is now well known, the Government have entered into an agreement with the National Telephone Company for the purchase of the latter's undertaking, or such of it as the Post Office require, at the expiration of the company's licence in 1911. When the agreement was ratified by the House of Commons in August, 1905, Lord Stanley (now the Earl of Derby), the then Postmaster-General, assured the House that all efficient servants of the company should be taken into Government employ under certain conditions. As things are at present proceeding, there will be but few of the company's staff left in 1911 to take advantage of this promise.

The reason for these increasing and wholesale dismissals is fairly obvious. The company, owing to its life being limited to three more years, will not expend capital upon which it cannot see the return of the outlay and a margin of profit by the end of that period. Hence orders for telephones are being refused by the hundred, and men who should be employed in the construction of lines are thrown idle, to swell the already overcrowded labour market. The responsibility for this state of things lies with the Government, who, by their action in ending the existence of the National Telephone Company, are stopping the legitimate growth of the telephone industry. That a serious state of affairs is created is obvious from the fact that already the number of men discharged approaches 1,000, and it is stated on the authority of high officials of the company that 6,000 men will be discharged prior to 1911.

Men who have had seven, ten, and up to twenty-five years' service with the Telephone Company have received their discharge notices, and after having spent the best years of their lives in the telephone industry, are thrown idle without the possibility of obtaining employment in their own field. It must be remembered in this connection that the telephone industry is practically a Government monopoly, and whereas men discharged in other walks of life have the opportunity of obtaining work with employers of the same nature as those by whom they were discharged, the telephone man has no alternative employer.

The remedy lies with the Government, who are pledged to deal with the unemployed question, yet are directly or indirectly responsible for its aggravation in the manner indicated. The Government can either take into their employ the men discharged by the company, and construct the lines which the company are daily refusing, or they can, by financial assistance, keep going the constructional works which would be carried out by the National Telephone Company but for its transfer to the State, and thus give employment to the men who are now being discharged. For every telephone subscriber who is connected now is a potential asset to the Post Office.

The question of economy which was pleaded in the case of the Woolwich discharges cannot now be raised, as the work is of a remunerative nature; so much so, that the National Telephone Company were able to realise a profit of £480,641 during the past half-year, a sum which is £40,661 in excess of a similar period in 1907, and which enables the company to pay a dividend of 6 per cent. for the half-year on all its stock, and add £140,000 to the reserve fund, making its total £2,664,960. The only reason which causes the company to refuse orders is its inability to see a profit in the three years it has still to exist. This fear, however, does not apply to the Post Office, who are masters of the situation, and who would be undertaking profitable work were they to accept the orders which the company are refusing, and to employ the men who are at present being discharged for the construction of the lines.

The following correspondence has since passed between the editor of ELECTRICAL ENGINEERING and the Society:—

"ELECTRICAL ENGINEERING,"
203-6 TEMPLE CHAMBERS,
LONDON, E.C., *Sept. 14th*, 1908.

The Secretary,
The National Society of Telephone Employees,
4 Great James Street, W.C.

DEAR SIR,—I notice that a statement has been circulated to the daily papers, and published this morning, to the effect that nearly one thousand men have been discharged from the service of the National Telephone Company, and that six thousand men will be discharged prior to 1911, when the Company's licence expires. From the wording of the statement, it is not clear to me whether the object in issuing it is to ventilate a grievance against the Company, or to make an actual endeavour to replace in work the discharged men. If the latter has been the case, however, I am somewhat surprised that the statement should not have been circulated to the electrical engineering journals which are read by the heads of technical departments likely to employ such workmen. If, however, the latter is really the true reason of your publishing the statement in question, I should be obliged if you will give me information on the following points, in order that I may publish it in our issue of this week:—

1. How many men of each trade and from each district have been discharged?
2. The period during which nearly one thousand men have been dismissed is not mentioned in the statement. This is a material point, and I should be glad to be informed with regard to it.
3. How many men were discharged during the corresponding period of last year?
4. Has any other reason been given for these discharges other than slackness of work?
5. What is the actual authority for the statement that "6,000 men will be discharged prior to 1911"?
6. Your statement says that "orders for telephones are being refused by the hundred, and men who should be employed in the construction of lines are thrown idle." Can you give me any figure to substantiate this, for the statement hardly appears to agree with that made by the Secretary of the National Telephone Co. on the occasion of the last staff dinner of the Company, in which the increase in the number of telephone stations during the previous twelve months was quoted. Perhaps you can give me the number of additional telephone stations that have been connected, say, during the last three months, compared with the number for the corresponding period of last year?
7. How is it that none of the discharged men have been re-employed by the Post Office? It would appear that if it is true that the National Telephone Co. are refusing subscribers in order that the stations may be connected to the Post Office exchanges instead of to those of the National Telephone Co., exactly the same number of men would be needed to connect up these stations, and the work would be not diminished.
8. Have you any figures to prove that the aggregate number of linesmen, electricians, exchange employees, clerks, and others employed on telephone work in this country is diminished?

I have asked you for a considerable amount of information in the above questions, but I have no doubt that you will be able to reply to them with little trouble, as doubtless the statement which you have issued to the daily Press must be based on definite information and figures of this sort.

Awaiting your reply, Yours faithfully,

F. CHARLES RAPHAEL,
Editor.

4, GREAT JAMES'S STREET,
LONDON, W.C., *Sept. 15th*, 1908.

To the Editor, ELECTRICAL ENGINEERING.

SIR,—In reply to yours of 14th inst., I must request you to carefully re-read the statement as published in the *Daily Telegraph* of 14th, when you will see that there is no indication of a desire "to ventilate a grievance against the company," and no suggestion that this society is agitating unnecessarily against a party whom it recognises is only acting in a businesslike manner.

The object of the statement is to arouse public opinion on this question to aid the society in its endeavours to get the Government to take the question into consideration either for the direct employment of the men discharged or to financially assist the company to carry out those constructional works which are necessary if the legitimate extension of the telephone industry to 1911 and immediately after is to be carried on.

With regard to your series of questions, I am not at the moment in a position to divulge all the information I have to the public Press, but it is needless to say that a statement of the character which has been issued by the society must necessarily be backed by ample evidence. However, there are certain points raised on which I can give you some enlightenment.

1. For answer to this see Answer No. 8.
2. The period during which nearly one thousand employees have been discharged is, roughly, six months.
3. During the corresponding period of the previous year there was an increase in the total staff employed.
4. Completion of constructional works is the reason officially given as the cause of discharges. But here I would refer you to the interview with Mr. Franklin, President of the company, in to-day's *Daily Mail*, as a direct confirmation of the society's statement.
5. The authority for the statement that 5,000 to 6,000 men would be discharged is that of prominent officials of the Telephone Company, whom it would be invidious to name. This is also confirmed in the interview with Mr. Franklin indicated above.
6. The statement that "orders are being refused by hundreds" is one which can also be substantiated and one which the society made by the advice of its members in the Contract Departments of the company's service. I may add that instructions have been issued to many districts, including the metro-

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politan, that all orders for line whose cost of construction would exceed a very limited sum are to be refused, thus stopping the larger constructional jobs and consequently diminishing the staff previously required.

7. I am unable to state the reasons why the Post Office refuse to employ the discharged men. It appears to me that application for information on this point should be addressed to the Postmaster-General. Your reasoning is inaccurate, as it must be remembered :—

(1) That the P.O. system in London is an underground one, and the N.T.C. aerial, and therefore once a P.O. cable is laid there is less constructional work required than under the N.T.C. system.

(2) That in the vast majority of centres throughout the country, such as Manchester, Liverpool, Leeds, Bradford, Birmingham, Bristol, &c., the Post Office have no telephone system for local calls, and therefore when the National Telephone Co. cease constructional work telephone development entirely ceases.

8. We hold figures that the constructional staffs, both engineering and electrical, and also the contract or canvassing staff in this country have considerably diminished during the past six months. But I consider it inadvisable to give our figures at the moment, firstly, because they are not official figures, which can only be obtained from the company; and, secondly, they are supplied by our branch correspondents. The number of discharged shown by them is probably less than the actual total, as there are still a few centres in which this society is not represented whose number of discharged men are not included.

In conclusion, I may say that no disrespect is or was intended to the electrical Press by the issuing of the statement to the daily Press, as the reason for the issue of the same was to arouse public opinion, which the electrical Press are not in touch with, and, further, it was known that the heads of departments in the telephone industry are already fully informed as to the position of affairs.

The writer of this would be pleased to be interviewed by you to add to this already lengthy statement of affairs, if you will notify him of your desire to do so.

Yours faithfully,

R. JEFFREYS,

Assistant Secretary.

Mr. George Franklin, President of the National Telephone Co., has authorised the publication of the following interview with a Press representative; part of this interview, published in the *Daily Mail*, is referred to in the above letter.

It was alleged that orders for telephones were being refused by the hundred, and the discharges already approached 1,000. Mr. Franklin pointed out that the telephone company were in no way responsible for the statement, and added, "It is quite true that there must be some limitation of expenditure in the closing years of the business, because, obviously, the company cannot go on spending capital which would not be productive within the period of the license, and for which they might only receive a depreciated value. That is really the basis of the whole question.

"I very much doubt the statement that the discharges already approach 1,000. There have been discharges; and, of course, there must be more as time goes on. The company, with all the willingness in the world, cannot go on employing labour if they cannot make anything productive out of it. The total number of employees affected before 1911 might approach 5,000 or 6,000."

The President denied the statement that orders were being refused by the hundred. "We are," he said, "undertaking all the orders we can. At present, as a matter of fact, we have a smaller number of unexecuted orders on our books than for many years past. That may be due to bad trade. It should be clearly understood that the company are not in any way ceasing to give people who desire it a telephone service. What we are ceasing to do is to provide capital that will not be productive."

Mr. Franklin referred to the position of the Government, saying that the company were ready to do anything that was possible to meet the case. "All that is required is that we should be satisfied that any money spent on behalf of the period subsequent to 1911 shall be recouped to the company without loss. It would be a great advantage, I think, to the Government if some method can be found, and probably some method may be found. The company have had to adopt this policy, but would welcome some way by which the control of the expenditure should be exercised by the Post Office, and the company would be recouped for their expenditure."

The *Daily Mail*, however, adds :—

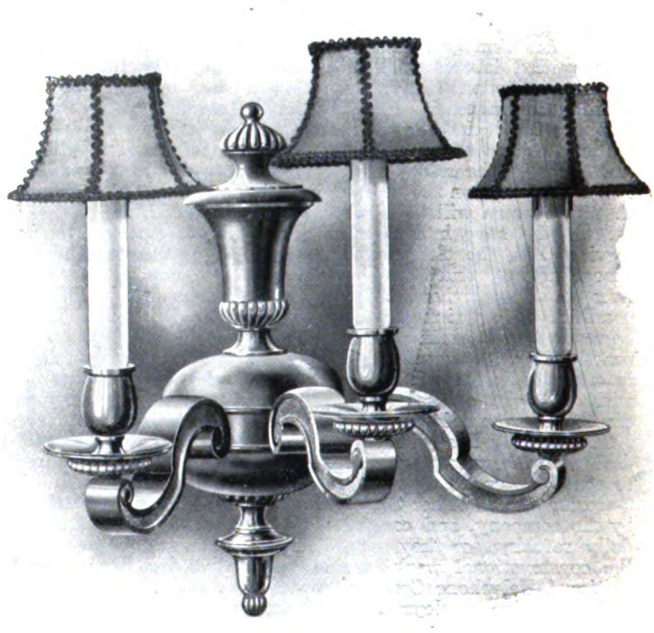
An official of the Post Office telephone department stated that, as a matter of course, all the employés of the company would be taken on by the Government. "When the Post Office takes over the system," he said, "there will no doubt be much extra work, and men who have been in the service of the National will be given work."

CATALOGUES AND PAMPHLETS RECEIVED

BATES & PEARD ANNEALING FURNACE.—A new leaflet has been published by the British Insulated & Helsby Cables, Ltd., Prescot, upon the Bates & Peard patent annealing furnace, which will deal with copper, brass, nickel, aluminium, gold, silver, and all non-ferrous metals. This furnace consists of an airtight chamber or tube, the ends of which descend into and are sealed by water baths. The annealing chamber is set in a brick or other heating furnace, which may be fired by gas, oil, or coal. The metal to be annealed is placed on an endless chain conveyor, and is automatically passed, first through one water seal, then through the heated portion of the tube, then out through the other water seal by which it is cooled, the water seals, therefore, forming entrance and exit doors to the furnace.

BRITISH CORRESPONDENCE SCHOOL OF ELECTRICAL ENGINEERING.—A second edition of the new syllabus has been issued from 36 Maiden Lane, London, from which we notice that the scope of the work of this school has been enlarged. Several new courses have been added, notably those on Tramway and Railway Engineering, and Electrical Problems and their Solution.

ELECTRIC LIGHT FITTINGS.—Messrs. Galsworthy, Ltd., of Newman Street, Oxford Street, have issued an artistic little pamphlet describing their latest patterns of electroliers and other



fittings. The illustrations are in two colours, and a general view of their show-room is included in the pamphlet. Among the illustrations is one of a candelabra in the Georgian style, which we reproduce above.

"METALITE" LAMPS.—A leaflet from the Bryant Trading Syndicate, Ltd., Horsell Road, Highbury, London, deals with the "Metalite" lamp, which we described fully in our issue for April 10th, p. 592. These are made in all sizes from 17 to 40 c.p., 100 to 130 volts, and 34-40 c.p., 200 to 250 volts. The consumption of the 32-c.p. lamps is one watt per candle. These are claimed to be the only metal filament lamps entirely made in England.

NEW SLIDE RULE.—We have received from Mr. M. J. Eichorn, of 5759 Aberdeen Street, Chicago, a description of a new trigonometric slide rule for solving triangles. In order to find the third side of a triangle when the two others and the angle between them are given, a direct manipulation of the slide only is necessary. If the three angles and one of the sides are given, a double-line sine-scale on the back of the slide is made use of. This scale is also used when two sides and an opposing angle are given. When all three sides are given, a direct solution with the face of the rule is possible.

THE PRESCOT WELDER.—The various types of the Prescot Welder are described and illustrated in a booklet received from the British Insulated & Helsby Cables, Ltd., Prescot. These machines have now been designed to deal with copper, brass, iron, and weldable steel up to 2 in. diameter, mild steel tape, and for armouring electrical cables, perambulator rims, chains, &c. In cases where suitable electrical power does not already exist, the company supplies a special self-exciting alternating-current generator, which can be driven from any shafting and need not be near the welder.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Sept. 10th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

14,059. **Train Lighting System.** H. GROB. A series dynamo, driven from a train-axle, is connected across a battery of accumulators, and the exciting current is thus dependent upon the difference of pressure of the two sources of E.M.F. The lamps are connected across the armature brushes. A second battery is continually being charged by one of three methods. In the first method the dynamo is supplied with an auxiliary armature winding and commutator, and this winding in series with the main armature winding generates the higher pressure needed for charging. In the second method the lamp circuit, which is in parallel with the working battery, is supplied from auxiliary brushes on the commutator, which are displaced less than 180°. In the third method the lighting and the charging current are taken from the main brushes, while the auxiliary brushes are connected to the exciting winding and the working battery. In this case a resistance in series with the lamp circuit is needed. At very high speeds the residual magnetism of the dynamo field may cause reversal of the exciting current, but to prevent this, a negatively acting field-winding supplied from the auxiliary armature winding of the first method is provided. The usual centrifugal cut-out for the dynamo is used, and means for changing over the batteries at regular intervals must be provided. Nine claims, five figures.

27,543. **Tension Springs for Metal Filaments.** E. A. GIMINGHAM (EDISON & SWAN UNITED ELECTRIC LIGHT CO.). A method of manufacturing helical springs for exerting a small but constant tension on the metal filaments of electric lamps, and capable of withstanding high temperatures. The method consists in attaching one end of a weighted fibre of glass or quartz to a heated platinum mandrel, and then slowly rotating the mandrel at the proper angle to produce the helix. Five claims, one figure

1908 Patents

2,307. **Ozone Water Steriliser.** A. DE BOUILLANNE. An apparatus for sterilising water by means of ozone. The principal feature is that the water is broken up into very fine drops, and the resulting cloud is given a gyratory ascending motion in a bell from the upper part of which the ozonised gas descends in the direction opposite to that of the water, thus ensuring an intimate mixture. Three claims, four figures.

4,274. **Brushholders for Motor Meters.** C. E. J. O'KEENAN. This is a device to compensate for the perturbations due to the friction of the brushes in motor meters, especially at light loads. The brushes are mounted on the armature of an electro-magnet, provided with a make-and-break contact device. It is said that the oscillatory motion in a direction tangential to the commutator thus imparted to the brushes, compensates for the above-mentioned perturbations. Four claims, nine figures.

11,511. **Platinum Contacts.** SIEMENS BROTHERS & CO., LTD. (*Siemens & Halske Akt. Ges.*). A contact for electrical apparatus consisting of a support of copper or brass enclosed in a cap of platinum. The amount of the non-oxidising precious metal is reduced to a minimum, while the copper gives the required strength, and also serves for fixing to the contact springs by rivetting. One claim, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

12,072, MAVOR, & MAVOR & COULSON, LTD. Motor equipments for marine propulsion.
16,781, SCHALLER. Pressure regulation on a network supplied by a variable speed generator.
18,764, LEADER. Railway signalling apparatus.
19,241, LECOCHE. Electro-magnetic cut outs.
19,424, MAVOR & BILES. Electrical propulsion of marine vessels.
19,562, DEUTSCHE GASGLUHLICHT AKT.-GES (AUER GES.). Suspension of metal filaments.
20,068, HUNTINGTON. Switches.
20,495, JACOBY. Speed regulation of alternating current commutator machines.
21,197, ASSERSOHN. Fittings for tubular lamps.
22,211, OPPERMANN. Secondary batteries.
22,526, JACOBY. Alternating current motors.
23,303, MAJOR, STEVENS, & STEVENS. Electric lifts.
23,809, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Wire stringing devices for insulating wire.
24,291, SPRAGUE & HOOKHAM. Counting trains for meters.
24,486, HAGEN. Electrodes.
24,992, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Dynamo-electric machines.
25,340, HOLT & WALLIS. Track circuits for railway signalling.
25,553, LÉVY. Electro-deposition of metals.
26,352, WOOLLISCROFT. Brush holders.
26,844, BARTELS, & LAND-UND SEEKABELWERKE AKT.-GES. Sparking-devices.
27,926, ALLGEMEINE ELEKTRICITÄTS GES. Electric welding of rings, hoops, and chain-links.

1908 Patents

69, CASPAR. Manufacture of refractory substances.
1,502, HOOKHAM, & CHAMBERLAIN & HOOKHAM, LTD. Electricity meters.
1,517, SIEMENS BROS. DYNAMO WORKS, LTD., & LYDALL. Apparatus for stopping railway or tramway vehicles in case of failure of the driver.
1,606, MARSHALL & PENMAN. Railway Signalling.
3,056, STRUBLE. Alternating-current relays.
4,111, SIEMENS BROS. DYNAMO WORKS, DALZIEL, BROOKS, & JENKIN. Recording apparatus for use with electrical measuring instruments.
4,181, LASSEN. Electrically-propelled motor-car.
5,016, HARRISON (*Electric Railway Improvement Co.*). Bonding rails.
5,054, NEALE & POWELL. Electric clocks.
5,271, BUTTERWORTH. Automatic fire and heat alarm.
5,444, VARELA. Electric automatic sounding apparatus.
6,170, MAWDSLEY. Brush holders.
9,569 JAEGER. Electric wire poles or masts for electric wires.
10,343, KITSEE. Preventing induction between conductors.
10,929, GAZZARD & MILLER. Emergency brake.
11,346, GUILLOT. Insulators for overhead systems of electric railways.
12,389, SIEMENS BROS. DYNAMO WORKS, LTD., & KLOSS. Oil switches, &c.
13,133, DEGOUMOIS. Brakes for electric cars.
13,450, SIEMENS BROS. DYNAMO WORKS, LTD. (*Siemens Schuckertwerke Ges.*). Fuse holders.
14,116, KITSEE. Telegraphic relays, or receiving devices.
14,262, NOY. Fenders or guards for tramcars.
15,377, CONDON. Electrical water heaters.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

13,451, SIEMENS-SCHUCKERTWERKE GES. Repulsion motors.
17,349, VON LEPEL. Apparatus for producing rapid electric oscillations.
17,421, KÖRTING & MATHIESEN AKT.-GES. Arc lamps.
17,535, ALLGEMEINE ELEKTRICITÄTS-GES. Arc lamps.
17,536, ALLGEMEINE ELEKTRICITÄTS-GES. Controller for cranes and lifts.
17,618, ARSEIN. Manufacture of refractory conductors.
17,619, FULLER. Manufacture of refractory conductors.
17,620, COOLIDGE. Manufacture of refractory conductors.
17,621, COOLIDGE. Manufacture of refractory conductors.
17,622, ALLGEMEINE ELEKTRICITÄTS-GES. Electric cranes and lifts.
17,687, PHEYSEY. Electric heating apparatus.

Application for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of Sept. 9th, 1908.

12,329, of 1906. **Electric Furnaces.** THE GRÖNDAL KJELLIN CO., LTD., seek leave to amend this specification granted to H. RÖCHLING and W. RODENHAUSER for "Improvements in electric furnaces." The amendment consists in striking out Claim 4, which is said to be of questionable validity.

Expiring Patent

The following patent expires during the current week after a life of fourteen years :—

17,774, of September 18th, 1894. **Telephonic Apparatus.** THE PHONOPORE CO., LTD., and E. W. SMITH. Calling apparatus for telephony, consisting of a relay with a vibrating magnet armature and a bell circuit. Also a switch-hook for cutting out the receiver and connecting the relay magnet coils to the line when the telephone is not in use.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½%	9½—10	
Do. 6% Cum. Second Pref.	10	6	6%	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—104	+1
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	—	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—97	
Brompton & Kensington E. S. Co., Ltd.	5	10	5%*	6¾—7¾	
Do. 7% Cum. Pref.	5	7	7%	6½—7⅝	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3½—4	
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	2¾—3¼ xd	-¼
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10¼	
Do. 6% Cum. Pref.	10	6	6%	12—13	+¼
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ld.	10	5	—	7½—8½	
Do. 6% Cum. Pref.	10	6	6%	10⅝—16⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E. L. Co.	10	4%	4%*	7¾—8¾	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—102	+1
London Electric Supply Corporation	3	2½	—	⅜—1⅛	
Do. 6% Pref.	5	6	6%	4⅜—4⅞	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4½—4¾	
Do. 4½% Cum. Pref.	5	4½	4½%	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. D	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	5	2½%	5½—5⅝	
Do. £2 Paid	5	8	2½%	3¼—3⅜	
Do. 5% Pref. (fully paid)	5	5	2½%	5¼—5⅜	
Do. £2 Paid	5	5	2½%	3¼—3⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅝—6⅛	
Do. 4% Deb. Red.	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	7—8	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	80—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅛—⅜	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2⅞	
South Metropolitan E. L. & P. Co.	1	2¼	—	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7%	1⅝—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	—	½—1	
Do. 5% Cum. Pref.	5	5	5%	1½—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	7½—8½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	-⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	92—94	
Central London	Stock	3	3%*	67—69	-1
Do. 4% Preferred	Stock	4	4%	84—86	
Do. Deferred	Stock	2	—	48—51	-2
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	82—84	
City and South London Cons.	Stock	4½	1½%	32—33	
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—1	
Gt. Northern, Piccadilly & Brompton	10	4	3½%*	7—7½	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	¼	⅛%	36—37	+1
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	73—76	
Do. 3½% Convertible Pref.	Stock	3½	3½%	70—73	
Metropolitan District	Stock	—	—	12½—13½	+1½
Do. 6% Perp. Deb.	Stock	6	6%	116—119	
Do. 4% Deb.	Stock	4	4%	71—75	
Do. Perp. Extension Pref. (5%)	Stock	—	—	18—22	-1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	48—52	
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	5%	39—43	+1
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅜—½	
Do. 4½% Deb. Red.	Stock	4½	—	85—90	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	+1
British Electric Traction Co., Ltd.	10	—	—	1¼—1⅝	
Do. 6% Cum. Pref.	10	6	6%	3½—4⅛	
Do. 5% Perp. Deb.	Stock	5	5%	99½—99½	+½
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—7	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4⅜	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%	%		
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	
London Street Tramways Co.	4	4/6	2½%	⅞—1⅛	
London United Trs., Ld., Cm. Pf.	10	5	—	5½—6½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	75—80	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5%	¾—1⅛	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—¾	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	½—⅝	
Do. 5% Cum. Pref.	1	5	2½%	⅝—⅞	-1/32
Do. 4½% Deb. Red	Stock	4½	4½%	93—96	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	78—82	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅜	
Do. 6% Cum. Pref.	5	—	—	3⅛—3⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	+1
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	58—61	
Do. 6% Pref. Ord.	Stock	6	6%*	104—105	
Do. Def. Ord.	Stock	1	—	17—17½	-¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	89—91	-½
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3¼	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4¼	4¼%	13½—13¾	+⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—101½	
Do. do. (Mauritius Sub.)	25	4	—	101½—103½	+½
Eastern Ext. Australasia & China	10	7	6%	12½—13¼	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100½—102½	
Eastern Telegraph Co.	Stock	7	11½%*	135½—138½	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	28—30	+½
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6%*	118—120	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—12½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—12½	
Do. 5% 3rd Pref.	5	5	2½%	5—5¾	
Do. 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red.	Stock	4	4%	102½—104½	-½
Western Telegraph Co., Ltd.	10	7	6%*	13⅜—15⅜	
Do. 4% Deb.	Stock	4	4%	101½—102½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	7%	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	—	3¼—4	
Do. 6% Pref.	1	6	—	1½—1⅝	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6½—6⅝ xd	-¼
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	1⅝—1⅞	
Do. 4% Mort. Deb. Red.	Stock	4	4%	41—46	-2
Brush Electrical Engineering Co.	2	—	—	0—½	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9—10¾	
Do. 5% Cum. Pref.	5	5	5%	5½—5⅝	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	+5
Dick, Kerr & Co., Ltd.	1	10	—	1¼—1½	
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
Edison & Swan United "A," £3 paid	5	2/6	—	⅛—¾	
Do. do. (fully paid)	5	4/2	—	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	⅝—¾	
Do. 7% Cum. Pref.	2	7	—	1½—2	+⅛
Do. 4% 1st Mort. Deb.	Stock	4	4%	66—71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7⅛—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	86—90	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10¾—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	15½—16½	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	10%*	32½—34½	+⅛
Do. 4% Deb. Bds. Red	100	4	4%	101—103	+½
Willans & Robinson, Ord. Shres	1	5	—	¾—1½	
Do. 6% Cum. Pref.	5	6	6%	2½—3	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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LOCAL NOTES

ABERDEEN: *Tramway Receipts.*—The receipts upon the tramway system from the beginning of the financial year amounted to £23,303, a decrease of £119 compared with the corresponding period of last year.

Underground Telephone Wires.—It is announced that the Engineer's Department of the General Post Office have made great progress with the scheme of laying the telephone wires underground. Most of the central thoroughfares have now been trenched, and the conduits laid, and work is now proceeding in the outlying districts.

ARBROATH: *Electricity Works Assessment.*—The valuation of the electric lighting works has been fixed at £225 for the present year. This is a considerably lower assessment than will be the case when the works are fully equipped and fully employed.

BELFAST: *The Engine Contract.*—Arbitration proceedings are to take place between Messrs. J. G. White & Co. and the Corporation, with reference to the engines used in connection with the tramway supply. The Council has decided to retain Mr. A. E. Porte to give evidence on their behalf.

BELGIUM: *Ghent.*—An American Consular report gives some particulars of the new harbour and deep canal which is to be constructed in order to connect Ghent with the sea-coast. There are to be a number of lift bridges over the canal, which will be opened and closed electrically, whilst arc lamps will be placed at intervals of 490 ft. along the total length of 20 miles of the canal.

BRADFORD: *Street Lighting.*—In connection with the experiments decided upon of lighting a certain portion of the streets by electricity and gas for the purposes of comparison, the Electricity Department has decided to make use of flame arc lamps attached to the tramway posts. There are 18 lamps of 2,500 c.p. each, and the length of the thoroughfare lighted is about 640 yards. So far the Gas Committee have not decided upon steps which they will take in the competition.

BRISTOL: *Tramway Inspection.*—Lieut. Col. von Donop inspected the first portion of the new Westbury tramway extension last week, and the line was subsequently opened to the public.

BURSLEM: *Electricity Statistics.*—The number of units generated during August was 32,745, the number for the corresponding period of last year being 22,145. The total number of 8 c.p. lamps or their equivalent, in use, exclusive of street lighting, is now 13,547, against 9,423 last year, whilst the motors installed have a total capacity of 493½ h.p., against 319 h.p. in August of 1907.

BURTON: *Electricity Undertaking.*—In submitting the report of the Gas & Electricity Committee at the last meeting of the Council, the Chairman called the attention of the Council to the gratifying increase in the consumption of electricity, which was almost entirely due to the power consumers.

BUXTON: *Refuse Destructor Works.*—The new refuse destructor works, which has been erected by the Council in connection with the electricity works, are now completed.

CANADA: *Montreal.*—The Canadian Electric Light & Power Co. has been granted powers to give a supply of electricity in Montreal. The contract provides for the commencement of a supply within two years, and a schedule of charges has been arranged which is said to be considerably lower than any at present existing.

CHESTERFIELD: *Tramway Report.*—The annual report of Mr. R. L. Acland, the Tramway Manager, states that the capital account for the year ended March 31st, 1908, has been increased by £1,263, being the cost of two new cars. The total capital expenditure upon the undertaking now amounts to £89,722, the total borrowing powers being £95,000. On the revenue side of the accounts the traffic expenses have increased from 2·34d. to 2·4d. per car mile. Repairs and maintenance have been reduced from 0·67d. to 0·63d. per car mile, there having been an increase on permanent way electrical equipment and fixtures, but a decrease on cars. The total cost per car mile has increased from 5·32d. to 5·78d. After meeting all liabilities and a contribution to the rates, there is a balance to renewals reserve and depreciation account of £978, compared with £922 last year. The following statistics are taken from the accounts :—Traffic revenue, £11,536; total revenue, £12,154; working expenses, £6,798; sinking fund and interest on capital, £4,378; car miles run, 282,228; number of passengers carried, 2,449,961; units per car mile, 1·31; percentage of working expenses to receipts, 56; total revenue per car mile, 10·34d.; reserve fund at March 31st, 1908, stood at £3,027.

CHIPPING NORTON: *Public Lighting.*—The Lighting and Watch Committee have drawn the attention of the Electric Lighting Co. to the unsatisfactory condition of the public lighting.

DUBLIN: *Financial Position of Electricity Undertaking.*—At the last meeting of the Corporation, Mr. Sherlock moved the following resolution :—"That the City Treasurer and City Accountant be requested to inquire into and report to Council upon the general financial position of the Corporation electricity undertaking; that the report detail the names, positions, and salaries of all employed thereon; and that reference be made in the report to the original estimates of Mr. Hammond and the various promises made by the Lighting Committee in regard to extensions and how far they have materialised." It was time, he said, that the Corporation should take same active steps to inquire as to the general position of the electricity works. After some discussion the resolution was carried.

EAST HAM: *Tramways.*—The Tramways Committee reported on Tuesday having considered a letter from the Board of Trade to the effect that they were advised that the bridge carrying the Romford Road tramways over the London, Tilbury & Southend Railway at Forest Gate does not satisfy the requirements as regards the strength of cast-iron over-bridges, and they therefore cannot grant a certificate to permit the tramways to run over the bridge until same is strengthened. The Borough Engineer has made drawings showing the proposed means of strengthening the bridge, and same are to be forwarded to the Railway Co. and the Board of Trade for their approval. In the meantime temporary arrangements have been made with the West Ham Corporation for running the new section up to the western side of the bridge and having communication between the two tramways there.

EDINBURGH: *Cost of Electric Power.*—The Electric Light Committee has resolved to recommend the Town Council to reduce the minimum charge for power for electric motors from £2 to £1 10s. per annum.

National Exhibition Finance.—A statement as to the financial position of the Scottish National Exhibition of the first four months of its existence, states that the cost of electric light and gas, and upkeep, has been £4,400.

FALKIRK: *Electric Lighting Tariff.*—The Electric Light Committee recommend that the price of electricity for lighting purposes be reduced from 5d. to 4d. per unit, and that the charge for lamps outside shops, offices, &c., for which separate meters are used, shall be 3d. per unit. It is stated that this latter special rate is proposed in view of the aid such lamps afford in the illumination of the streets, and with the object of inducing more business people to erect such lamps outside their premises.

FINLAND: *Electric Lighting.*—A Consular report upon the trade of Finland during 1907 states that public and private electric lighting has been brought into use in Lovisa. A new form of electric bath has also been introduced into the well-known hydropathic establishment there.

HALIFAX: *Tramway Compensation Claims.*—The special subcommittee of the Tramways Committee, which has been dealing with the claims for compensation in respect of the Pye Nest tramway accident, has reported that the claims number 50 in respect of personal injuries, seven for damage to property, and twelve others. With the exception of two personal injuries all the 74 claims have now been settled, at the estimated cost of £11,000. The liability of the Corporation, however, will only be £10,000, as the sum of £1,000 has already been received from the insurance company in respect of their indemnity.

Tramway Accounts.—The annual report of the tramway manager for the year ended March 31st, just issued, shows that the total capital expenditure amounts to £394,614. The total receipts amounted to £81,872, and the working expenses to £62,534. The gross profit is returned at £19,337, but as the capital charges reached £21,608, there is an actual loss on the year's working of £2,270. The total working expenses were 8·4d. per car mile, and the capital charges 2·91d. per car mile, making a total of 11·31d. per car mile.

Financial Position of Tramway Undertaking.—The Tramways Committee will hold a special meeting next week to consider the financial position of the tramways undertaking, and report with respect to through running, overlapping, and alterations in the service generally.

HARROGATE: *Electric Lighting Charges.*—The Engineer recommends that in order to obtain a bigger revenue from the lighting of small properties, a charge of 2s. 9d. per quarter for every 30-watt lamps be made on the following conditions :—(1) The amount to be paid quarterly in advance; (2) all apartments lighted under this tariff are to be adequately lighted by windows during daylight; (3) the maximum number of lamps per tenement to be three; (4) the number of applications to be limited to twenty existing customers and twenty new ones. During the discussion upon this proposal the Town Clerk stated that a part of it was illegal, but nevertheless the Council carried the Committee's report. The Mayor, however, stated that as the Town Clerk had ruled the proposal illegal, it was his duty to see it was not carried out.

HEYWOOD: *Electricity Undertaking.*—At the last meeting of the Electricity and Tramways Committee, the Chairman of the Finance Committee drew attention to the position of the undertaking. He said that there were signs that the loss at

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the end of the present year would be £2,000 instead of £1,000 as last year, and that a decrease in the receipts of £100 and an increase in the expenditure of £100 had taken place during the past month.

Tramway Agreement.—At present the Corporation tramways in Heywood are worked by the Bury and Rochdale Corporations, but the agreement will shortly expire, and as the Heywood Council claims that it is entitled to better terms, it will not be renewed in its present form. A suggestion has been made that unless a better bargain can be made the Heywood Council shall work the cars themselves, but it is understood that as a result of the meeting between the engineers of the three towns, fresh terms have been practically agreed.

HYTHE: *Tramway System.*—A special meeting of the Society for the Preservation of the Beauty of Hythe has passed a resolution objecting to the proposal of the National Electric Construction Co. to substitute the overhead trolley system for the surface-contact system upon the proposed tramways between Folkestone, Sandgate, and Hythe. During the discussion it was mentioned that so far as the overhead system would not interfere with the beauty of the town, the Association would express no opinion, but they did not think it possible that the overhead system could be other than a great disfigurement to the district. The feeling of the members of the Society seems to be that visitors will stay away from Hythe if the overhead trolley tramways are introduced. At the meeting of the Council on Friday it was decided not to sanction any alteration in route or system. A poll of the ratepayers has been taken, which shows a majority in favour of the decision of the Council by 44. The electorate numbers 1,200 and 841 votes were recorded.

JAPAN: *Electric Traction.*—A British Consular report states that nothing was done during the past year in connection with the proposed electric tramway between Chofu and Shimonoseki, but preliminary arrangements in connection with the Moji electric tramway were completed. The rails are to be laid between Moji and Kurosaki *via* Dairi, Kokura, and Yawata, with a branch line to the Imperial Government Steel and Iron Works at Wakamatsu.

KIRKCALDY: *Electric Lighting Accounts.*—The report of the Electrical Engineer for the year to May 15th, 1908, shows that the total income was £10,118 and the working expenses £6,327. From the credit balance of £3,790, interest on capital and sinking-fund charges absorb £3,653, leaving a net credit balance of £137. An analysis of the expenditure shows that the cost of fuel has increased from 0·385d. to 0·536d. per unit sold, the quantity consumed per unit being 9·83 against 9·372 last year. During 1908, however, Lochgalley coal was used, whilst Bohwell coal was used last year. Works costs are 0·89d. per unit against 0·75d. for the previous year, the total costs being 1·10d. against 0·98d. for last year. The units sold to private consumers for lighting purposes have increased by 33·6 per cent., and attention is specially drawn to this satisfactory rate of increase in view of the adoption of the higher efficiency metal filament lamps. The consumption by power users has increased by 67 per cent., and in this connection it may be pointed out that the load factor is gradually rising, being now 19·5 per cent. The total number of units sold was 1,381,106, of which 679,069 were for tramways, 100,378 for public lighting, 206,314 for private lighting, and 395,345 for power purposes. The average price received was 1·752d. per unit, compared with 1·657d. per unit for the previous year, when the output was 1,178,223. The total equivalent 3-c.p. lamps connected is 42,413 and the number of consumers 422, the figures for last year being 34,850 and 341 respectively. The maximum load was 811 kw., compared with 723 kw. last year. The estimates for the current year's working show a profit of £393.

Tramway Accounts.—The accounts of the tramways undertaking for the same period show that the total receipts were £14,993 and the working expenses £10,069. Interest on capital sinking fund, and depreciation amounts to £4,900, leaving a net balance of £23. The working expenses amounted to 5·26d. per car mile against 4·95d. last year, this increase being entirely accounted for in the cost of current, which has been charged at 1½d. per unit against 1⅛d. last year. Mention is made in the report of an improved working arrangement with the Wemyss Tramway Co., whereby the wasteful blanketting of the Wemyss cars alongside the Corporation cars has been got over. The total number of passengers carried upon the Kirkcaldy cars was 4,264,419, whilst the Wemyss cars under the through-running arrangements carried 609,780. The corresponding figures for last year were 4,369,835 and 270,783. The committee again recommend the favourable consideration by the Council of an extension to Dysart. The estimate for the current year's working shows a profit of £836. On the question of depreciation the committee recommend that a definite scheme for renewals and depreciation should be drawn up subject to reconsideration at period of five years.

LONDON: *Southwark: Electric Power Supply.*—The Electricity Committee of the Borough Council report that they have considered the London Electric Supply Bill and the London & Westminster & Kensington Electric Supply Cos.' Bill. The committee look with disfavour upon the proposals, which will enable the companies, numbering 15 in all, to link up their concerns, as the companies will thereby be enabled to combine for the purposes of supplying the current in competition with the Council's undertaking, and on such terms as are likely to seriously affect and be detrimental to the commercial interests thereof. The committee feel that if a general scheme for the co-ordination of the electric supply throughout London is to be carried out, a serious injustice would be done to the ratepayers, in the absence of any reservation clause being inserted in the Bills making it obligatory to purchase such undertakings as the Southwark Council's at a fair value, and before the plant is depreciated by cheap current being forced in competition. A petition is to be presented against both Bills.

St. Pancras: Reinstatement of Roads.—Last year £400 was charged to the Electricity Department for reinstating paving, &c., over trenches, £119 was charged to the Post Office telegraphs, £22 to the National Telephone Co., and £60 to sundry electricity, &c., companies.

Tramways.—A Joint Committee, which has been negotiating with the London County Council in regard to the electrification of the tramways from Euston Road to Holloway, has (subject to the usual sanction) approved the plans conditional upon the wood paving being retained in the tramway tracks of Hampstead Road and High Street, Camden Town. There are some small matters which are still the subject of negotiation.

MELTON MOWBRAY: *Public Lighting.*—The Lighting Committee have received a letter from the Electric Light Co. with regard to the contract for street lighting which expires at the end of the present year. The Committee, however, were unable to come to a decision as to advertising for fresh tenders, and have left the matter for the Council to decide.

PONTYPRIDD: *Tramway Men's Union.*—A branch of the Amalgamated Tramwaymen's and Vehicle Workers is to be formed by a combination of the tramwaymen of the Pontypridd and Rhondda districts.

RAMSGATE: *Tramway Nuisance.*—The Manager of the Isle of Thanet Electric Tramways & Lighting Co. has had his attention called to the fact that some of the old cars in use by the company are considered by the Town Council to be a source of annoyance and danger.

SHEFFIELD: *Tramway Funds and Unemployed.*—At a Council meeting last week it was decided to vote the sum of £10,000 from the tramway funds towards starting relief works of various descriptions.

SUNDERLAND: *Position of Electricity Undertaking.*—At the meeting of the Corporation on Thursday, Alderman Turnbull moved his resolution asking for details of the costs of electric supply to various large consumers, his reason being that the prices being charged were unremunerative. After a short discussion, however, the motion was overwhelmingly lost.

SWANSEA: *Inspection of Electricity Works.*—The annual inspection of the electricity works took place last week under the guidance of Councillor Sinclair, the Chairman of the Electricity Committee. At the subsequent luncheon, Councillor Sinclair stated that the works were started eight years ago with a capital expenditure of £60,000, which had now grown to £144,000. Between the two periods also the number of consumers had increased from 96 to 1,216, and, roughly speaking, they were connecting up four new consumers per week. With regard to the revenue, this in the first year was £4,571, whilst last year it was £20,824. He was happy to say that the undertaking had fulfilled all its financial obligations, and, in addition, made an absolute net profit of £800.

SWINDON: *The Tramway Undertaking.*—A resolution has been forwarded to the Council by the Ratepayers' Association expressing the opinion that the tramway undertaking should be sold, but by a large majority the Council has declined to take any action in the matter.

TAUNTON: *Tramways and Electricity Supply.*—In consequence of strong complaints as to the unnecessary use of the gongs on the tramways, a communication has been sent to the tramway company asking them to take steps to avoid this nuisance in future. Some objection has been taken to the recent resolution of the Council to supply the Tramway Co. with current at 1·2d. per unit, and at the last meeting of the Council a resolution was moved that the price be 1¼d. It was pointed out, however, that the previous resolution could not be rescinded.

TURKEY: *Importation of Telephones.*—In addition to the withdrawal of the prohibition of the importation into Turkey of electrical instruments, the Board of Trade have received a dispatch from the British Consul-General at Constantinople reporting that the prohibition of importation has also been withdrawn in the case of telephones, amongst other goods.

WALSALL: *Tramways.*—The Wolverhampton District Electric Tramways, Ltd., have agreed that the increased payment of 1½d. per car mile to be made by the company to the Corporation in respect of the mileage run by the cars of the Corporation over the company's line at Willenhall shall commence as from July 1st last.

WEDNESBURY: *Electricity Supply.*—It is stated that quite unexpectedly the Midland Electric Corporation for Power Distribution has notified the Corporation of its intention not to supply in the district any further. It will be remembered that serious competition was threatened between the company and the Corporation owing to the latter having decided not to take

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power in bulk from the company any longer, owing to a disagreement over the price. Both the company and the Corporation possess supply powers in Wednesday, and a loan was recently granted to the Corporation for the erection of a generating station. The action of the Company has not placed the Corporation in any dilemma, as their preparations are sufficientiy far advanced to enable them to take over the company's consumers when the latter's notice expires.

WELLINGTON (N.Z.): *Electricity Accounts.*—Since the undertaking of the Wellington Electric Light Co. was taken over by the Corporation eleven months ago, it is estimated that the profits for the year will be about £700 more than those of the company during the last year of its life, in spite of the fact that the municipality has reduced the price to consumers which will reduce the revenue by about £3,000. After setting aside £13,000 for capital charges and depreciation, a net profit of about £5,000 is shown for the eleven months' working.

WORKSOP: *The Engineer's Salary.*—A motion to increase the salary of Mr. J. C. Crowther, the Borough Electrical Engineer, to £200 per annum, with further annual increments of £25 per annum until a maximum of £300 is reached, was rejected at the last meeting of the Corporation by 8 votes to 6.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA.—In connection with Mr. C. H. Merz's report upon the electrification of the Victorian railways, tenders may be looked for shortly for a scheme involving an expenditure of some £800,000.

BURSLEM.—A Local Government Board inquiry was held on Thursday into the application by the Corporation to borrow £12,000 for the purposes of the electricity undertaking.

BURY.—A Local Government Board inquiry into the Council's application for sanction to borrow £72,000 for electricity developments, new works to be built at Chamber Hall, was held last week.

DARWEN.—An inquiry was conducted by the Local Government Board last week into an application by the Corporation for powers to borrow £4,300 for the new electricity undertaking.

HULL.—The Tramways Committee invite tenders for the supply and erection at the Osborne Street power station, of a surface condensing plant with motor-driven pumps, capable of dealing with 20,000 lbs. of steam per hour. Particulars from the City Engineer (fee, £1, returnable), and tenders to the Chairman of the Tramways Committee, Town Clerk's Office, by September 18th.

ILFORD.—An overhead travelling crane is required by the Electricity Department. Particulars from the Electrical Engineer (fee, £1 1s., returnable), and tenders to the Town Clerk by September 22nd.

LEITH.—The Tramway Committee have resolved to recommend the Council to proceed with extensions of the tramways from Bonnington Terrace to Pier Place. It has been further agreed to recommend that the work be carried out by the Corporation employees.

NEATH.—A loan of £18,000 for electric lighting purposes is to be applied for, made up as follows:—purchase of the South Wales Electrical Power Co.'s generating station, £7,000; overdraft, £597; extensions of mains and services, £4,764; over expenses, £1,700; extras, £1,000.

TAUNTON.—A double acting steam engine is to be purchased at an estimated cost of £300.

WIMBLEDON.—A Local Government Board inquiry was held last week into an application by the Corporation to borrow £6,000 for the purposes of the electrical undertaking. Of this sum £1,059 represents excess of expenditure over previous loans, and the remainder is the estimated cost of mains, sub-stations, &c., until March, 1909.

Miscellaneous

BLACKPOOL.—Tenders are invited for the following materials by the Tramways Committee:—100 tons of steel rails, No. 4 B.S. Section, 30 cwt. of fishplates, 20 cwt. of tiebars, 300,000 (about) hardwood paving blocks. Particulars from the Borough Engineer, and tenders by September 19th.

HULL.—Tenders are invited for one year's supply of ironwork, and one year's supply of insulator bolts and caps. Particulars from the Town Clerk (fee, £1 1s., returnable), and tenders by September 23rd.

PORTSMOUTH.—The Council has decided to extend the tramway system to Milton, which has of late years become a populous and growing suburb of Portsmouth.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations, and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Adaptation of premises in Holborn for occupation as branch of Capital and Counties Bank, 39 Threadneedle Street, E.C.

Buildings on sites of 33, 34, 35 Gutter Lane and 6 Carey Lane. Builder, J. W. Jerram, Crown Works, Boundary Road, East Ham.

N.W.—Buildings, Hampstead Road (near Euston Road). Builders, Howell J. Williams, Ltd., 11-17 Bermondsey Street, London Bridge.

S.E.—Additions to factory, Thurndley's Road, Deptford. Builder, G. Parker, 124 Sumner Road, Peckham, S.E.

W.—Hotel, Berners Street and Castle Street. Architect, John Slater, 46 Berners Street, W.; builders, Holloway Bros., Belvedere Road, Westminster Bridge.

Adaptation of 32 North Audley Street, Mayfair, for occupation by Edwin & Co., court hairdressers and manicurists, 49 Park Street, Grosvenor Square, W.

Adaptation of 37 North Audley Street, Mayfair, for occupation by Lewis Soloman, fruiterer, &c., Covent Garden Market, W.C.

Alterations to 2 Carlton House Terrace (£2,000); 74 Brook Street (£650); 7 Hyde Park Gate (£1,250); 45 Baker Street (£1,050); 12 and 13 Montagu Place (£1,640). Architect, F. W. Foster, 41 Bedford Row, W.C.

Re-building 439 to 451 Edgware Road (£7,700). Architect, F. W. Foster, 41 Bedford Row, W.C.; builder, C. Gray, Wellington House, S.W.

PROVINCES.

ALLOA (CLACKMANNAN).—Extension of County Buildings (£5,000). Architects, Melvin & Kerr, Alloa.

ASPULL (LANCS.).—Additions to Dicconson Mills.

BARNES.—Six houses, Bollo Lane. Builder, J. J. Fuller, 63 Ivy Crescent, Chiswick.

School (£5,000). Architects, Jarvis & Richards, 10 Queen Anne's Gate, Westminster; builders, R. T. Hughes & Co., Ltd., 37 Sheen Lane, Mortlake.

BARNET.—Completion of St. John's Church. Rev. E. J. Hall, Rector, Friern Barnet.

BELFAST.—Alterations to United National Club, Berry Street.

BELPER.—Public baths (£8,000). Builders, W. Ford & Sons, Summer Hill, Victoria Street, Derby.

BERWICK-ON-TWEED.—School (£8,000). R. Dickinson, Surveyor, Town Council.

BIRMINGHAM.—Mess-room and drill-hall, Metropolitan Road, for the Metropolitan Amalgamated Railway Carriage & Waggon Co., Ltd.

BOSTON.—School (£3,600). G. E. Clarke, Surveyor, Town Council.

BRIDGEND (GLAM.).—Additions to workhouse infirmary (£1,250).

BRIDGWATER.—Additions (£4,000) to Town Hall. F. Parr, Surveyor, Town Council.

BRIDLINGTON.—School (700 places). G. G. O. Sutcliffe, Clerk, Education Committee.

BRISTOL.—Addition to Ashton Gate Brewery. Architect, J. A. Wright, 6 Unity Street, College Green.

COLWYN BAY.—First portion (£1,065) of church. Architects, J. M. Porter & Elcock, Colwyn Bay.

CROYDON.—Additions and alterations, Baptist Chapel, Whitehorse Lane. Architect, E. Stones, 1 Trump Street, Cheapside, E.C.

Two houses and shops, Selhurst Road. Architects, Dartnell & Banks, 34 High Street, Croydon.

Twelve houses, Richmond Road. W. M. Lucas, 91 Brigstock Road, Croydon.

Additions to Whitehorse Laundry. W. Hards, 19 Selsden Road, Croydon.

Additions and alterations, 70 Westow Hill. Builders, Macey & Sons, 24 Essex Street, Strand, W.C.

Six houses, Whitehorse Lane. F. H. Milton, 76 Haslemere Road, Croydon.

Six houses, Barmouth Road. W. B. Coomber, 65 Pemdevan Road, Croydon.

Six houses, Melfort Road. C. Omerod, 5 Station Road, West Croydon.

Three shops and two houses, Brigstock Road. H. E. Davey, 20 Cassland Road, Croydon.

Additions, St. James's Vicarage, Tavistock Road. Builders, Umlandt & Gibson, 98 Cherry Orchard Road, Croydon.

School (£12,100). Architect, H. Carter Pegg, Thornton Heath; builder, W. Wallis, 207-9 High Road, Balham.

DARLINGTON.—Three houses and additions to Union Offices, Crown Street. Architects, Hoskins & Brown, Darlington.

DEVONPORT.—School (£11,180). Architects, Thornely & Rooke, 29 St. Aubyn Street, Devonport; builder, A. N. Coles, Plymouth.

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DUDLEY.—Enlargement of post office. H.M. Office of Works, Storey's Gate, S.W.

FLEETWOOD.—Addition to cottage hospital (£1,500). Architect, B. Drummond, 4 Alfred Terrace, Fleetwood.

GAINSBOROUGH.—Refuse destructor (£2,000). S. W. Parker, Surveyor to Council; builder, A. J. Elmes, Gainsborough.

GLASGOW.—Church, Rose Street and Dalhousie Street, for Rev. A. C. Knight.

Offices in St. Vincent Street, for Northern Assurance Co. Head office, 1 Moorgate Street, E.C.

HENDON.—Additions to Workhouse Infirmary. F. J. Lea Crook, clerk to the Guardians.

KINGSTON-ON-THAMES.—Additions to Guardians' workshops, &c. Architect, W. H. Hope, 12 Clarence Street.

LEICESTER.—Additions to Fairfax Mills. Architects, Tait & Herbert, 28 and 18 Friar Lane, Leicester.

LICHFIELD (STAFF.).—Additions to Hammersmith School. G. Balfour, Education Offices, Stafford.

LUTON.—Two villas. Builder, F. Chandler, 78 Cromwell Road, Luton.

Bakery. Builder, A. Turner, 72 Hilbert Street, Luton.

Factory in George Street West, for Luton Cardboard Box Company, Ltd.

MERTHYR TYDVIL.—Eleven houses, for the Woodlands Building Club.

NOTTINGHAM.—Alterations to premises for General Life Assurance Company. Head office, 103 Cannon Street, E.C.

SHIPLEY.—Additions to Water Pits' Mills.

STOCKPORT.—High school (£15,000). J. Atkinson, Borough Surveyor.

SUNDERLAND.—Extension to St. Oswald's Mission Church, Corporation Road, for Rev. W. R. Egerton.

SWANSEA.—Additions to the Cambria Cold Storage Warehouse on the Strand.

Warehouse at the rear of 10 Picton Place for Mr. W. S. Clarke.

Additions to St. Winifred's Convent, St. James's Crescent, for the Rev. Mother Superior.

Additions to Hill Chapel, North Hill Road.

Additions to offices, Angel Chambers, Angel Street, for the United States Metallic Packing Co.

THAMES DITTON.—School (£4,150). Architects, Jarvis & Richards, 10 Queen Anne's Gate, S.W.

TILBURY DOCKS.—Residence (£1,150). Architect, C. M. Sliever, 10 John Street, Adelphi, W.C.

TWYNY-RODYN.—Additions (£8.683) to school. Architect, J. Llewellin Smith, Town Hall, Merthyr Tydfil.

WALSALL.—Country house. Architect, B. A. Porter, 88 Colmore Row, Birmingham.

WEST HAM.—Alterations, &c., in schools, for handicraft instruction. Architect, W. Jacques, 2 Fen Court, Fenchurch Street, E.C.

WEST HARTLEPOOL.—Alterations to the Brunswick Hotel, Brunswick and Musgrave Streets.

WIMBORNE.—Pumping station and other works in connection with Poole water supply. Engineer, Wm. Matthews, 39 Victoria Street, Westminster.

WORKSOP (Notts).—Public baths. Geo. Rawson, Surveyor to the Council.

YORK.—School (£10,289). Builders, Wm. Airey and Sons, 2 Claro Road, Servia Road, Leeds.

London's Electric Omnibuses.—The London Electrobus Co. has now 20 electric omnibuses in service in London, all of which are garaged at the Horseferry Road Garage, Westminster, which we described in our issue of December 5th, 1907, Vol. II., p. 903. A 'bus with a top cover on, after the style of that employed on tramways, will shortly be put on the service.

Electric Supply in the Bahamas.—As we announced a short while ago, the contract has been placed with Messrs. Crompton & Co., by the Crown Agents for the Colonies for the electric lighting of the city of Nassau, capital of the Bahama Islands. The consulting engineers are Messrs. Preece & Cardew, and the contract includes the supply and erection of all station plant, machinery, and mains. The plant will consist of three 81-b.h.p. Y.E.-type Crossley gas engines and suction-producer plant, the engines being direct-coupled through flexible couplings to three of Messrs. Crompton's standard continuous-current interpole dynamos, each capable of developing 45 kw. at 200/220 volts when running at a speed of 200 revolutions per minute. All the necessary circulating water pipes, two electrically-driven centrifugal pumps for circulating the water, a balancer set, dealing with an out-of-balancer current of 100 amps. in the middle wire, and a switchboard for the control of the three dynamos, balancer, and feeders. The mains will consist of overhead bare copper conductors carried on steel cross-arms mounted on wooden poles, on which brackets will also be mounted for carrying the incandescent lamps for street lighting. The contract includes the running of all service mains to consumers. The system of supply will be three-wire continuous-current, 100 volts for lighting, and 200 volts for power. The erection will commence about the beginning of October.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The *Australian Mining Standard* states that one of the earliest recommendations made by Mr. H. R. Forbes Mackay, City Electrical Engineer for Sydney, on taking up his duties, was that a storage battery be installed at the town hall sub-station as early as possible, in order to cope with emergency demands, which, at the present rate of development, will fall on the lighting station during the 1909 winter. Tenders were called, and at a recent meeting of the City Council, that of Messrs. Noyes Bros. (Sydney), Ltd., at a cost of £23,338, was accepted. The battery is of 300 Tudor cells, with a capacity of 4,000 amperes per hour, at one-hour rate of discharge. It has two automatic cell regulating switches; one charging booster set, consisting of a British Westinghouse three-phase 5,000-volt motor, and two booster generators, each to boost 2,000 amperes at 150 volts; and one motor-driven "Milking" booster. The contract for the supply of both alternating and direct current motors of over 5 h.p. for the City Council has also been obtained by the same firm for British Westinghouse motors.

BAHAMA ISLANDS.—We give particulars in another column of the contract which the Crown Agents for the Colony, through their consulting engineers, have placed with Messrs. Crompton & Co. for an electrical installation in the town of Nassau, the capital of the Bahama Islands.

EDMONTON.—At their last meeting the Guardians of the Edmonton Union had under consideration forty-two tenders which had been submitted to the specification of Messrs. May & Hawes, the consulting Electrical Engineers for the Electric lighting installation of the Nurses' Home. The tender of Messrs. Tilley Bros., 53 Kingsland Road, London, amounting to £376, was accepted. This is the first section of a large extension scheme which the Guardians are carrying out in connection with the new infirmary. The specification for the electric lighting of the infirmary itself will be issued in a few months' time.

GREAT WESTERN RAILWAY CO.—The contract for the erection of generating station buildings at Fowey, Cornwall, has been let to Mr. J. H. Endean, of Plymouth.

LEEK.—The following tenders have been received for a short length of cable:—Edison & Swan United Electric Light Co., £43; Callenders Cable & Construction Co., £37 17s.; W. T. Glover & Co., £37 17s. The tender of Mr. E. Phillips for the wiring of the station extensions at £19 has also been accepted.

LONDON: *St. Pancras.*—The Borough Council has accepted the tender of Messrs. Dorman, Long & Co., at £66 6s. 6d., for strengthening the stanchions of the old building in the King's Road generating station.

Stoke Newington.—The Council has accepted the tender at £46 19s. of James Keith & Blackman Co., Ltd., for the supply and fixing of an electric fan and case and air trunk for ventilating the generating station.

MANCHESTER.—The Lancashire Dynamo & Motor Co. have received an order from the Corporation for a three-wire hand-reversible booster.

The contract for a storage battery at Stuart Street Station has been given to the Tudor Accumulator Co., for the booster and switchboard in connection therewith to the Lancashire Dynamo Co., and for the low pressure pipe-work at Dickinson Street, to Messrs. Newton, Chambers.

METROPOLITAN ASYLUMS BOARD.—The following tenders have been received for the installation of a storage battery, booster, switchboard, and connections on board the training ship *Exmouth*:—Johnson & Phillips, Ltd. (accepted), £302; the General Electric Co., Ltd., £304; Pinching & Walton, £307; G. E. Taylor & Co., £310 13s. 3d.; Union Electric Co., Ltd., £312 5s.; Cox-Walkers, Ltd., £325; Watford Engineering Works, £327; Nursey & Marr, £345; Whipp & Bourne, £352; Edmundson's Electricity Corporation, Ltd., £354; Dargue, Griffiths & Co., Ltd., £365; Millwall Electric Co., £375 4s.; Pritchetts & Gold, Ltd., £382; the D. P. Battery Co., Ltd., £406; Electric Construction Co., Ltd., £409; W. Harvie & Co., Ltd., £410; Crompton & Co., Ltd., £415; Premier Accumulator Co., Ltd., £415; Chloride Electrical Storage Co., Ltd., £450; Siemens Bros. Dynamo Works, Ltd., £485; Electrical Power Storage Co., Ltd., £487; C. Pullan, £499; Hart Accumulator Co., Ltd., £520 17s.; R. Pope, Ltd., £555; S. Newton & Co., £715. The Engineer-in-Chief's estimate was £300.

STRETFORD.—The following tenders have been accepted:—boilers and pipe-work, Ed. Heaton & Sons, £1,860; mechanical stokers, Hodkinson & Co., Ltd., £286 12s. 2d.; economiser, Green's Economiser Co., Ltd., £492 18s.

SWANSEA.—The Town Council has accepted the tender of Glasbrook Bros., Ltd., for the supply of small steam coal (Garngoch) for 12 months.

WALSALL.—The Town Council has accepted the following tenders in connection with the electricity undertaking:—cast iron pipes, Lambert Bros.; flanged pipes, Roberts & Co. (socketted pipes); spare coil for the 66 kw. transformers, Thomas Parker, Ltd., £15 10s.; foundations for cooling tower, O. W. Wistance, £212.

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WESTMINSTER ELECTRIC SUPPLY CORPORATION.—The Westminster Electric Supply Company, Ltd., have, at the advice of their Engineers, Messrs. Kennedy and Jenkin, placed an order for five surface condensers for their new power station in the Horseferry Road, in the hands of Willans & Robinson, Ltd., Rugby, at £7,072 18s. 6d.

COMPANIES' MEETINGS AND REPORTS

BRITISH ELECTROMOBILE CO.—The report which has just been issued states that to March 31st there was a loss of £2,411. As the company has now a sufficient number of carriages available to meet the present demand, the directors have decided to close and sub-let the works. They have also decided to waive all claims to their remuneration as directors up to March 31st, and further, offer to cancel 3,928 shares of their respective holdings in order to write off the loss in revenue account, the preliminary expenses (£329) and the loss on fixtures, plant, and stock, mainly due to the closing of the works (£1,161), on the condition that eight founders' shares of nominal value of 1s. each be created, and that the Board shall have the right of subscribing for such shares in proportion to the shares surrendered. The founders' shares are to be entitled to a sum equal to 25 per cent. of the future profits of the company distributed in dividends on the remaining £12,447 ordinary shares.

CIA TELEGRAFICA, TELEFONICA, NACIONAL (Buenos Aires).—At the recent annual general meeting, the report and accounts were adopted, and a dividend of 7 per cent. declared. The profits amounted to $22,287 gold.

DIRECT WEST INDIA CABLE CO.—The accounts for the year ended June 30th, 1908, shows a net profit of £36,196, including the amount brought forward from last year. After providing for debenture interest, a further dividend of 3 per cent. is recommended, making the usual 6 per cent. for the year. During the year debentures have been paid off to the extent of £6,100, leaving £50,900 outstanding. The company's investments, apart from the value of its cable and equipment, are now valued at £58,850.

HALIFAX & BERMUDAS CABLE CO. There is an available balance, after providing for debenture interest, and including £17,848 brought forward from the last account, of £20,943 for the year ended June 30th. A further dividend of 2½ per cent. is recommended, making the usual distribution of 5 per cent. for the year. The carry forward is £17,193.

JOHNSON, LUNDELL ELECTRIC TRACTION CO.—A meeting was called for 11 a.m. on Wednesday last week at Cannon Street Hotel, but the Press were refused admission.

UNITED ELECTRIC CAR CO.—The report for the year ending June 30th, 1908, states that the works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest amounting to £2,500, and charging £5,677 for depreciation, the profit for the year is £7,092, to which is added £5,095 brought from last year, making a total of £12,187. Deducting preference dividend for the six months ending December 31st, 1907, there is an available balance of £9,187. The directors recommend the payment of the preference dividend for the half-year ending June 30th, 1908, which absorbs £3,000, carrying forward £6,187. Mr. Ludford C. Docker, owing to ill-health, resigned his position as a director during the year, and the directors have accepted his resignation with much regret. In his place the directors have elected Mr. Henry Mercer Malcolm, of London. The retiring directors are Mr. Kerr and Mr. Barningham, who offer themselves for re-election. The meeting will be held to-day at Preston.

Admiralty and Wireless Telegraphy.—The temporary installation of wireless telegraphy which was erected some time ago on the roof of the new Admiralty buildings in Spring Gardens is, says the *Daily Graphic*, being replaced in a permanent form in the three great towers overlooking the Horse Guards' Parade.

Marseilles Electrical Congress.—The International Electricity Congress in connection with the Marseilles Electrical Exhibition was opened on Monday, delegates being present from twelve countries.

Telegraph Traffic.—Telegraphic communication "via Kassala" was restored on the 9th inst. The submarine cable connecting Cadiz and Teneriffe was restored to working order on the 10th inst., having been inoperative since August 20th last. The Indo-European Telegraph Company's system ceased working on the 11th inst. between Tiflis and Tauris, and was in working order again on the 12th. The Lagos-Kotonou cable is still down. Telegraphic communication has now been established with the Island of Pemba, Zanzibar. The French Cable Company has again suffered a misfortune by the breaking of the cable between Cape Hayti and Mole St. Nicholas. Messages for Port au Prince will therefore have to go via Santiago de Cuba. It is very possible that the cable was broken owing to the recent hurricane at Turks Island, which travelled in a south-westerly direction. At the time of going to Press we also learn that telegraphic communication with Barbados has stopped owing to interruption of the two cables between St. Vincent and that island.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £63 to £63 10s. per ton (last week, £63 10s. to £64 10s. per ton).

BRYANT TRADING SYNDICATE.—The employees of the "Metalite" lamp department of the Bryant Trading Syndicate had their annual outing on Saturday last to Clacton.

ELECTRICAL TRADES' FOOTBALL LEAGUE.—The League will hold its first concert and presentation of medals on November 7th in the large hall at the Robertson Electric Lamp Works, Brook Green, Hammersmith.

GILBERT ARC LAMPS.—The Gilbert Arc Lamp Co. have appointed Messrs. Parmiter Hope & Sugden, of Hulme Electrical Works, 50 Ellesmere Street, Hulme, Manchester, to be their agents for Lancashire & Yorkshire, as from September 1st. Messrs. Parmiter Hope & Sugden will keep a large stock of the Gilbert standard apparatus, so that the ever-increasing number of orders for Gilbert lamps can be executed without delay.

"GRAL" METAL FILAMENT LAMP.—The Armorduct Manufacturing Co., Ltd., Farringdon Avenue, London, have secured the exclusive sale for Great Britain and the Colonies of the "Gral" high-voltage metallic filament lamp. The lamp is manufactured from 40 c.p. upwards; the size is considerably below that of any similar lamp at present on the market, being only 4½ in. by 2¾ in. overall, and the efficiency is 1 watt per c.p.

EXHIBITION AWARD.—The Union Electric Co., Park Street, Southwark, have been awarded a medal of the first class at the Camborne Mining Exhibition for their exhibit of motors, arc lamps, mining switchgear, and measuring instruments.

DISSOLUTIONS OF PARTNERSHIPS.—C. T. Brown and H. I. Lewenz, electrical and mechanical engineers, Romsey, Hampshire, have dissolved partnership.

The partnership between J. R. Middleton, Alfred Daniels, and F. W. Balch, carrying on business as electrical engineers, 11A King Street, Dover, as Middleton & Co., has been dissolved so far as concerns F. W. Balch, who retires from the firm.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—G. H. Smith, electrical engineer, 15 Ashley Road, Altrincham, has been adjudicated bankrupt. The first meeting of creditors took place yesterday at the Official Receiver's offices, Byron Street, Manchester, and the public examination takes place to-morrow at the Court House, Quay Street, Manchester.

A meeting of the Lancashire Electric Supply Co. will be held at 4 Chapel Walks, Manchester, on October 20th, at 3.30 p.m., to hear the liquidator's account of the winding up.

NEW PUBLICATIONS

"The Management of Dynamos." By G. W. Lummis-Paterson. Fourth edition. (London: Crosby, Lockwood & Son.) 4s. 6d.

"Electrical Engineers' Pocket-Book." By Horatio A. Foster. Fifth edition. (London: Archibald Constable & Co.) 21s.

The Telephone Tariff.—In view of the meeting of the Associated Chambers of Commerce at Cardiff, at which the question of telephone charges will be discussed, the following particulars of a correspondence which has taken place between Mr. Charles Lancaster, a member of the Telephone Committee of the Chambers of Commerce, and the Postmaster-General, is interesting. Mr. Lancaster asked the Postmaster-General whether a total of 10,000 outward telephone calls per annum, for a subscription of £10, could be contracted for by the Government to leave (*a*) a moderate profit, or (*b*) without loss. The reply of the Postmaster-General was to the effect that in his view such a tariff would certainly involve a financial loss, and, further, that 10,000 outgoing calls on a single line would overload it and seriously impair the efficiency of the service. In the course of a lengthy reply, Mr. Lancaster endeavours to show the kind of tariff that ought to be charged by the Government, by means of a very detailed statement, based upon the assumption that the National Telephone Co.'s system, as it stood on June 30th, 1908, was in possession of the Post Office. In this he eliminated those items which the Government would not be called upon to pay in the form in which they appear in the company's books, viz., royalties, income tax, pension fund, and compensation fund. The purport of the statement is that a tariff, under the measured rate system, should be capable of arrangement which would approximate to a subscription of £10 per annum for 10,000 outgoing calls. In his reply, the Postmaster-General expresses the opinion that, in existing conditions, 5,000 originated calls per annum made up a full load for the telephone line of an average subscriber who receives as many calls as he originates. At the conclusion of his letter, the Postmaster-General expresses his willingness, in the interests of the larger users, to consider a proposal on the lines laid down, which might lead to an equitable working arrangement.

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THE RUBBER EXHIBITION AT OLYMPIA

THE International Rubber and Allied Trades Exhibition was opened on Monday last at Olympia. There are many exhibits of general interest, but few of particular interest to electrical engineers. Samples of various kinds and qualities of raw rubber from places all over the world are exhibited, and machines and photographs illustrating the different processes in the collection and treatment of the raw rubber and the operations of vulcanisation and compounding are to be seen. The Indiarubber, Gutta-Percha, and Telegraph Works Co., Ltd., have a large exhibit, which includes, among other things, pliers with ebonite covered handles, ebonite covered spanners, telephone cases, accumulator cells, switch-handles, and other ebonite and vulcanite productions. There is, of course, on this company's stand, also a good selection of sections of telegraph, telephone, power, and other cables, with both rubber and gutta-percha insulation. Messrs. Francis Shaw & Co., of Bradford, have several machines on exhibit, among which is one especially designed for grinding waste rubber. The rollers are of chilled cast iron, 28 in. long by 16 in. diameter. The caps are of solid forged steel, and the gearing throughout consists of machine-moulded wheels. The gearing is arranged to run the rollers at two speeds, the change being effected by means of a double clutch. The machine is motor-driven through double helical machine-cut wheels. A drum type starter is fixed on one side of the machine and an emergency switch above the rollers, so that in case of accident the whole machine can be stopped in a moment by pressing the button. Sections of electric cables, for both low- and high-pressure work are exhibited by the Société Industrielle des Téléphones of Paris, and a large number of books on rbuber and its applications are shown by various publishers. Messrs. Brooks & White have carried out the lighting of the stands, and the installation of the motors for driving the exhibits. The cable manufacturer who is interested in the origin and preparation of his raw materials should certainly pay the exhibition a visit, and we may mention that the catalogue issued by the Committee contains much valuable information on this subject.

MISCELLANEOUS CITY NOTES

BROMLEY (KENT) ELECTRIC LIGHT & POWER CO.—A dividend of 4 per cent. per annum upon the ordinary shares has been announced.

BUENOS AIRES GRAND NATIONAL TRAMWAYS CO.—The *Stock Exchange Gazette* states that there is no longer any room to doubt that the time is not far distant when this company will be absorbed in the Anglo-Argentine system, and its capital shares exchanged for those of that concern.

CIA ANGLO-ARGENTINA DE ELECTRICIDAD.—The *Review of the River Plate* comments upon the fact that during the first year of its existence this company paid two half-yearly dividends, but that since October last no dividend has been paid, and that the shareholders are beginning to wonder what the company is doing in view of the fact that the other similar concerns pay regular interim dividends.

FELTEN & GUILLEAUME LAHMEYERWERKE A.G.—It is announced that this company has decided to increase their share capital from M20.000.000 to M25.000.000, and that the new shares will be offered to the existing shareholders. It is also proposed to issue M5.000.000 of 4½ per cent. bonds. The proceeds of these bonds will be employed in the redemption of the floating debt of the company.

NEWCASTLE & DISTRICT ELECTRIC LIGHTING CO.—The directors have decided not to pay an interim dividend for the half-year just ended.

ROBURITE EXPLOSIVES CO.—An interim dividend of 10 per cent. is announced per annum upon the preference shares.

APPOINTMENTS AND PERSONAL NOTES

Mr. V. A. Brown has resigned the sub-managership of the Grand National Tramway Combine (Buenos Aires), and, after a few months' holiday in England, will return to take up the General Managership of the Buenos Aires Lacroze Tramways Company.

Mr. A. C. Ellis, General Manager of the Metropolitan Railway, has resigned. Mr. R. H. Selbie, the Secretary of the company, succeeds Mr. Ellis.

Mr. C. D. Taite, the popular engineer and manager of the Lancashire Electric Power Co., was married on Saturday at St. Marylebone Parish Church, London, to Miss Eleanor Kathleen Corneille, fourth daughter of the late William Corneille, of Tipperary.

THE NATIONAL TELEPHONE EMPLOYÉS GRIEVANCES

As we go to press, an intimation reaches us to the effect that the Post Office does not regard as serious the complaint made by the National Society of Telephone Employés, with regard to the dismissal of some of the National Telephone Co.'s workmen at the end of construction work. It will be seen from the correspondence which we publish on page 437 that the Society is loth to give any very definite information as to the number of workmen of each class discharged, and the districts in which any wholesale dismissals have taken place, and that our request for precise figures in order to obtain an idea of the gravity of the situation has been replied to by a repetition of statements more or less of a general nature. The Post Office now say that the number of dismissals is not more than usual at the end of construction work. The announcement made by the department yesterday continues as follows:—

Employees, at all events, have nothing to fear as a result of the impending transfer to the Post Office, for this department is prepared to take over all employees who have been in the service of the company for a period of two years before December 31, 1911. Moreover, it is finding employment now for the temporary men who have been discharged. While the company cannot be expected, in view of the early transfer of their system, to do more than carry out the engagements already entered into, the Post Office has stepped into the breach and has taken over their obligations. It is constructing new lines every day, and is renting the wires to the company. For instance, the Post Office has built the new large exchange at Cardiff, and in several provincial towns it is laying down underground wires and performing work which otherwise would fall to the company. Thus there is no possibility of the telephone system's suffering in view of the position in which the company finds itself, and the lot of the employees cannot be greatly affected.

Further, the Post Office authorities have asked the permanent engineer of the company to let them know of any dismissals, in order that employment may be found for the men by the Post Office. Judging by the number of applications received, it is found that the number discharged is not more than usual. Naturally, the employees are afraid of losing their employment, and it is presumed that their fears are due to inaccurate statements. At present the Post Office is doing thousands of pounds' worth of work for the National Telephone Company, and before 1911 it is estimated that the Post Office outlay in this connection will exceed £500.000.

The inability of the National Society of Telephone Employés to furnish us with the numbers and status of unemployed in the various districts is therefore explained by the fact that the heads of the engineering departments of the Post Office and National Telephone Co. are in communication on the subject, with the result that re-employment of the capable men is already taking place, apparently without the necessity of any co-operation on the part of the Society.

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For further particulars and detailed Syllabus of each Course, see Prospectus.

C. T. MILLIS, *Principal.*

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ELECTRICAL ENGINEERING

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Binding Cases for Vol. III. may now be ordered, price 2s. each, post free 2s. 4d. Readers can have their volumes bound by their own bookseller; or they may send their numbers to us, carriage paid (with the reader's name and address), and a remittance of 4s 6d. under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad.

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PUBLISHERS' ANNOUNCEMENT

On and after October 1st, the price of "Electrical Engineering" will be reduced to 1d.

The first number of "Electrical Engineering" was published on January 3rd, 1907, and the paper immediately took the leading position among the electrical newspapers. A thoroughly sound and practical technical paper, written and edited by men with long experience on the practical side of the electrical engineering industry, and illustrated with useful drawings to scale and well-printed photographs, was welcomed, and in spite of the comparatively high price of 6d., which it was necessary to charge for it, the paper scored an immediate success. The proprietors have been repeatedly urged to reduce the price in order to bring the paper within the reach of a wider circle of readers, and they are now in a position to make a concession in this direction that was not possible hitherto. They do not believe in half measures. On and after October 1st, therefore, "Electrical Engineering" will be on sale throughout the United Kingdom at the popular price of 1d. weekly (post free 1½d.), and it will therefore appeal to everyone connected with the electrical engineering industry. The leading features of the Paper will remain unaltered. No change has been made in the Editorial Staff, the same high-class printing and illustrations will be maintained, and the proprietors rely absolutely on the enormous increase of circulation which is assured, to recompense them for the sacrifice they are making in decreasing the price.

We feel confident that our readers will assist us by bringing the paper to the notice of engineers engaged in kindred branches of the engineering industry. It will be unnecessary, moreover, that

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single copies of "Electrical Engineering" should circulate among 20 or 30 readers, as frequently happens at present; in future each reader will be able to buy and retain his own copy at 1d.

Arrangements have been made by which "Electrical Engineering" will be obtainable at all Messrs. W. H. Smith & Sons' and Messrs. Wyman's bookstalls, and through every newsagent in the United Kingdom. If any difficulty is experienced in obtaining it, complaint should at once be made to the Publishers. Readers who prefer to receive the paper through the post should order it direct from the Publishers (The Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, London, E.C.). The annual subscription rate, including postage, is 6s. 6d. for the United Kingdom, 8s. 8d. for Canada, and 13s. for other Colonies and abroad. (Subscriptions should be paid in advance.)

Existing subscribers will have the unexpired period of their subscriptions extended in proportion to the difference in price.

WE regret to say that Messrs. Cassell and Co. Ltd., are issuing in sevenpenny fortnightly parts a publication entitled "Electrical Engineering," in spite of our protests that confusion is likely to arise in the newspaper trade owing to the title being the same as ours. Particulars of this serial appear in our advertisement pages. There is no possibility of any of our present readers being misled, but to avoid mistakes by their newsagents they are recommended to make it clear when ordering their copies that they require "Electrical Engineering," the weekly newspaper.

SUMMARY

WE are now able to give some further information as to the report of Mr. C. H. MERZ on the electrification of the Victorian Railways, supplementing the brief outline of the proposed scheme in our last issue. The system recommended for the lines, which are principally suburban, is a protected third rail at 800 volts, with power taken from a large steam turbine-driven generating station, transmitting at 10,000 volts three-phase to rotary converter sub-stations. An acceleration of 0·92 mile per hour per second is recommended, and the trains are to be made up of standard units, each consisting of one motor coach, with two motors on one bogie, and one trailer. The whole net capital cost of the conversion, which is to be taken in hand in four stages, is estimated at £1,801,460, and the operating expenses per train mile are estimated as 11·03d., as against 18·93d. for steam traction. (Page 451.)

Two new patterns of automatic switches for indicating, by flickering or total extinction of the light, when a consumer's demand has exceeded the maximum permissible according to his contract, have been recently put on the market by two well-known German firms. The first type operates by the action of an electromagnet on a swinging balance wheel, to which is attached the main-switch arm, and the second makes use of the expansion of a stretched wire in series with the load. The former pattern produces flickering of the lamps, the latter intermittent extinction every few seconds. (Page 456.)

THE seventh annual conference of the Municipal Tramways Association commenced yesterday, with Mr. J. ALDWORTH'S presidential address, in which he reviewed the year's work of the association and touched on a number of tramway problems awaiting solution He said he was watching with interest the development of the trackless trolley system, which he hoped would prove a valuable factor in the extension and linking-up of tramway systems. A Paper was also read by Mr. H. E. BLAIN on through-running, in which the advantage of its adoption wherever circumstances permitted, was urged, and particulars were given of the methods adopted in a number of actual cases, including the author's own system at West Ham. (Page 457.)

A LETTER from Mr. MILES WALKER answers some of the criticisms on his proposed scheme of new physical symbols. (Page 458.)

A LARGE "superfine" spinning mill, newly-built at Bolton and shortly to be put in operation, has been constructed from the outset with electric driving. A detailed description gives full particulars as to the arrangement of the motors, and it also includes a detailed description of the 400 kw. Zoelly turbine used in the power-house. (Page 459.)

A FIRE occurred at the main Paris Telephone Exchange between 8 and 9 o'clock on Sunday evening, which resulted in the whole of the centre of Paris, on the right bank of the river Seine, being cut off from telephonic communication. By yesterday, however, communication had been re-established with London and Brussels, as well as with a considerable number of French towns outside Paris. (Page 464.)

A DEMONSTRATION of a system of wireless operation of the keyboards of Linotype or other machines was given in London on Thursday last by the inventor, Mr. HANS KNUDSEN. The apparatus consists essentially of two travelling brushes moving synchronously over a row of contacts at the transmitting and receiving stations respectively. The system is not yet sufficiently developed for practical working. (Page 465.)

A NEW form of double tumbler switch has been introduced. (Page 465.)

THE new engineering laboratories and workshops of the Heriot-Watt College, Edinburgh, were formally opened by Lord Rosebery on September 16th. The laboratories are devoted entirely to mechanical engineering and include steam and gas engine plants specially designed and arranged for experimental purposes. The metal and wood-working tools in the workshops are electrically driven. (Page 467.)

THE report of Colonel YORKE and Mr. TROTTER on the fire which occurred on the City and South London Railway in July states that the actual origin of the fire cannot be ascertained with certainty, but the opinion is expressed that it probably did not originate from any defect in the insulation or continuity of the cables, but began with a smouldering which may have developed into flames by the draught of passing trains. Some recommendations are made with a view to reducing the risk of fire or smoke, especially as regards the more complete removal of dust and dirt. The section of the line where the fire took place was opened before the present Board of Trade regulations regarding tube railways were in force. (Page 468.)

MAJOR PRINGLE'S Board of Trade report on the Bournemouth tramway accident attributes the running away of the car to a defect in the rear controller unknown to the driver, which prevented the magnetic brake from acting when called upon. Major Pringle also severely criticises the management of the undertaking. Some letters from the officials of the tramways refute his criticisms. (Page 469.)

THE economies obtainable by the adjustment of the load of electrochemical works to fill up the inequalities of the load curve of central stations are discussed under

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ELECTROMETALLURGY and ELECTROCHEMISTRY. The electrolytic refinery at the San Francisco mint is also described. (Page 472.)

A PATENT relating to the construction of polyphase motors for marine propulsion was published by the Patent Office on Thursday last. This was granted to H. A. MAVOR and MAVOR & COULSON, LTD., and is for a method of building the motor into the framework of the ship for the purpose of saving weight. Among the other specifications published is one by O. SCHALLER for a train lighting system, which consists in making the lighting pressure the sum of the voltages of two generators, the speed of one of which drops as the speed of the other rises. A double suspending hook for metal filaments, by which the sides of a loop are prevented from touching, has been patented by the DEUTSCHE GASGLÜHLICHT AKT.-GES., and a specification by J. W. HUNTINGTON describes a combined wall-plug and switch. The specifications of H. C. E. JACOBY for the single-phase variable-speed motor, recently described in these columns, have also been published. A specification by E. L. OPPERMANN relates to an improved form of case for accumulator cells. The BRITISH THOMSON-HOUSTON Co. have one for a method of cross-connecting the armature windings of high-speed direct-current machines, whereby the voltage per segment is considerably reduced without, it is said, any detrimental self-induction, due to the cross-connecting conductors, being inserted in the coils. A patent granted to THE HALL SIGNAL Co., U.S.A., for a motor-operated railway signal, expires during the current week. (Page 473.)

THE Belfast Corporation is not sending official delegates to the Municipal Tramways Conference in Nottingham, owing to the Local Government Board having surcharged the expenses of the Corporation delegates to the Municipal Electrical Association this year.—There is a net loss of £358 upon the Kilmarnock electrical undertaking for the past year, and a deficit of £1,852 upon the tramways undertaking.—Surveys are being carried out in connection with the Euston-Watford electric railway.—An independent expert is to be engaged by the West Ham Corporation in connection with the Local Government Board inquiry for a new loan.—The Board of Trade have refused to insert a clause in the York Light Railway Order giving the Corporation power to sell the undertaking.—The Chairman of the Bray Electric Lighting Committee has resigned owing to the lack of interest taken in the undertaking by other members of the Council.—In reply to an inquiry from the Dundee Council, the Board of Trade state that they have no *prima facie* objection to electric trolley omnibuses.—There was a loss of £1,789 upon the Ipswich Electric lighting undertaking for the past year, and a loss of £1,450 upon the tramway undertaking. (Page 475.)

TENDERS are invited by the Watford Council for generating plant; a 200 h.p. induction motor is required by the Birmingham, Tame, and Rea Drainage Board; London County Council advertises for fuel economisers, feed-pumps, and two 5,000-kw. horizontal steam turbo-generators. Local Government Board inquiries have been held as follows:—Holyhead (£3,000); Stoke (£15,365); Maidstone (£18,440). Switchgear is required by the Radcliffe Council. (Page 476.)

THE accounts of Messrs. Dick, Kerr & Co. for the year ended June 30th show a gross profit of £125,867. The dividend upon the 6 per cent. preference shares is recommended, and 10 per cent. upon the ordinary shares. A dividend for the June half-year of 1s. 7½d. is declared by Messrs. Babcock & Wilcox. (Page 478.)

MR. R. NELSON, of Messrs. Merz & McLellan, has been appointed to the newly-created post of H.M. Electrical Inspector of Mines. (Page 479.)

THE electrical equipment of the Victorian railways is an important scheme, and we are glad to be able this week to publish some additional information with regard to Mr. MERZ'S project, supplementary to the brief description we gave last week from a condensed official abstract of his report. We have now been privileged to see a copy of the full report, and have been able to gather some additional particulars. In the first place it is now clear that the total length of 124 route miles, which it is proposed eventually to run electrically, consists of several lines, radiating more or less from a centre, and all of an essentially suburban character. The area of distribution, therefore, is by no means too great to reach from one power house on the high-tension three-phase system with converting sub-stations, and the total power required—estimated at about 35,000 h.p.—is not unduly large for a single generating station when compared with the totals estimated in the most recent London power schemes. Mr. Merz's recommendation to use a D.C. third rail system is also quite intelligible when the conditions are properly appreciated. As we have said, the system is a suburban one—a system with heavy passenger traffic and no goods traffic—one to be run with motor-cars on the multiple unit system rather than with locomotives. To apply an alternating-current system for this would entail not only extra weight but extra complication, the addition of transformers on the trains, and the employment of motors on more of the axles. A continuous-current third-rail system on the other hand, would be largely on standard lines of design, and notwithstanding the campaign against this system a few years ago, there can be no doubt that it is possible to protect the third rail adequately in such a way that danger can be avoided. In fact, it is not even necessary to go so far as to use an "under-running" system; the ordinary third rail protected by boards on both sides should be quite sufficient, and we believe that no accidents have been recorded for rails guarded in this manner. If, however, an under-running system is regarded as a *sine quâ non*, Mr. Merz offers an alternative to the New York rail, which is worthy of serious consideration. Finally, we would call attention to the acceleration question that has recently become almost too much of a fetish. That rapid acceleration is desirable on suburban lines is a doctrine which must, of course, be accepted, but it is possible to go too far in this direction. A point is reached at which one can pay too much for this, and it must be remembered also that there are suburban lines and suburban lines, and that the conditions of the London tube railways are not reproduced everywhere. In considering this question, and also the question of A.C. *versus* D.C., it must be remembered, moreover, that the cost of power is only one item in the cost of running a railway; the cost of maintenance is, in most cases, of equal importance. To gain a slight economy in energy consumption by adding to the equipment of each train, is bad policy if the total amount of inspection and repairs is increased in greater proportion. We are unable to publish Mr. Merz's report in full, as it fills a large volume, and the account of it we give on another page is necessarily somewhat condensed. In giving consideration to the subject, however, the points we have mentioned should not be overlooked.

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DUST, of sorts, is officially declared to be the cause of the fire near Moorgate Street Station on the City and South London Railway on July 16th, as will be seen by the report of Col. Yorke and Mr. Trotter, which we publish on another page. The dangerous character of combustible dusts, especially those of coal, flour, cotton-seed, and linseed, has been abundantly verified during recent years, and it is recognised that their safe removal is as important as that of inflammable gases or vapours. But that the dust which gathers in a tube railway should constitute a fire risk is rather surprising. The two constituents specifically charged with this property are iron from the brakes, rails, and wheels, and carbon from the motor brushes. Incidentally, it may be mentioned, that on the newer tube railways in which the schedule speeds are higher and braking consequently more powerful than on the City and South London, iron dust has given so much trouble by causing leakage over the insulators that compressed treated cotton brake blocks are being tried as subsitutes for iron. The rusty appearance of the sleepers in the open stations on the District Railway in wet weather reveals the large quantity of iron dust produced. Finely divided iron requires a high temperature to ignite it, and, moreover, it is somewhat surprising that it should remain unoxidised for a sufficient time to remain in appreciable quantity as metallic iron on sleepers and cables. Carbon dust should be present, only in much smaller quantity than iron. Oil or grease mixed with the dust, however, will greatly increase its inflammability and promote the maintenance of combustion, and as practically all the lubricant used on the railway is finally distributed on and about the track, and the quantities are much in excess of the brake blocks and brushes used up, we are disposed to suspect this as the chief culprit. Sparks from a collecting shoe, or creeping leakage over an insulator, may have ignited the greasy dust, and there is good evidence that no cables failed until burnt through from outside. The incident will, doubtless, result in greater attention to cleanliness on tube lines, and to a rigid avoidance of combustible materials and open spaces between the sleepers, although the recently constructed tube lines are open to little improvement in this respect. In this, as in every other tube or tunnel fire, smoke was the dangerous element. It drove off the railway men and prevented the firemen reaching the fire for nearly two hours, and yet the actual damage done and amount of stuff burnt was quite small. It is a matter of congratulation that no loss of life or limb resulted, and that the City and South London Railway retains its reputation for safety.

MAJOR PRINGLE'S report on the disastrous runaway car accident at Bournemouth on May 1st shows the primary cause to have been an electrical fault which put the magnetic brake out of action. The controller defect is of the same character as that which led to a recent accident at Glasgow, and was hardly recognised as a possible cause of brake failure until Colonel YORKE investigated that accident. There will be no excuse for overlooking it in future. Beyond the particular cause, the Bournemouth case is additional evidence to the weak points of the magnetic brake, viz., its dependence upon a complete electrical circuit through a large number of contact points, some in parallel, and the absence of any indication of failure until the brake is wanted. On long or steep inclines where the coasting brake is essential to safety, the risk of brake failures must be removed by the adoption of the most certain appliances. In the Bournemouth case the car worked over a route with several long descents, perfectly safe to work with a reliable brake, but entirely dependent on the brake for safe working. The gradient on which the runaway took place is not very steep, but it is capable of giving an unbraked car a speed of 40 miles per hour by the time it reached the point of derailment. The driver, unfortunately, did not recognise the failure of the magnetic brake until it was too late to control the car with the hand-brake, but he stuck to the car, did his best, and was badly hurt, so he escapes censure. The management of the Bournemouth tramways comes in for the inspector's criticism. He regards it as a capital error to run a tramway system without a chief officer, responsible for the whole conduct of the undertaking, an error that would appear to be committed by a considerable number of municipal authorities. He also condemns the practice of sending a car to different sheds, so that it is impossible to say that a particular man is responsible for failing to observe a defect. We are afraid that the traffic manager's notion that this system excites emulation in the discovery of faults is based on a too partial estimate of human nature. Emulation could be better maintained between the different sheds by recording and publishing to the men periodically the car miles run per stoppage on the road by the cars belonging to each shed.

Electrification of the Berlin Stadtbahn.—According to *Elektrotechnik und Maschinenbau*, the conversion of the Berlin Stadtbahn to electric traction will be commenced shortly. The total cost of electrification is estimated at 180 million marks (approximately £9,000,000). The *Elektrotechnischer Anzeiger* states that the plans for the electrification have been drawn up entirely by the Berlin railway authorities, with the exception of the cost estimates, for which the assistance of the large electrical firms was allowed. Two new pairs of rails are to be laid adjacent to the existing double track, and on each of the two tracks for the one direction, a two-minute service will be run; this gives a one-minute service in either direction, which is three times as good as the present service. The total length of single track to be electrified amounts to over 300 miles, including the Stadt and Ringbahn and the suburban railways. It is proposed to connect the Potsdam and Stettin stations on the suburban railways by an underground line. An increase in the tariff to help to cover the expenditure is expected.

Manchester Exhibition.—Following the policy adopted at the Olympia Exhibition in 1905, the management of the Manchester Electrical Exhibition has decided to arrange for a series of lectures on electrical and allied subjects to be delivered by well-known authorities during the holding of the Exhibition. Complete details, however, are not available at the moment. Among the other many attractive features of the Exhibition will be working exhibits showing the processes of incandescent lamp manufacture. In this, the Olympia Exhibition of 1905 will also be followed, there being two such exhibits on that occasion. Arrangements are also well advanced in connection with the model home, in which the latest developments of electricity to domestic necessities and luxuries will be effectively demonstrated. We understand that this home is to be inside the Exhibition buildings, and not, as was at one time proposed, in the grounds. In order to obtain the fullest possible effect, at all times in the day, from the electric lighting exhibits, the building has been so arranged that daylight will be to some extent excluded, and artificial light principally relied upon for its illumination during the day time. Facilities for telephonic communication are to be available in the building.

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THE ELECTRIFICATION OF THE VICTORIAN RAILWAYS

WE gave in our last issue a short summary of the long report which Mr. C. H. Merz has submitted to the Victorian Railway Commissioners on the proposed adoption of electrical working on the railways in the neighbourhood of Melbourne. We have now had an opportunity, through the courtesy of the Commissioners, of seeing the complete report, and are able to give some more extended information as to its contents.

The primary object of the report is to determine whether the substitution of electric traction for steam traction on the Melbourne suburban system is financially justifiable. This involves a decision as to how, from an engineering point of view, such a change should be carried out, and the consideration of the advantages it offers the public.

In the introductory letter Mr. Merz points out that the steady growth of the suburban traffic will make it necessary for the railways to provide additional facilities before very long, in any case, and the present is therefore a good time for examining the possibilities of electric traction. So many heavy suburban lines in Europe and America have been converted to electric traction that there is nothing experimental about the present proposal, and the results obtained on these other systems enable a pretty close estimate to be made of the results obtainable in Melbourne.

The report analyses the nature of the traffic on the railways under consideration and shows how the Melbourne suburban system is a very much more important part of the railway system as a whole than is the case in most great cities.

A general map showing the extent of the suburban system is given in Fig. 1.

In considering the general advantages to be obtained by the substitution of electric for steam traction, it is pointed out that electrical operation necessitates a higher capital expenditure than steam operation, but it gives a considerable saving in operating expenses and many other advantages, of which the principal are as follows :—

From the Public Point of View.—Regular and more frequent service throughout the day. Greater punctuality, due to the greater ability of an electric train to make up lost time. General improvement in the smoothness and safety of working, due to the automatic controlling devices whose adoption usually accompanies electrification. Prevention of fires on property adjacent to the line arising out of sparks from locomotive uptakes. Practical abolition of smoke, steam, and dust, and a great reduction of noise. Possibility of shortening the time of journeys below anything possible with steam. Improved lighting and cleanliness of carriages and stations. Satisfactory regulation of the heating of coaches.

From the Railway Manager's Point of View.—Higher schedule speed, enabling a larger mileage to be obtained from a given amount of rolling stock and a greater number of trains to be operated over a given length of track. Continuous and regular movement of trains, and, in consequence, more economical employment of train crews. Greater

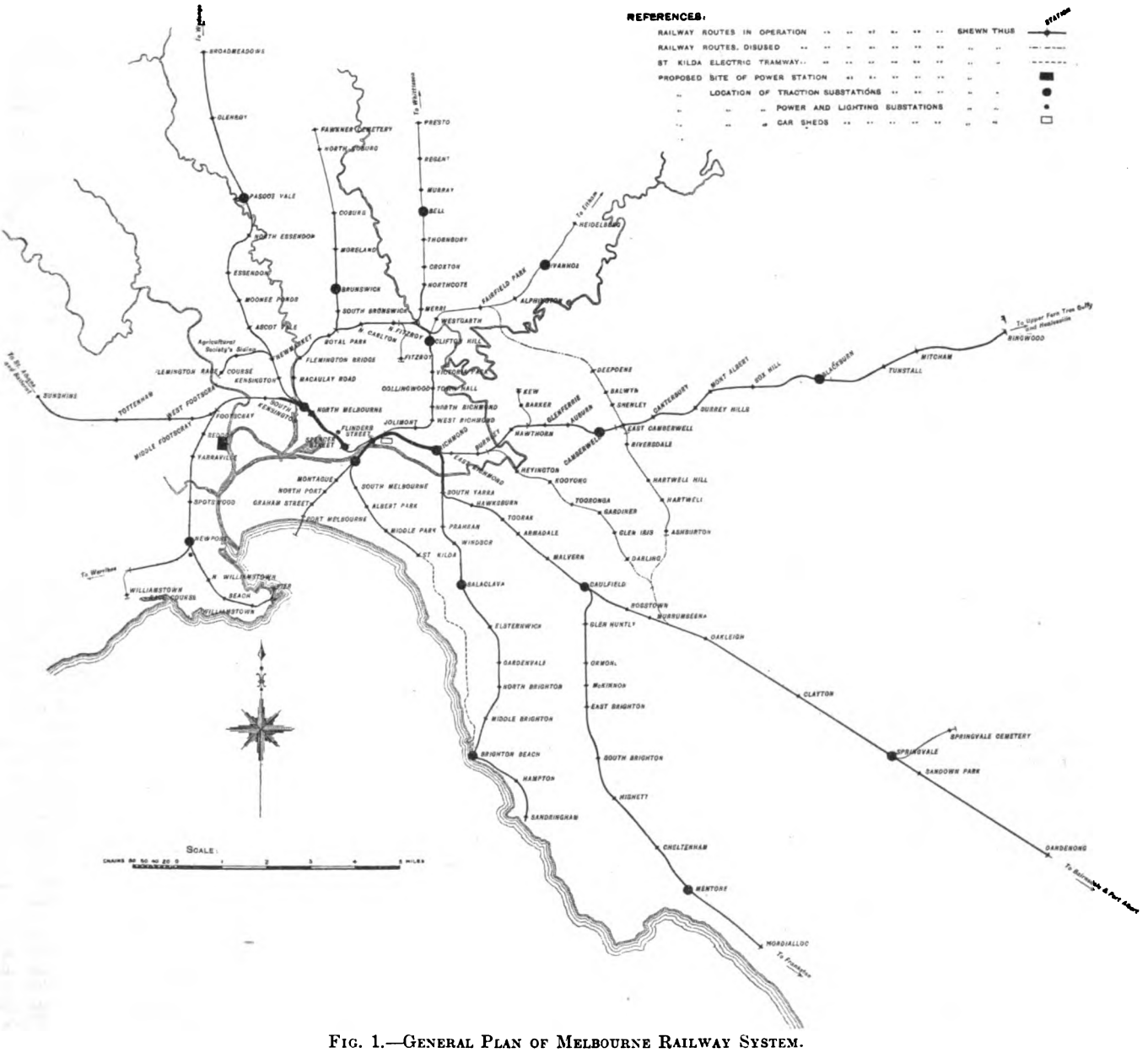

FIG. 1.—GENERAL PLAN OF MELBOURNE RAILWAY SYSTEM.

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flexibility in making up trains to meet the varying requirements of the traffic, both throughout the day and on special occasions, such as race days. Ability to reverse trains at termini immediately without engine shunting, thus reducing the time wasted, the tracks occupied, and the signal and point movements, and entirely dispensing with shunting locomotives, and in consequence (assuming the adoption of the multiple-unit system) increase in capacity of termini, and postponement of terminal extensions. Elimination of the lighting up of locomotives, and of the inefficient water, coal handling, auxiliary, lighting, and heating appliances. Use in the power station of a cheaper fuel than can be used in locomotives. Supply of electric power at a low price available for a number of purposes, such as railway workshops, cranes, and capstans, for which an independent installation would not be justifiable or economical. Reduction in repairs and an increased life of track due to the weight of the driving machinery being distributed throughout the train instead of being concentrated, as in the steam locomotive. Reduced cost of painting, and increased life of metallic structures near the railway due to absence of corrosive fumes.

From the Profit Point of View.—Reduction of operating expenses even for the same train mileage, and considerably greater saving in the expenses per train mile when the mileage is increased. Increase of revenue due to an increase of traffic. Improved earning power of capital sunk in lines, stations, and rolling stock, due to the increased traffic capacity, thus saving capital expenditure which would otherwise be necessary to meet growth of traffic.

The question of acceleration is dealt with. The average length of run on the Melbourne system is five-eighths of a mile, and the average time taken rather more than 2½ minutes. With electrical operation it would be possible to accelerate the trains much more rapidly than with steam, and reduce this to about two minutes.

Numerous attempts have been made on other railway systems to obtain high acceleration with steam locomotives, but it has not been very satisfactory. In actual operation it is usual to take advantage of the high acceleration possible with electric traction, and for economy's sake to accomplish as much as possible of the run by coasting. It is always possible in emergency, as when it is desired to make up time, to cut down coasting and keep the current on until the brakes are applied. The present schedule speed of the Melbourne system averages about 16 miles an hour, and with electric traction it is proposed to increase it to 20 miles an hour. A table is given to show how these figures compare with other railways of varying lengths and average distance between stops. On the Pennsylvania Railway (West Jersey), a line 160 miles in length with an average distance of 8,800 yards between stops, the schedule speed is given as 28·8 m.p.h.; on the Liverpool Overhead (13 miles and 670 yards between stops), it is 19 m.p.h., and the figure for the Central London Railway, of the same length, with 840 yards between stops, is 14 m.p.h.

The acceleration recommended to attain the desired result with sufficient margin for making up time is (on the level) 0·92 miles per hour per second, that is, 1·35 feet per second per second. In determining this figure for acceleration a number of considerations were taken into account, and calculations were made as to the effect of varying the accelerations upon the power consumption, and some curves are given in this connection. A study of these shows that the gain in economy by raising the acceleration above one mile per hour per second is comparatively small for the schedule speed chosen, whilst the increased consumption of electricity, if an acceleration of less than 0·8 be chosen, is very marked indeed. Another important consideration was the margin of speed at the disposal of the driver for making up lost time on different lengths of run. A large collection of speed curves worked out for the actual conditions, with a motor and control equipment designed for the above acceleration, with the weight of train proposed, accompany the report.

It is unnecessary to recapitulate the advantages of the multiple-unit system as given in the report, as they are now universally recognised for this class of work. The normal train recommended by Mr. Merz for Melbourne would be made up of an equal number of motor and trailer coaches; that is to say, the unit is a two-coach train. On outlying routes, of course, the traffic will sometimes be dealt with by a single-coach train, but on busy routes, especially at morning and evening, the trains will consist of two, four, six, or eight coaches. Except where arranged to operate only in four- and six-coach trains on the heavy sections of the system, the trailer coaches will be provided with a driving cab; all motor coaches will be furnished with at least one driving cab.

There follows in the report a detailed exposition of the time-table which it is proposed to adopt, and in framing this attention has been devoted to the desirability of keeping a uniform and frequent service throughout the day, and for economic reasons of encouraging traffic during the slack hours.

The relative merit of various systems of electric traction were very fully gone into before the final recommendations were arrived at, including "third-rail systems" with low or high pressure direct currents, and overhead systems with high pressure direct current (1,200 volts), three-phase at 3,000 volts or over, and single-phase at 6,000 to 10,000 volts.

As the investigation proceeded and the conditions to be met with on the system were fully realised, it was considered that all the systems might be put on one side with the exception of the unprotected third-rail system, the protected conductor rail system, and the single-phase overhead-wire system.

The calculations show that a protected conductor rail system with a voltage of 800 has many advantages over the unprotected third-rail system at a lower voltage, from both financial and operation points of view. Although the unprotected third-rail system has been operated with great success both in England and abroad, and although the accidents from shock have been remarkably few even in a country like England, where for a large part of the year the ground is more or less saturated with moisture, there is no doubt as to the superiority of the protected conductor rail system even in a climate like that in Melbourne. When in addition it is found, as is here the case, that an 800-volt protected conductor rail system can be installed for considerably less money, and will operate at a higher efficiency on account of the lower losses in the conductor rails and track, Mr. Merz has no hesitation in recommending it in preference to any unprotected third-rail system, even under the particularly favourable conditions of track and climate existing in Melbourne. For the Melbourne suburban railways, therefore, it comes down to a choice between the 800-volt direct-current protected conductor rail system and the single-phase overhead-wire system.

It has been claimed that even for such suburban railways on which there is a frequent service, the single-phase system shows very considerable advantage in first cost compared with the direct-current system. This, however, has not proved to be the case after having worked out in detail the cost of dealing with the Melbourne suburban traffic, for not only would the overhead lines be very much more costly than has frequently been stated to be the case, but the additional cost of the large number of train equipments required would practically balance the extra expenditure on the sub-stations required in the case of the direct-current system; in fact, the very complete investigation which was made into the first cost of providing the electrical equipment for the Melbourne suburban railways has confirmed the opinion as to the relative first cost of the two systems which Mr. Merz had formed in investigating similar problems for the other suburban railways. In the case of Melbourne, it is only when including very long and sparsely populated lines, such as the Frankston Branch, to which in any case Mr. Merz does not consider the extension of electrical operation justifiable, that the single-phase system shows any appreciable saving in first cost over the direct-current system.

However, when coming to consider the total annual cost (which is the important figure), including operating expenses and interest charges, it is found that under Melbourne conditions the direct-current system shows a saving compared with the single-phase system. It is, therefore, not found possible to recommend the adoption of the single-phase system on financial grounds.

As, therefore, Mr. Merz cannot recommend the Commissioners to consider the single-phase system for financial reasons, and as he considers that the direct-current system is superior to it in a case such as that of the Melbourne suburban railways from an operating standpoint, he has decided, after having studied the whole problem in great detail and from all points of view, that the direct-current 800-volt protected conductor rail system is the right one to adopt for Melbourne.

As a mechanical structure a protected conductor rail, compared with overhead wires, is superior in both simplicity and reliability; it not only needs less repair, but less inspection. Most important of all, the inspection and repair work can be done by the ordinary permanent way staff in daylight, and when the service is in full operation, whereas the inspection and repair of overhead wires requires a special staff, not only because it has to be done at night, but also on account of the class of labour required. This is obviously very important in a country where electrical operation has not hitherto been adopted and where labour is dear. When it is also considered that the wear on the conductor rail is practically negligible, whereas the wear on the overhead wire is not inconsiderable, this point becomes still more important. While overhead wires may be in every way suited to long lines on which the service is not so frequent and where there is consequently less wear and tear, and where, also, there may be time between trains to inspect and to do repair work, the protected conductor rail, which needs less inspection, and can be, and is, inspected at any time by the ordinary permanent-way men, offers a more reliable service on a busy suburban system.

The question of interference with the important telephone system of Melbourne, although not a matter which concerns the State so much as it does the Commonwealth Government, might have justified, Mr. Merz considers, the taking into consideration—though this has not been done—of the large extra expense which the installation of high-tension overhead wires closely adjacent to the telephone wires would probably mean, not to mention the great public inconvenience of having the telephone service seriously interfered with even temporarily.

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On the basis of 83·7 watt-hours per ton mile (which includes allowances for lighting, heating, control circuits, make, compressors, &c.), it was estimated that the maximum E.H.P. required from the power station for the Port Melbourne and St. Kilda branches—which, as stated in our last issue, is the first instalment proposed for conversion—would be 1,920, and that the whole scheme would call for a maximum of 32,100 E.H.P. Allowing, therefore, also for an extensive power and lighting scheme, the total maximum demand is put initially at 3,480 E.H.P. with a load factor of 34 per cent., and ultimately, on the completion of the third stage, at 35,000 E.H.P. As there are no existing power schemes of a nature suitable for the supply of the large amount of power required, there is no alternative to the construction of an entirely new generating station.

The question of coal and water supply is fully dealt with, and after discussing the relative possibilities offered by stations near the railways and in the Victorian coalfield district, a site for the power station is recommended at Yarraville, where seaborne coal from New South Wales can be unloaded, or Victorian black or brown coal obtained by train. This site is satisfactory as regards water supply, and is within three miles of the centre of the system. A plan of the proposed station is given in Fig. 2. For its equipment the steam turbine has been chosen as being the most efficient machine for producing power with large variations of load, and possessing advantages over the reciprocating engine in steam consumption, attendance, oil, and repairs. With regard to the possibility of using gas engines, Mr. Merz writes as follows :—

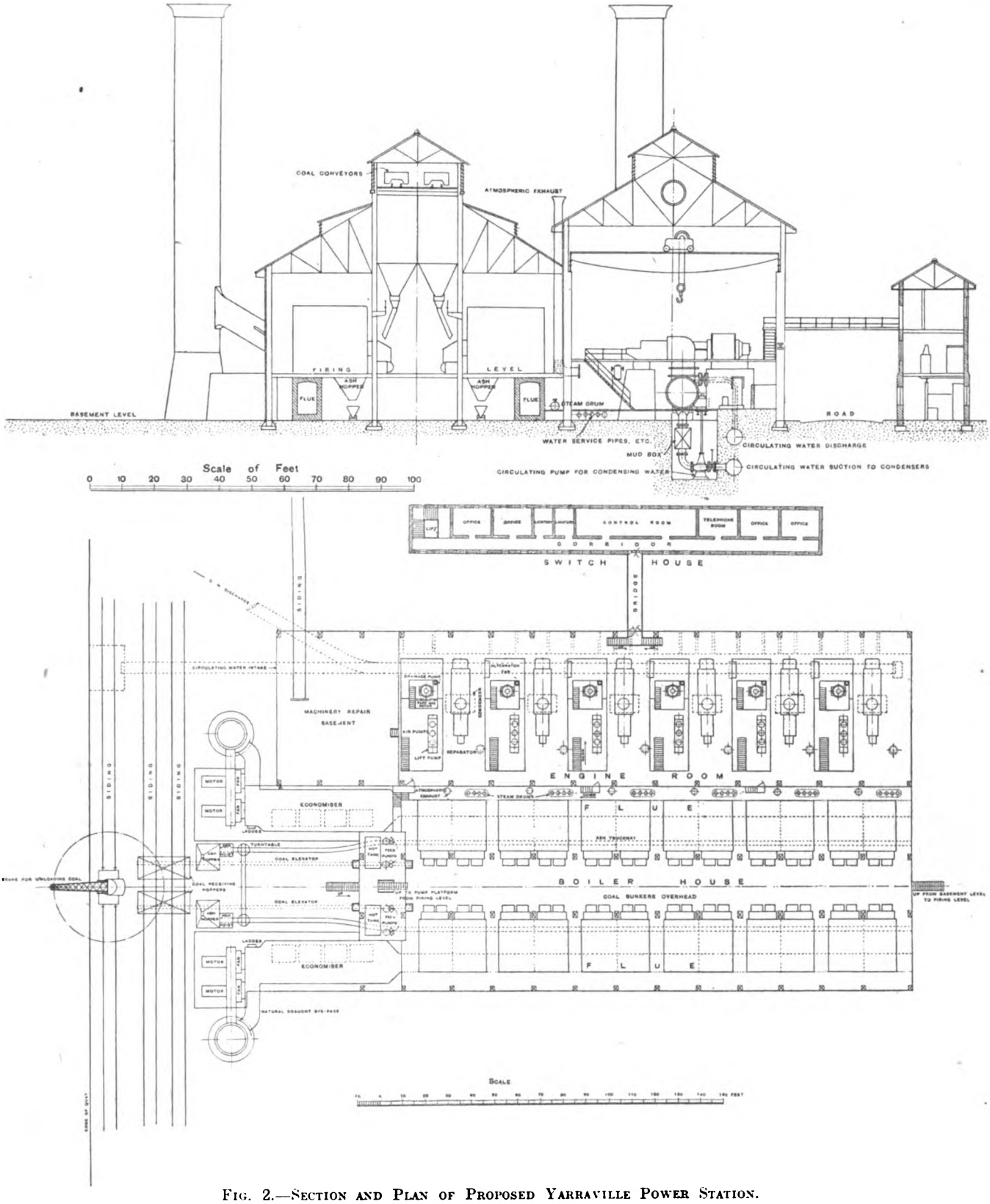

FIG. 2.—SECTION AND PLAN OF PROPOSED YARRAVILLE POWER STATION.

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"Though gas engines might be considered for dealing with a load which resulted in a much better load factor on the station, 70 per cent. to 100 per cent., and which had not the same momentary variations, they could not, on account of the absence of overload capacity, deal with a load such as that now under consideration without very excessive capital expenditure. This is the position to-day and is likely to remain the position for some considerable time. In saying this I have fully in mind the possibility of saving and disposing of the by-products if gas were utilised."

The station is designed to deliver three-phase current at 25 cycles per second at a voltage of 12,000 volts. This voltage was chosen as the highest for which turbo-generators could be recommended, and is sufficiently high for economical transmission to the various sub-stations. The buildings will be steel-frame structures caried on concrete foundations, and the coal will be delivered to coal bunkers situated above the boilers by automatic coal conveyors. The engine-room will contain turbo-generators each of a capacity of 6,000 horse-power. This size of turbo-generator was chosen because it is about the maximum size of alternator that can be built conveniently for 1,500 revolutions, the highest speed for which a 25-cycle generator can be built. In order to deal with the first stage of conversion of the lines, four generating sets will be put down, two of which will be easily able to deal with the load, thus allowing two generator sets as spares. Mr. Merz emphasises the fact that it is advisable to have two spare sets in order that the one set may be standing by while the other is overhauled.

The station can readily be extended for any number of units that may be required from time to time, though the intention is that it should not be extended beyond a total of 10 units. The boilers will be of the water-tube type, delivering steam at a pressure of 200 lb. per sq. inch superheated to 300° C.

A special feature of the design will be that the switchgear from which the operation of the machinery and the circuits will be controlled, will be situated in a separate building, where the operators are undisturbed by the noise of machinery or accidents. An elaborate telephone system connects this control room with each engine, and also connects it with the various sub-stations throughout the system to which the high-pressure current is conveyed, and where it is transformed into low-pressure current suitable for use on the trains. These sub-stations vary in capacity from 1,500 to 6,000 kw., and for the complete scheme would be sixteen in number.

With regard to the transmission of current to the sub-stations, estimates are given for various alternative arrangements for cables throughout, for overhead lines, and for a combination of the two, which on the whole is considered preferable. The proposed equipment for the sub-stations includes rotary converters, and does not call for special remark.

The collection of current from the conductor rail is to be by means of a contact shoe attached to the bogie truck, and this may be of either the under-, over-, or side-contact type. The decision as to which of these alternatives should be adopted depends upon the exact design of protection. Two of the rails which are shown in Fig. 3 are for under-contact shoes and one for top-contact shoes. Whilst Mr. Merz was in Melbourne some samples of typical forms of protection were made and erected on the track, and it was decided to leave these exposed to the atmosphere for a considerable time before coming to a final decision as to the best form of protection and kind of wood to adopt. He also had samples of various woods which it would be possible to use for this protection sent to England and tested in his laboratory, and, although it seems certain that Messmate gives the best result electrically, he withholds his decision as to the exact design of protection for the time being until it is seen how the samples erected in Melbourne stand the effect of sun and weather, and also until some further laboratory tests now being made are completed. The estimates, however, allow for the adoption of any of the type shown, and the specifications provide for the supply of rails, insulators, and bonds of such design that the conductor rail may be completely protected throughout its length.

On double-track roads the conductor rails for both tracks will be laid in the six-foot way, as shown in Fig. 4, thus leaving the tracks themselves, and the outside of the tracks, free from obstruction. Where there are level road crossings or special track work, such as cross-over roads or junctions, the conductor rail will be discontinued and the gap bridged by lengths of low-tension cable laid underground.

The rail bonds are to be placed under the existing fish plates. Section switches are to be installed in the signal-boxes at all junctions. The capital cost of the track equipment for the whole scheme is estimated at £568,139.

It is recommended that the trains be made up of standard train units consisting of one motor coach and one trailer coach, with a seating capacity of 160, and equipped with two motors on one bogie of the motor coach. The type of body recommended is a combination of the compartment and corridor coach, having cross compartments with separate sliding doors and communication on one side. The use of automatic doors is not recommended. Some of the existing trucks can be used

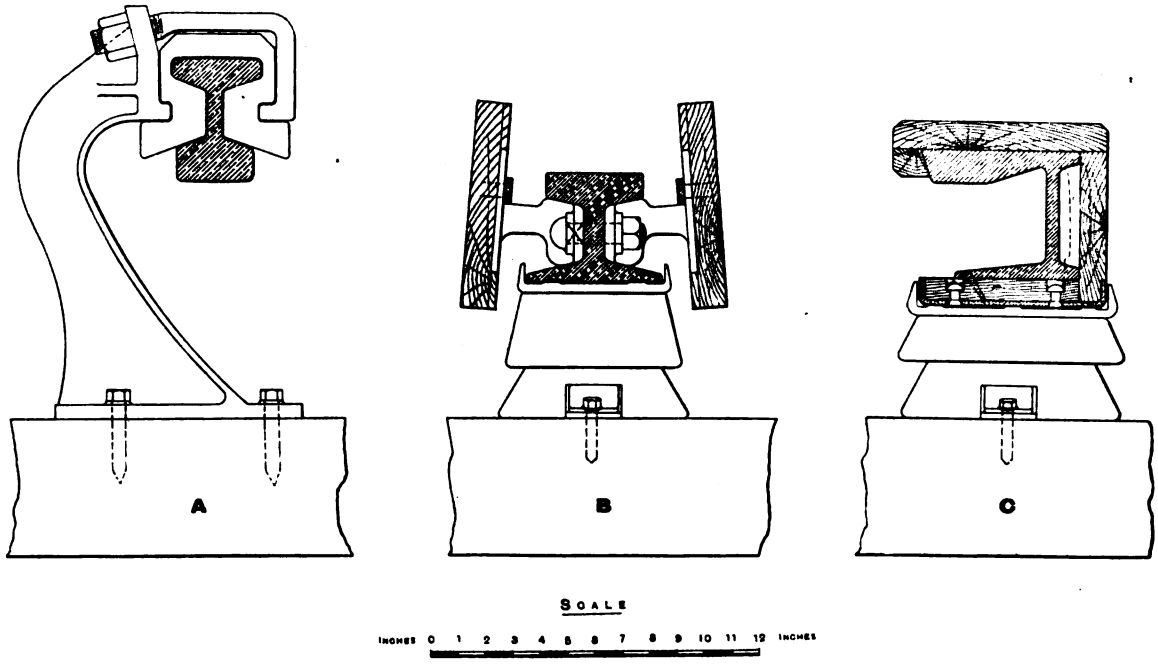

FIG. 3.—ALTERNATIVE TYPES OF PROTECTED CONDUCTOR RAIL.

FIG. 4.—SECTION OF TRACK SHOWING PROPOSED POSITION OF CONDUCTOR RAIL.

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for trailers, but new motor trucks would, of course, have to be constructed. A certain amount of existing stock can be altered to become available.

Mr. Merz assumes that all the work in connection with the rolling stock for the electric service would be carried out in the railway workshops; he has, however, fully allowed in the estimates for the cost of this work, basing his figures upon the information prepared by the Chief Mechanical Engineer.

The report then deals with various auxiliary works, such as new block sections, systems of signalling and train despatch, alteration of existing lines, increase in the number of passenger stations, provision for holiday and race traffic, and general power and lighting, but makes no definite recommendation except that it would be better to defer making any radical changes in signalling and train despatching until experience has been gained from electric working.

Details are also given in the report of a general power and lighting scheme in connection with the railways.

With regard to the lighting of the stations, Mr. Merz recommends that all the stations in the central area be lighted by enclosed arc lamps or else by groups of metallic filament lamps. For stations outside the central area, he recommends that the lighting should be done from the conductor rail by means of incandescent lamps arranged in series. In the more important stations, where, on account of the number of offices and buildings, it might not be convenient to adopt series incandescent lighting, he recommends the provision of a small motor generator supplied from the conductor rail, suitable for transforming down to 100 volts and running in parallel with a small emergency battery. The average cost of wiring, fittings, &c., may be taken as ranging from £2 10s. to £3 per point for platform and outdoor lighting generally, and £1 per lamp for interior work. Arc lighting, with enclosed arcs, for piers and yards may be taken as £17 per lamp inclusive.

The following tables, taken from the report, summarise the capital and operating expenses, and compare the increased cost of electric service with the increased revenue derived :—

Table I.

Summary of Capital Expenditure involved by Electric Traction and Resultant Increased Interest Charges.

	Port Melbourne and St. Kilda Branches.	Stage I.	Stage II.	Stage III.
	£	£	£	£
1. Power Station, high-tension feeders and sub-stations, including spares for Power Department.	221,333	386,357	580,430	846,689
2. Track Equipment, including low-tension cables and alterations to permanent way, and spares	53,330	170,328	311,035	568,139
3. New Rolling Stock (less credits), alterations to existing stock and electrical equipments, including spares	67,674	221,657	426,044	754,881
4. Inspection Pits and Flinders Street Car Shed	14,392	23,538	45,179	57,341
5. Total Cost of Electrical Scheme	356,729	801,880	1,362,688	2,227,050
6. Less Expenditure to deal with Traffic by Steam Traction...	41,730	149,945	274,696	425,590
7. Nett Additional Cost of Electrical Scheme ...	314,999	651,935	1,087,992	1,801,460
8. Interest Charges at 4 per cent. per annum	12,600	26,077	43,520	72,058

Table II.

Operating Expenses with Electric Traction.

	Port Melbourne and St. Kilda Branches.	Stage I.	Stage II.	Stage III
	£	£	£	£
Power Department:—				
Cost of Power	7,719	24,809	46,267	70,591
Rolling Stock Department:—				
Motormen's Wages and Stores	2,693	10,052	19,027	29,079
Inspection and Maintenance of Rolling Stock and Equipment	4,692	25,714	49,570	76,911
Transportation Department:—				
Additional Staff at Stations ...	510	1,968	3,640	6,840
Guards' Wages and Stores ...	2,229	7,728	15,158	23,479
Way and Works Department:—				
Maintenance of Electrical Track Equipment	720	3,300	6,700	12,800
Electric Traction:—				
Operating Costs—Total	18,563	73,571	140,362	219,700
,, ,, per train mile	13·34d.	12·1d.	11·52d.	11·03d.
Steam Traction:—				
Operating Costs—Total	23,100	85,877	160,097	246,967
,, ,, per train mile	19·38d.	19·06d.	18·96d.	18·93d.
Difference in Favour of Electric Traction:—				
Total	4,537	12,306	19,735	27,267
Per train mile	6·04d.	6·96d.	7·46d.	7·90d.

Table III.

Comparison of Increased Cost of Electric Service with Increased Revenue due to Improved Facilities.

	Port Melbourne and St. Kilda Branches.	Stage I.	Stage II.	Stage III.
	£	£	£	£
1. Interest charges at 4 per cent. on capital cost of Electrification Scheme	12,600	26,077	43,520	72,058
2. Saving in operating expenses with Electric Traction ...	4,537	12,306	19,735	27,267
3. Extra cost of Electric Traction including interest charges	8,063	13,771	23,785	44,791
4. Additional increase in Revenue on a basis of 5 per cent. greater traffic, with Electric Traction...	2,500	11,073	20,520	28,632
5. Additional increase in Revenue on a basis of 10 per cent. greater traffic[1]	5,000	22,145	41,040	57,265
6. Additional increase in Revenue on a basis of 15 per cent. greater traffic[1]	7,500	33,218	61,560	85,897
7. Actual percentage increase of Revenue above the assumed normal growth of 20 per cent. necessary for the revenue at the different stages to balance the additional capital charges less the saving in operating expenses ...	16·1%	6·2%	5·8%	7.8%

[1] The estimates assume a difference of 5 per cent. only in additional revenue, but for convenience corresponding figures are also given for increases of 10 per cent. and 15 per cent.

The report concludes with the summary of conclusions given on p. 422 of our last issue.

Wireless Telegraphy in the West Indies and the Pacific.—An American Consular report gives some further particulars in regard to the network of wireless telegraphy which it is proposed to establish among the scattered islands of the Pacific Ocean, referred to in our last issue. It is stated that capitalists who are interested in the extensive phosphate operations on Ocean and Pleasant islands of the Gilbert group, and in the new works about to be established on the island of Makatea of the Tuamotu Archipelago, have recently begun a movement to connect nearly all the groups of islands in the South Pacific by a system of wireless telegraphy. It is proposed to include in this system the Commonwealth of Australia, the Dominion of New Zealand, the Fijis, the New Hebrides, the Solomon, Samoan, Cook, Society, and Marquesa islands, and the phosphate islands of Ocean, Pleasant, and Makatea. It is expected that the various governments having possessions in the South Pacific will aid in the establishment of the proposed system. Negotiations have already proceeded so far that the success of the efforts seems to be almost assured. As the nearest available ocean cable office to Tahiti is at Auckland, 2,250 miles away, from which a steamship of the Union Line of New Zealand arrives at Papeete once every 28 days, and a direct communication by a steamship of the Oceanic Co. with San Francisco, 3,658 miles distant, is had once in every 36 days, it will be understood how deeply interested the French colony of Tahiti and its dependencies are in the complete success of these negotiations. Other groups of islands are equally interested in the establishment of this system, which means so much to the inhabitants of these widely separated archipelagoes. The name of the proposed company is the Pacific Islands Radio-Telegraph Co. Of the proposed capital of £70,000, the owners of the phosphate deposits on Ocean and Pleasant islands have subscribed £10,000. In this radial system there will probably be ten or twelve circles, the largest having a radius of 1,250 miles, and requiring for each station an engine of 60 h.p. It has not yet been decided where the main office of the proposed company will be.

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TWO NEW LIMIT SWITCHES

IN certain cases of electricity supply, the supply company has made arrangements whereby the consumer pays for current either on a contract basis or on a somewhat reduced flat rate, on the condition that the consumer's demand shall never exceed a certain amount. It will be remembered that a general tariff based on the same principle was recommended in a Paper read by Messrs. Handcock and Dykes before the Institution of Electrical Engineers last session. In such cases it is to the interests of the supplying authorities to see that the customer's demand never exceeds the predetermined amount, and for this purpose so-called "limit switches" are used. Two patterns which have recently been put on the market in Germany, are described in a recent issue of the *Elektrotechnische Zeitschrift*.

The first of these has been brought out by the Allgemeine Elektricitäts Gesellschaft, and is constructed so that, as soon as

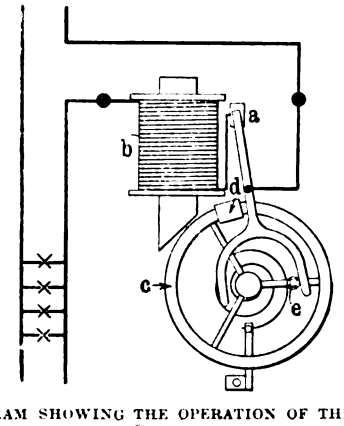

FIG. 1.—DIAGRAM SHOWING THE OPERATION OF THE A.E.G. LIMIT SWITCH.

the current exceeds the maximum permitted, the consumer's lamps are caused to flicker continuously, and thus warn him that he is taking too much current. The working of this switch can be understood by an inspection of the diagram in Fig. 1. In this diagram *a* is a switch in the main circuit, and *b* is an electromagnet which actuates the balance wheel *c*. The switch is in series with the magnet-winding, and the consumer's lamps. If the current exceeds a predetermined amount, the armature *d* is attracted to the electromagnet, and the balance wheel is set in motion. At a certain angle, the stud *e* on the balance wheel comes in contact with the forked end of the switch, and opens the circuit, putting out the lights. The magnet no longer attracts the armature, so the balance wheel swings back, and the circuit is closed again. So long as the load is not reduced this action is repeated; but, directly the current is reduced below the maximum permitted, the swinging ceases, and the switch is permanently closed. The apparatus is enclosed in

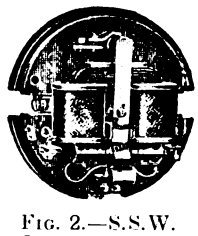

FIG. 2.—S.S.W. LIMIT SWITCH.

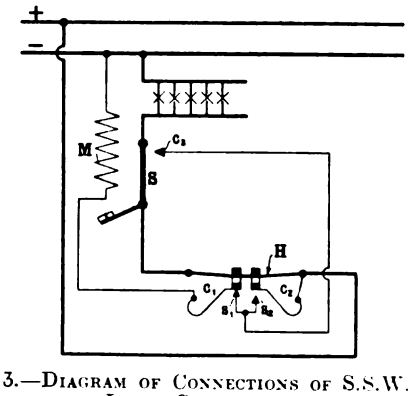

FIG. 3.—DIAGRAM OF CONNECTIONS OF S.S.W. LIMIT SWITCH.

a circular aluminium case, which measures 4¾ ins. in diameter, and is about 2½ ins. high. The standard sizes are: 5 amp., 150 volt, and 3-amp. 250 volt for continuous-current circuits; and 5 amp. 250 volt for alternating-current circuits: but of course they can be set to operate at lower current values.

The second pattern described is that brought out by Siemens-Schuckertwerke, of Berlin, and is illustrated in Fig. 2. The operation of this limit switch is shown in the diagram of Fig. 3. In this case, also, when the consumer takes too much current, his supply is cut off for a certain length of time. In the diagram, *S* is the switch in the main circuit, which is opened when the armature shown in the diagram is attracted by the electromagnet *M*. *H* is a stretched wire in series with the main circuit; c_1 and c_2 are contact springs, which tend to make contact with the corresponding contact studs s_1 and s_2, but are prevented from doing this as they are fixed to, but insulated from, the stretched wire *H*. There is a third contact stud c_3. The heating effect of the current causes the stretched wire *H* to lengthen, and first to make contact between c_1 and s_1; this, however, has no effect on the switch. Further heating, however, causes contact to take place between c_2 and s_2, which closes the shunt circuit from the positive main through c_2, s_2, s_1, c_1, and *M*, to the negative main. The electromagnet is energised and the circuit broken, but a new circuit through c_3, s_1, c_1, and *M* is made. The wire cools and the contact c_2, s_2 is broken; the electromagnet remains in circuit, however. After further cooling the contact c_1, s_1 is broken, the armature is released, and the main circuit closed again. This action is repeated continuously if the load is not reduced. The apparatus can be set to operate within 5 per cent. on either side of the permissible maximum current value, and is supplied for both continuous and alternating-current circuits up to pressures of 220 volts.

Wiring Rules.—The International Electrical Congress, which closed its sittings at Marseilles on Saturday last, adopted, among other resolutions, one suggesting that the International Electro-Technical Commission, which will meet in London, should consider the question of drawing up general regulations regarding electrical installations in the interiors of buildings.

Russia's Copper Output.—A British Consular report upon trade in St. Petersburg during 1907 gives some figures with regard to the output of copper in Russia during the year. According to preliminary figures published, the total quantity smelted in the country was about 14,401 tons, which is stated to be a record compared with previous years. To the above quantity of 14,401 tons, some 4,500 tons must be added, representing the import of electrolytic copper. At the present time Russia's capacity for producing electrolytic copper is far short of satisfying the demand. For the moment there is only one electrolytic plant in the country capable of producing a large quantity, though it is interesting to note that in the near future a British-controlled plant will begin operations in the Urals at Kyshtim. Last year Russia's consumption of electrolytic copper was about 5,700 tons, of which native works produced 1,200 tons, while, as stated above, 4,500 tons were imported. The total quantity of ordinary ingot (non-electrolytic) copper consumed in the country was about 13,000 tons, and about 1,400 tons were exported, this latter figure representing the surplus in excess of home requirements of ordinary ingot copper. There is a heavy duty on copper imported into Russia, approximating £33 per ton, but in spite of this fact the trade is by no means in a healthy condition, the main reason being apparently the excessive cost of output. There are at the present time three British copper-producing companies working in the Russian Empire, one in Siberia (Spasski), one in the Urals (Kyshtim), and one in the Caucasus (Caucasus Copper).

Electric Railway Accidents in 1907.—The general report of the Board of Trade upon accidents that have occurred upon the railways of the United Kingdom during the year 1907, states that with reference to accidents by contact with the live rails of electric railways, although these are not, as a rule, attributable to railway working, they are nevertheless distinctly railway accidents, although not caused by the movement of vehicles. To this cause is set down the death of one servant and injury to 13 in 1907. Precautions against recurrence of such accidents have been taken by covering the live rails at exposed places, improving fencing and posting warnings, and accidents of this class have become less frequent than they were when electrical working was first introduced, and the special danger which it involves was unknown. In addition to servants of the company three persons have been killed and four injured during 1907 through trespassing on electrically-equipped track, making the total accidents for the year four killed and 17 injured. The details of these are as follows:—Charing Cross, Euston & Hampstead Railway, one servant injured; Great Northern & City Railway, one servant injured; Lancashire & Yorkshire Railway, three servants and one trespasser; London & South Western Railway, one servant injured; Mersey Railway, one servant injured; Metropolitan Railway, two servants injured; Metropolitan & Great Central Joint Railway, one servant killed; Metropolitan & Great Western Joint Railway, one servant injured; Metropolitan & Metropolitan District Joint Railway, one servant injured; Metropolitan District Railway, one servant injured; North-Eastern Railway, one servant injured, three trespassers killed, and three trespassers injured. In 1906, four persons were killed and 21 injured in this way, in 1905, two were killed and 18 injured, and in 1904, when only three of the above railways were using electric traction, eight persons were killed and 20 injured.

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ANNUAL CONFERENCE OF THE MUNICIPAL TRAMWAYS ASSOCIATION

THE seventh annual conference of the Municipal Tramways Association opened yesterday under the presidency of Mr. J. Aldworth (General Manager, Nottingham Corporation Tramways). A reception was held in the morning by the Mayor (Councillor Spalding), the Sheriff, and Chairman, and members of the Tramways Committee, at the Exchange Hall, after which the proceedings of the conference opened with Mr. Aldworth's address, which is given in abbreviated form below:—

Presidential Address.

After congratulating the members on another year's successful working of the Association, Mr. Aldworth suggested that the time had now arrived when the status of the Association should be raised, and that the Executive Committee be instructed to take the necessary steps to secure its incorporation. He mentioned that the membership of the Association now included over one hundred and twenty chairmen and vice-chairmen of committees representing practically all the local authorities operating their own tramways, with about one hundred general managers and chief officials, and remarked that local authorities had invested in these undertakings, roughly, 40 million pounds. They operated 2,500 miles of track with 8,000 cars and 40,000 employees, which served a population of 17¾ millions. Their joint revenue last year amounted to 8¾ million pounds, the number of passengers carried was 1,886 millions, and the cars ran 195 million miles.

The meeting of the Managers' Section was held this year at Wolverhampton, where opportunity was given to study the surface contact tramway system in operation there, and Papers were read on "Car Building in Departmental Workshops," and "Tramway Rating Valuations and Income Tax Assessments." Tabulated information respecting the distance at which a "Tramway Passenger paying a Penny Fare ceases to be remunerative," was also laid before the meeting.

Mr. Aldworth continued:—Although there has been no burning question before the members during the year, many matters of great importance to the tramway industry have been under consideration. Unquestionably the most important is that of brakes and safety appliances for cars. This has been emphasised by the distressing accidents which have taken place during the year. It is greatly to be regretted that such accidents should have occurred in spite of all the care and attention given to secure the safe working of the undertakings, and the splendid records that had been established as regards immunity from serious disasters. A large number of meetings of the Brakes Committee of the Association have been held, many undertakings visited, and a considerable number of brakes of various designs inspected and tested in operation. Exhaustive experiments and tests have also been carried out, and it is hoped that the results will indicate means by which the risk of accidents arising through cars getting out of control may be greatly minimised, if not entirely removed. The important question of what allowance should be made for depreciation of assets by the Board of Inland Revenue, when dealing with the profits for income tax purposes, has been receiving very careful attention, and appreciable progress has been made towards arriving at a settlement of this very complex subject.

Other matters, including proposed new regulations by the Board of Trade; the use of tramway poles for telegraph and telephone purposes; corrugation of rails; the maintenance of street paving along tramway routes; the report of the Departmental Committee on Accounts of Local Authorities, and Mutual Assurance against Third Party Risks, have also been under consideration by the Executive Committee. It is very disappointing that no solution of the rail corrugation problem is forthcoming. This is becoming a serious matter with many undertakings.

In speaking of the relations between the officers and staff, Mr. Aldworth said:—It is to be regretted that efforts have been made, in a few cases successfully, to transfer the decisions on matters of discipline from the manager to the committee, in other words, from an impartial to an interested tribunal—a departure from the policy which, it is generally conceded, has in the past worked very satisfactorily. The result of this means practically the transference of responsibility for the safe and efficient working of the undertaking from the manager to the committee: a serious departure indeed, as responsibility without control is impossible in any real sense. It may relieve the manager of a very onerous responsibility, but committees as well as the public who use the tramways might seriously consider whether such a procedure is not calculated to jeopardise the efficiency and safety of the service.

It is essential that the public should be given the best possible service, and carried at the lowest fares justified by the returns, but not lower than will permit of the undertaking being conducted on sound commercial principles. This result cannot, of course, be general so long as there are undertakings which run only through thinly populated districts attempting to compete in the matter of fares with other systems serving large cities with a dense population. In most of such districts the cost of living is considerably lower than in large towns, and in those districts the public can afford to be satisfied with being carried a shorter distance than is given for the same fare in large centres. This important fact should be taken into account by committees when determining their fares and stages. A satisfactory sign of the times is that much less is now being heard of the demand for halfpenny fares and stages, and many other concessions of a hazardous nature, which at one time were being so vigorously pushed, irrespective of local conditions.

On the question of intercommunication evidently a much broader view is being taken, as is shown by the continual increase in the number of municipalities which have entered into working agreements for this purpose with other undertakings, both municipal and company-owned. There can be no question that such arrangements give facilities which greatly encourage the use of the cars, and increase the usefulness and earning capacity of the undertakings concerned.

A matter providing a large field for thought, and deserving of our serious consideration, is the adoption of an improved method of collecting and checking fares. A considerable amount of attention has been given to this problem for some time past, and the "Pay as you enter Car" which is being introduced into Canada and the United States, appears to be making progress in this direction. Where a universal flat fare is in operation, this system appears to be an excellent one, and it now remains for some inventive genius to devise an equally effective method applicable to the general conditions prevailing in this country.

We are all more or less familiar with the irritating sound of cars running over defective rail joints and worn points and crossings, and we appreciate the great damage to the rolling-stock and rail bonding, as well as the discomfort caused to passengers and residents along the route. Recent improvements will, undoubtedly, go a long way to obviate this with new tracks; but the difficulty is to overcome the trouble on lines which have been in use for some years. A number of methods have been tried to this end with more or less success. In Nottingham the matter has received very careful attention, and as a result of experiments, extending over several years, it has been decided to repair defective joints by cutting away the worn portion of the tread and inserting a flat plate of special steel, which bridges the rail joint and rests on both rails. The ends are splayed and dovetailed into the rails. During the three years since the first joint was so treated not a single plate has worked loose, notwithstanding that there has been a two-and-a-half minutes' service running over the route. In this country, as in America, the method of conducting energy from the overhead wire to the car equipment is by means of the "grooved trolley wheel." The disadvantages of this system are all too well known, and many devices have been designed and tried for overcoming them. In many large cities on the Continent the "bow trolley" is almost universally employed. There is here ample scope for investigation of the comparative advantages and disadvantages of the two systems.

Very little, excepting complaints, is now being heard of the petrol motor 'bus, which a few years ago we were told was going to revolutionise street passenger traffic and practically exterminate tramways. The petrol motor 'bus has had a fair and impartial trial, and the verdict is certainly not in its favour. The electro-'bus now being tried is certainly free from many objectionable features inseparable from the petrol vehicle, and is far cleaner and more comfortable in every respect; but whether accumulators can be found to withstand the vibration and strain to which they are subjected, especially on rough and hilly roads, and enable the 'bus to be worked at such a cost as will allow it to give a fair return on the outlay, remains to be seen. So far, no reliable figures in connection therewith are forthcoming, and there appears to be as much uncertainty on this point as there was originally about the petrol 'bus.

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There is unquestionably a large field available for the successful working of a service of self-contained, reliable, and economically-operated vehicles. There are very few towns that have not some districts which could be connected with the tramway system by such means. Not only would they be greatly benefited by the adoption of these vehicles, but the traffic thus created would add considerably to the tramway receipts. The merits of the "Trackless Trolley Car" are now receiving careful attention, and it is satisfactory to know that one of our municipalities intends giving the system a trial. It will be watched with very great interest, and I trust that ere long we shall be in possession of reliable information as to the results of its working under British conditions. If these vehicles can be made to pay their way and at the same time gradually create such a traffic over the routes on which they are used as will justify the laying down of tramways, their introduction will prove a valuable factor in the extension and linking up of tramway systems.

After the presidential address the following Paper was read:—

Some Through-Running Problems and their Solution.

BY H. E. BLAIN (*Tramways Manager, County Borough of West Ham*).

The aim of this Paper was not to deal with all the through-running arrangements which have been tried, but rather to classify the main principles upon which experience shows that through running can be arranged to the mutual advantage of the contracting parties, and to the convenience of the travelling public. After quoting figures published some years ago by Mr. Stephen Sellon demonstrating the advantage to both systems working under a through-running arrangement, notably at Newcastle and Birmingham, the author thinks it hardly necessary to say anything to commend the "making" of through-running arrangements to every manager whose system adjoins any other system, whether Corporation or company, but "there are unfortunately tramway undertakings still with us which apparently desire to become firmly established as the High Priests of Haughty Isolation, with a Hindoo-like dread of any other tramway undertaking even casting the shadow of a trolley-pole over a corner of the sacred area within which any of their car mile meals are taken." This policy is regarded as financially unsound, a view which, the author says, is supported by an examination of the accounts of such undertakings. In fact, the whole-hearted view is taken, in sharp contrast to the opinions which existed almost universally amongst municipal tramway managers only a few years ago, that there are now so many through-running arrangements which have stood the test of time that there does not seem to be any valid excuse for change of vehicles being necessary where physical contiguity obtains, and in the London area, for example, it is certain that one of the strongest reasons for the establishment of a Central Traffic Board is the continued unwillingness on the part of some of the tramway-owning authorities to provide proper through-running facilities for the convenience of the public; a short-sighted policy to which much of the present motor-bus competition is due.

Through-running agreements divide themselves into four classes as follows:—(*a*) In which foreign lines are leased and operated by another authority. (*b*) In which both contracting parties run cars and each through passenger receives two tickets, either by a change of conductors at the boundary, or by each of the authorities furnishing the other with tickets to be sold when the boundary has been crossed. (*c*) In which both authorities run the number of cars to which their local mileage on the through route entitles them, the respective areas being taken as of equal earning value, and each authority retains all the receipts taken on its own cars. (*d*) In which both authorities run cars and the receipts are apportioned upon an agreed basis. The first, of course, is the simplest method, and is adopted in a large number of places, the details of the agreement varying according to local circumstances. Particulars are given of some 33 through-running agreements, including Birmingham, Blackburn, Burton-on-Trent, Bury, Manchester, Liverpool, Dundee, Kirkcaldy, Leeds, Sheffield, West Ham, and Wolverhampton, all arranged under one or other of the above classes, in many cases between local authorities and companies. The author hopes to show such tramway-owning authorities and tramway managers as are still unrepentant and unashamed obstructors of through-running facilities that such facilities are easy of arrangement, fair and remunerative to all parties concerned, of the greatest value in stimulating and increasing traffic, and are a public and private convenience which no authority which claims to be the representative of the public and the guardian of the public weal has a right to hinder.

In the afternoon the Trent Bridge Car Repairing Works and the St. Ann's Well Road Generating Station were visited. Both of these were described, in connection with the annual convention of the Incorporated Municipal Electrical Association in June, in ELECTRICAL ENGINEERING, Vol. III., pp. 965 and 971. A reception was held in the evening at the Art Museum, Nottingham Castle by the Mayor and Chairman and Vice-Chairman of the Nottingham Tramways Committee.

CORRESPONDENCE

SYMBOLS FOR PHYSICAL QUANTITIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Now that there has been some opportunity for discussing this question, may I be permitted to summarise the arguments that have been raised for and against the creation of new symbols? The most common objection is, "They are like Chinese characters; we could never remember them." But there will be no necessity to remember them. How many of us can remember what symbol Rankine uses for kinetic energy? Is it not sufficient for us to see it when we refer to his book? Every considerate writer to-day gives a list of the symbols he uses. If all writers used the same symbols we should soon become familiar with those with which we are most concerned, and for the rest, we would refer to the list just as at present.

Some objectors do not see why the letters we have at present are not sufficient. Let them try to make a list of symbols for the 200 physical quantities for which symbols are wanted. After they have made up a list to satisfy themselves (if such a thing is possible), let them try to convince someone else to adopt that list. There are about 20 letters, such as *m* for "mass," *t* for "time," &c., upon which there is almost universal agreement. One or two dozen more stand a fair chance of being agreed upon. Beyond these, there is hopeless confusion, simply because all the good letters are exhausted. As to the difficulty of printing new symbols, it is of interest to know that 25 of the leading technical journals of the world published an article containing five new symbols given as examples, without any difficulty. Several of them have expressed the view that there is no difficulty from the printer's point of view. The types supplied to them—which, by the way, cost 1d. for 30—were all of one size, and yet each paper used for the text of the article its usual standard type. The publisher of the *Elektrotechnische Zeitschrift* thinks that there would be no difficulty in arranging with a typefounder to make matrices, from which all printers could be supplied with type. Each printer would keep in stock those types which commonly occurred in his paper, and could get others on short notice. About 30 new symbols would be sufficient for articles on electro-technical science. Two papers have objected that the symbols cannot be set up on a linotype machine. It is, however, usual at the present time to set up mathematical expressions by hand.

Several critics have pointed out that the new symbols should be bold and simple in outline, so that they cannot be easily mistaken for one another. This, of course, is an important matter to bear in mind. I agree with M. Galliot that the name of the symbol should be, where possible, the name of the physical unit represented. Where the name of the unit cannot be employed, a word of one syllable might be chosen, as, for instance, "stroke," for the length of a piston stroke. Some critics say that the number of symbols required would be too great. As to that, we can make just as many as convenient. The symbol ~ became universal almost as soon as it was printed. Let us have a few more as good as that one; we are badly in need of them.

Yours faithfully,

MILES WALKER.

Hale, Cheshire.
Sept. 19th, 1908.

Deaths from Electric Shock.—Whilst a man was painting the girders of the overhead work carrying the conductors of the single-phase system of the Midland Railway Co. at Lancaster Castle station, on Friday, he received an electric shock which killed him before he could be rescued. It was stated that the man received a message that the current was to be switched on, and was endeavouring to get off the girder when he touched the overhead conductor.

An inquest was held last week into the death of a trammer, employed by the Wharncliffe Silkstone Colliery Co., at their Knoll Drift pit, Barnsley. The deceased man was engaged in moving some corves, *i.e.*, steel trucks, and was standing in water at the time, when he received a shock from a cable, brought down by a fall of roof, which had made contact with the corve.

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THE FALCON SPINNING MILL

WE were recently given the opportunity of inspecting the Falcon Spinning Mill at Halliwell, near Bolton, which is an extremely interesting example of electric driving. This is a typical case where electricity can be used to the best advantage, as the mill in question is a new one, and it has therefore been possible to arrive at an even more effective and economical arrangement than can be the case where electric motors are installed in an old mill to displace the previous rope-drive.

The mill is what is called a "superfine" mill, for spinning superfine yarn from No. 100s. to No. 300s. For this work a close speed regulation is essential, much more so than in the case of coarser yarn. Bolton, it may be mentioned, is the centre of this extra fine spinning industry, and the result obtained from this mill will therefore be watched with considerable interest. At the time of our visit the mill was not yet in operation; when the cotton industry resumes its normal condition there is no doubt that this will be one of the most active mills in the district, as there are 100,000 mule spindles. Another interesting point in connection with the mill is that it has its own power-house, in which the first Zoelly turbine built entirely in England by Messrs. J. Musgrave & Sons, Ltd., who are one of the three licensees in this country under the Zoelly patent, has been erected.

Fig. 1 is a reproduction of the pipe plan, which indicates the general lay-out of the generating plant. There are three 30 ft. × 8 ft. Yates & Thom Lancashire boilers for 160 lb. pressure, fitted with Sugden superheaters in the down-take, designed for a superheat of 150° Fahr. Each superheater contains 220 sq. ft. of heating surface. In the Sugden superheater, instead of the tubes being placed in contact in long rows, they are disposed in groups with a large space between each group. The object of this is to prevent undue punishment to the front rows of tubes, and the work is thus more evenly divided between them and the back rows, tending to ensure greater efficiency and longer life. To protect the superheater when steam is first being raised, and also from the effect of protracted stoppages, a system of isolation and damping is employed in place of flooding. The arrangement is shown in Figs. 2 and 3. In Fig. 2 the dampers are closed, and the whole of the heated gases impinge against the superheater tubes. In Fig. 3 the superheater is entirely isolated by the dampers in their upper position. The steam piping is so designed that the superheater can be isolated, and saturated steam passed directly to the turbines.

Green's economisers are used; there are 288 vertical heating tubes, roughly speaking nearly 3,000 sq. ft. of heating surface. The economiser is arranged on the modern principle in three groups of 96 pipes each; expansion elbows top and bottom couple these groups together, and thus easy access to any part of the apparatus is possible.

In the engine-room, when complete, there will be two Zoelly turbines, each driving three-phase alternators, by Siemens Bros. Dynamo Works, Ltd., having a normal output of 400 kw. The sets are designed, however, to supply, if required, 800 kw. for ten hours, or 600 kw. absolutely continuously. At the time of our inspection, only one of the sets had been installed, but we understand that the second one will be put in very shortly. By giving these large overload capacity, the necessity of duplicate or spare plant is obviated. This is an important consideration in cotton mills, for there are many cases in which mills have been driven by large horizontal Corliss

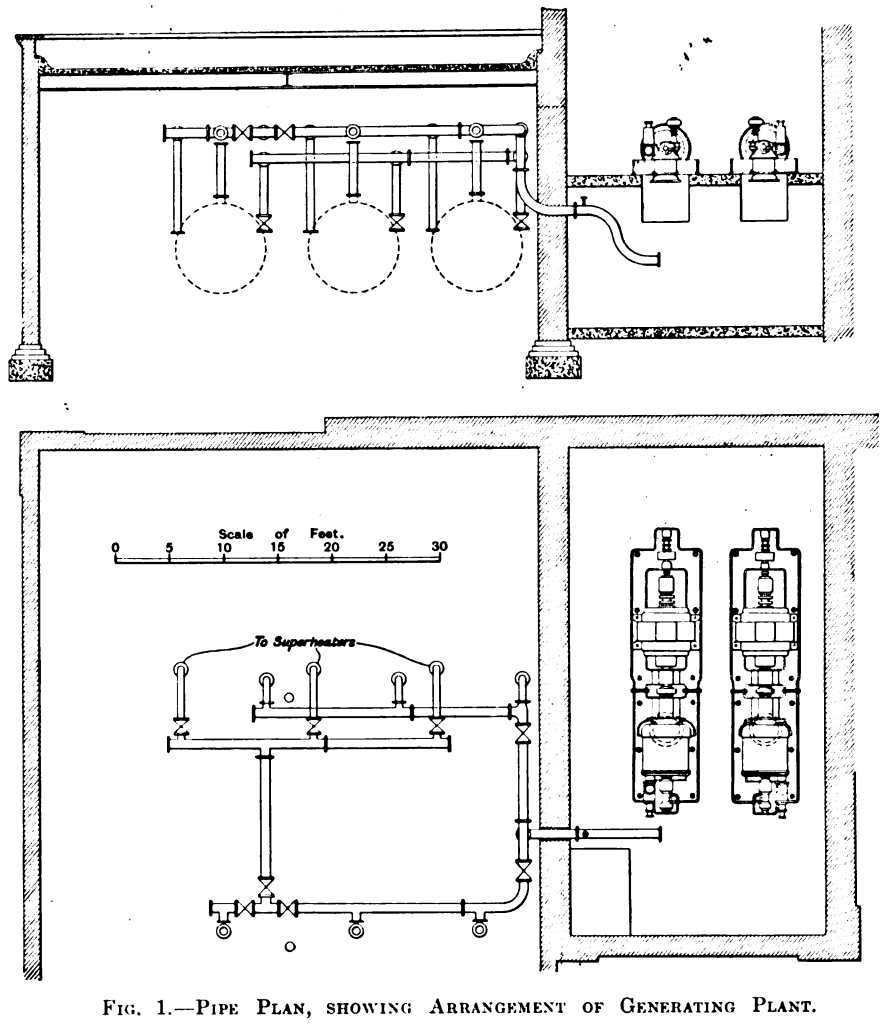

FIG. 1.—PIPE PLAN, SHOWING ARRANGEMENT OF GENERATING PLANT.

engines for years continuously without a single stoppage, and cotton spinners are therefore inclined to regard with suspicion any new machine which it is deemed necessary to duplicate in the event of breakdowns.

The Zoelly turbine is one which runs at a high speed, and the speed of these sets is 3,000 revolutions per minute. Each turbine is fitted with overload device which cuts off steam at 10 per cent. overload.

No actual tests have yet been made of steam consumption but it is confidently anticipated that the full load consumpion will not be higher than $11\frac{3}{4}$ lb. per b.h.p. at 28 in. vacuum. One of the special features of the Zoelly turbine, moreover, is the comparatively small steam consumption at lower loads. Fig. 4 gives a steam consumption test of a 2,000 kw. Zoelly turbine, from which the relative steam consumptions may be seen in the case of a large machine.

The section of the turbine is shown in Fig. 5, on

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which is also a view to a larger scale of the wheel and nozzle plate showing clearly the method of fixing the blades of the running wheel. The Zoelly is a parallel-flow turbine with pressure stages, in which the steam is expanded by the fixed blades, and the velocity only

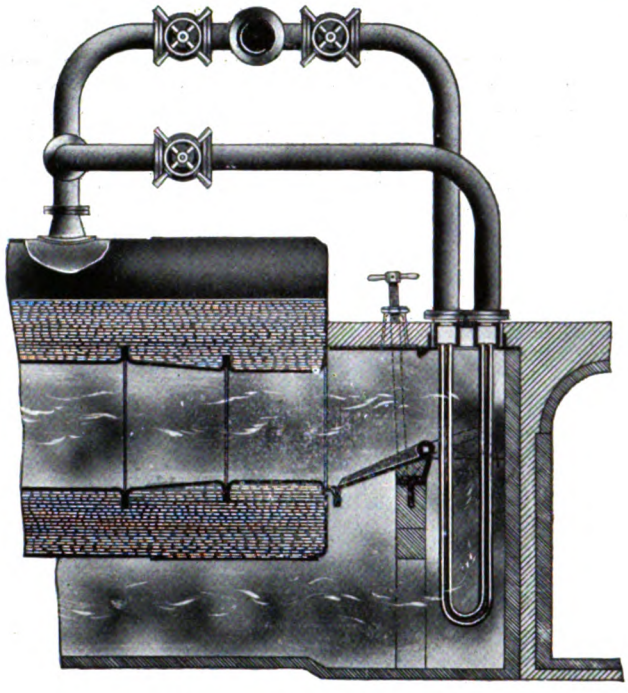

FIG. 2.—SUPERHEATER WORKING: DAMPERS OPEN.

is used on the moving blades, as distinguished from the reaction type, in which the expansion takes place in the moving blades. One of the features of this type is that the clearances can be larger than in turbines on the Parsons principle, and the danger of stripping is

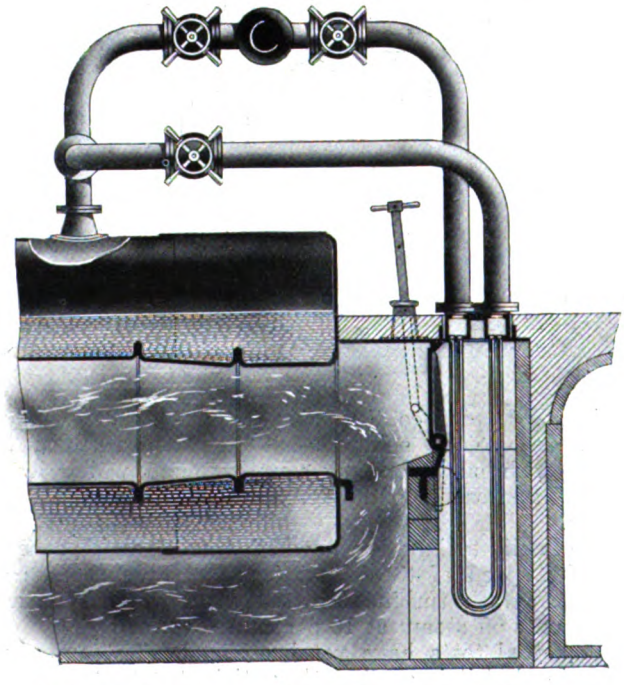

FIG. 3.—SUPERHEATER ISOLATED: DAMPERS CLOSED.

eliminated. In this particular set, the radial clearance is a full $\frac{1}{8}$ in., and in other directions even more. Steam enters the first high-pressure wheel chamber at the left-hand end in the section in Fig. 5, and passing through the nozzles is expanded down to a certain point. After doing its work on the running wheel, it passes through similar nozzles into the next chamber, and so on through each successive chamber to the exhaust port. In the turbine at the Falcon Mill there are ten expansions, and in the larger sizes the number is gradually increased, reaching 20 in the 6,000-kw. sizes. The fall of pressure in each stage is practically 58 per cent. of that in the previous one.

In following out the construction of the blades and guide wheels reference may be made to Figs. 6, 7, and 8, in addition to the section in Fig. 5. These three figures show a single blade, a section of the running wheel, and a section of the guide wheel respectively. The shape of the blades and the method of fixing is indicated in Figs. 6 and 5. Nickel steel is the material of which the blades are made, and they are thickened towards the base, so that the stress on the metal is the same at every radius. The disc in which the blades are fixed is of steel, and it is forged in one piece with the boss, and is annealed several times during machining. The blades are fixed into the disc by means of a riveted clamping ring, and the square dovetail joint seen in the illustrations prevents any outward thrust. The nozzles are of nickel steel sheet, cast into the frame of the guide wheels, which are of cast steel for the higher-pressure stages, and cast-iron for the lower pressure. As the pressure gets lower from stage to stage, a greater number of blades are, of course, necessary, and thus the diameter at the low-pressure end is greater than at the high-pressure end.

Heavy overloads are taken by bye-passing the high-pressure steam to the fourth wheel chamber.

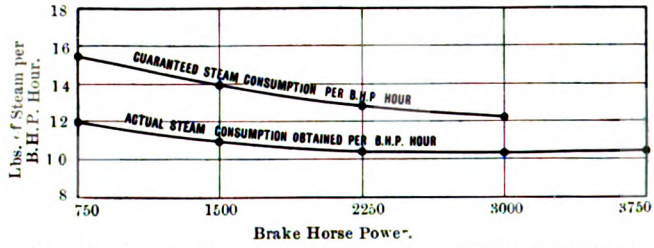

FIG. 4.—STEAM CONSUMPTION TEST OF A 2,000-KW. ZOELLY TURBINE.

An oil relay governor is employed. The governor lever controls a small distributing valve, which admits oil under pressure to the top or bottom of the cylinder seen in section at the top of the extreme left of Fig. 5. Two small oil pumps are driven off the governor spindle: one for supplying oil for this purpose, and the other for the bearings.

The turbines exhaust into a Klein barometric condenser. The drum of this is higher than usual, so that the water may gravitate on to a low cooling tower to save an additional pump. This cooler consists of 20 bays, each 10 ft. × 6 ft. The air pump is driven by a 10-b.h.p. 500-volt three-phase Siemens motor with a wound rotor, which is short-circuited when up to speed by means of a special switch at the end of the slip-rings, and at the same time the brushes are lifted. This set (which runs at 500 revolutions per minute) is placed in the engine-room.

Messrs. Siemens Bros. Dynamo Works, who have been responsible for the entire lay-out of the plant (at their Manchester branch), have supplied the alternators and all the motors, &c. The alternator is a two-pole three-phase machine, with a frequency of 50 cycles per second, and a voltage of 500. Its normal load is 460 k.v.a. at 0·87 power factor, and it is, of course, directly coupled to the turbine. A feature is the method of axial ventilation, which is now Messrs. Siemens' standard practice for such machines. A distributed field winding is employed on the rotor. The machine is totally enclosed, and the rotor bears a fan, inside the case, which draws the air up from an inlet pipe below, and passes it through the rotor and the stator windings.

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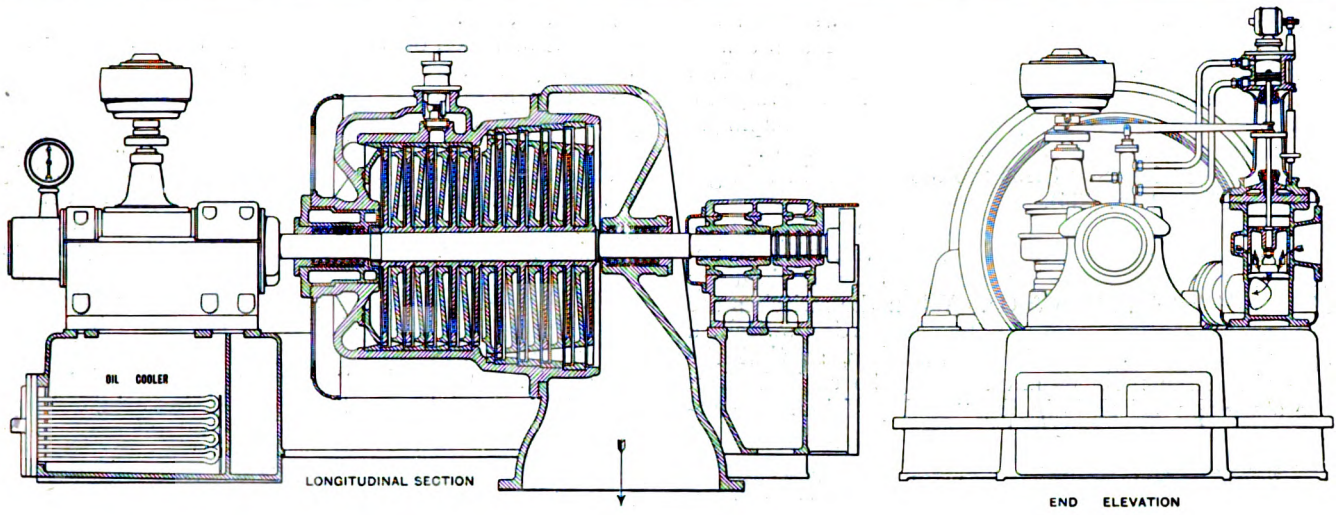
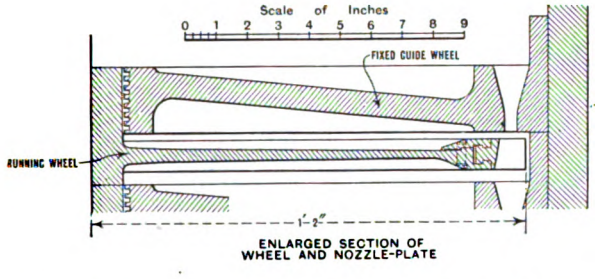


Fig. 5.—600-kw. Zoelly Steam Turbine.



Contrary to the usual practice on rotors with distributed windings, the rotor is wound with strip on edge. All the stator windings on the machine have an open passage immediately behind them for the circulation of the air which escapes at the top of the machine by an outlet seen in Fig. 9. The calculated efficiencies of the alternator are as follows:—100 per cent. overload, 92·6 per cent.; 25 per cent. overload, 91 per cent.; normal load, 87·5 per cent.; three-quarters normal load, 84 per cent. The exciters are placed at the end of the main shaft, and are 60-volt compound-wound

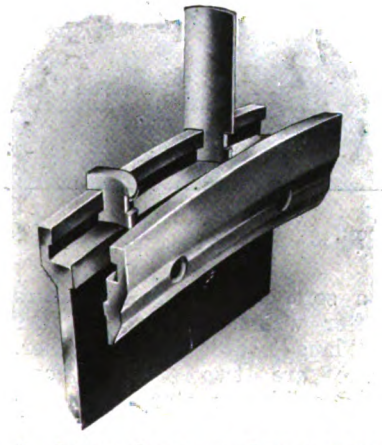


Fig. 6.—Single Blade of Zoelly Turbine.

machines with commutating poles. Voltage regulation is by means of resistances in series with the alternator field.

In addition to the main generating sets, there is a 34-kw. 105-volt Browett-Lindley-Siemens D.C. set used for lighting in the early morning before the main set is started up. Normally the lighting is supplied from the alternators through 500:105-volt transformers. Tantalum lamps are employed throughout for the lighting of the mill.

The switchboard calls for no special description. Knife switches are employed and plain copper fuses, which are passed through asbestos tubes. Each of the large main motors has its own distributing panel, and a throw-over switch is provided for connecting up the lighting circuits, either to the transformer or the small

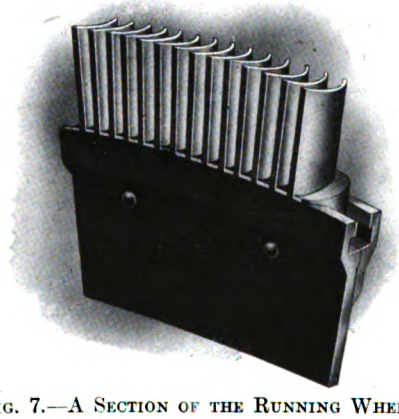


Fig. 7.—A Section of the Running Wheel.

generator. The mains from the generators to the switchboard are of bare copper tape on insulators, and three-core wire-armoured vulcanised bitumen cable is employed for circuits from the switchboard.

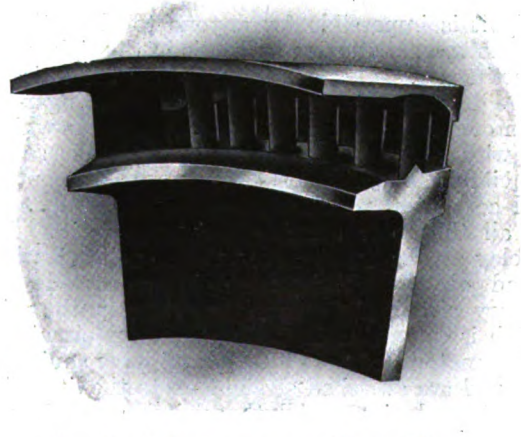


Fig. 8.—A Section of the Guide Wheel.

The arrangement of the main motors for driving the various floors of the mills is shown in Fig. 10 (p. 463). This is an adaptation of the usual rope-race arrangement

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in an ordinary cotton mill, for the motor tower takes the place of the rope race. The dimensions of this tower, however, are less than that required for the rope drive. It is seen that there is a motor on each floor driving one or two long lines of shafting (through flexible couplings) to which the various machines are connected. The arrangement of one of these motors is seen in a larger scale in Fig. 12 (p. 464).

At the motor end of the circuit, each motor is controlled by an oil-break switch, with overload and no-voltage releases, according to a system devised by Messrs. Eckstein, Heap & Co. When the switches are used in connection with a star-delta starting switch, a special contact is fitted to the switches, so that the solenoid of the main circuit can only be excited when the star-delta switch is in the "off" position. Consequently it is impossible for anyone to close the main switch unless the starting switch is in the right position for starting up. Figs. 13 and 14 show the switch and tripping device separately. A similar arrangement is used in conjunction with the 200-h.p. motors which are fitted with slip-rings and starting resistances in the rotor circuit, only in this case the extra contact is placed so that the solenoid can only be fully excited when all the rotor starting resistance is in. A two-pole relay breaks the circuit of the no-volt coil when an overload occurs. This relay is connected to the secondary circuit of a current transformer, the primary of which is connected in the main motor circuit. The smallest motors (of from 3 to 7 h.p.) have squirrel-cage rotors, and are switched straight on to the line without any starting device. All the switches are in water-tight cast-iron cells.

We will not pretend to describe the process of cotton spinning, and the notes which follow must be regarded rather as an indication to the electrical engineer, in an exceedingly rough and approximate manner, of the nature of the various stages of manufacture, than an actual description of what goes on in a mill. They will serve to guide them, however, to some extent as to the names of some of the machines and the amount of power required for the work.

The first room is the mixing room, in which bale-breakers and mixers are placed. These are driven by a smaller motor and not by the tower motor. On the ground floor also is a 200-h.p. slip-ring induction motor running at 585 r.p.m., and directly coupled by means of a flexible coupling to the line shaft, from which six pairs of mules will be driven. This motor is of 200 h.p., simply to be a duplicate of those above it, and to allow for extra mules being added later. On the first floor (Fig. 11) are the "blowing-room" and "card-room." In the former the cotton is opened out and made into a sort of wad, and then rolled up into a "lap," after which the lap is further cleaned, and four "laps" are put together. For this process there are two "single openers," each belt-driven by a 5-h.p. motor, a larger single opener with a hopper and pneumatic conveyer, belt-driven by a 7-h.p. motor, and a fan requiring 3 h.p. The motors for all these are of the squirrel-cage type, running at 1,410 revolutions per minute. On this floor also is the "carding" room. Carding is the final cleaning process. The machinery is driven by a 50-h.p. motor, which is directly coupled to a line shaft through a flexible coupling, and running at 360 r.p.m. This motor drives forty 38-in. "cards." It stands on heavy iron brackets, supported from the mill wall, and is started up by means of a star-delta switch. There is also one 40-h.p. inverted motor with similar control, running at 365 r.p.m., directly connected to a line shaft through a flexible coupling, and driving four "ribbon" laps, four "sliver" laps, 26 cards, and 26 combers. A 90-h.p. motor placed in the motor tower, running at 365

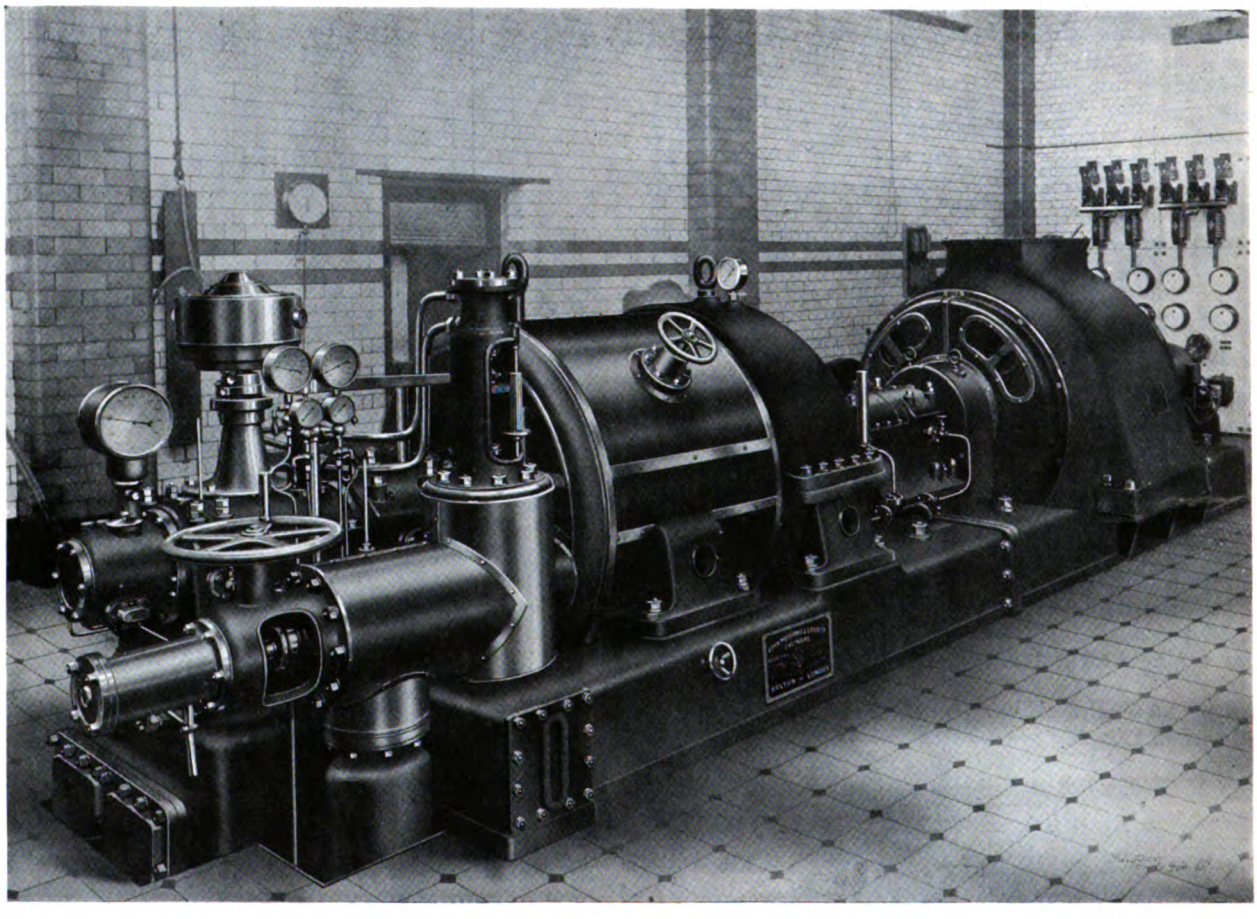

FIG. 9.—VIEW OF THE ENGINE ROOM.

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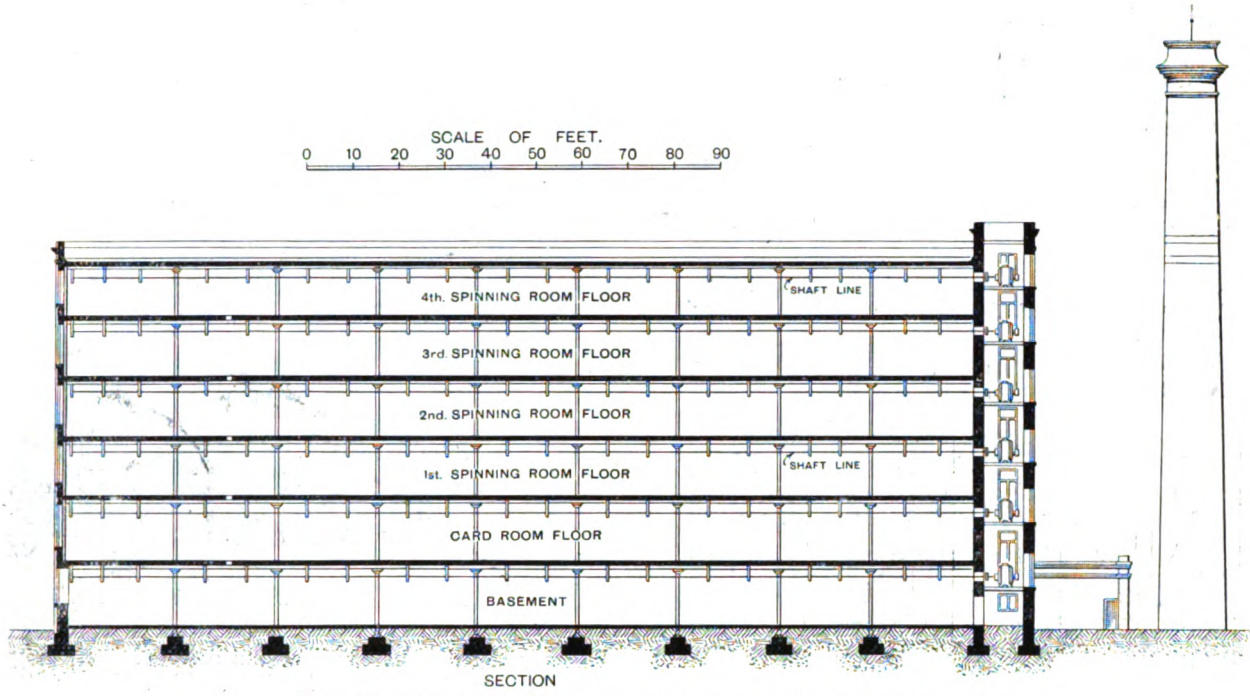

FIG. 10.—SECTION OF BUILDING SHOWING THE MOTOR TOWER.

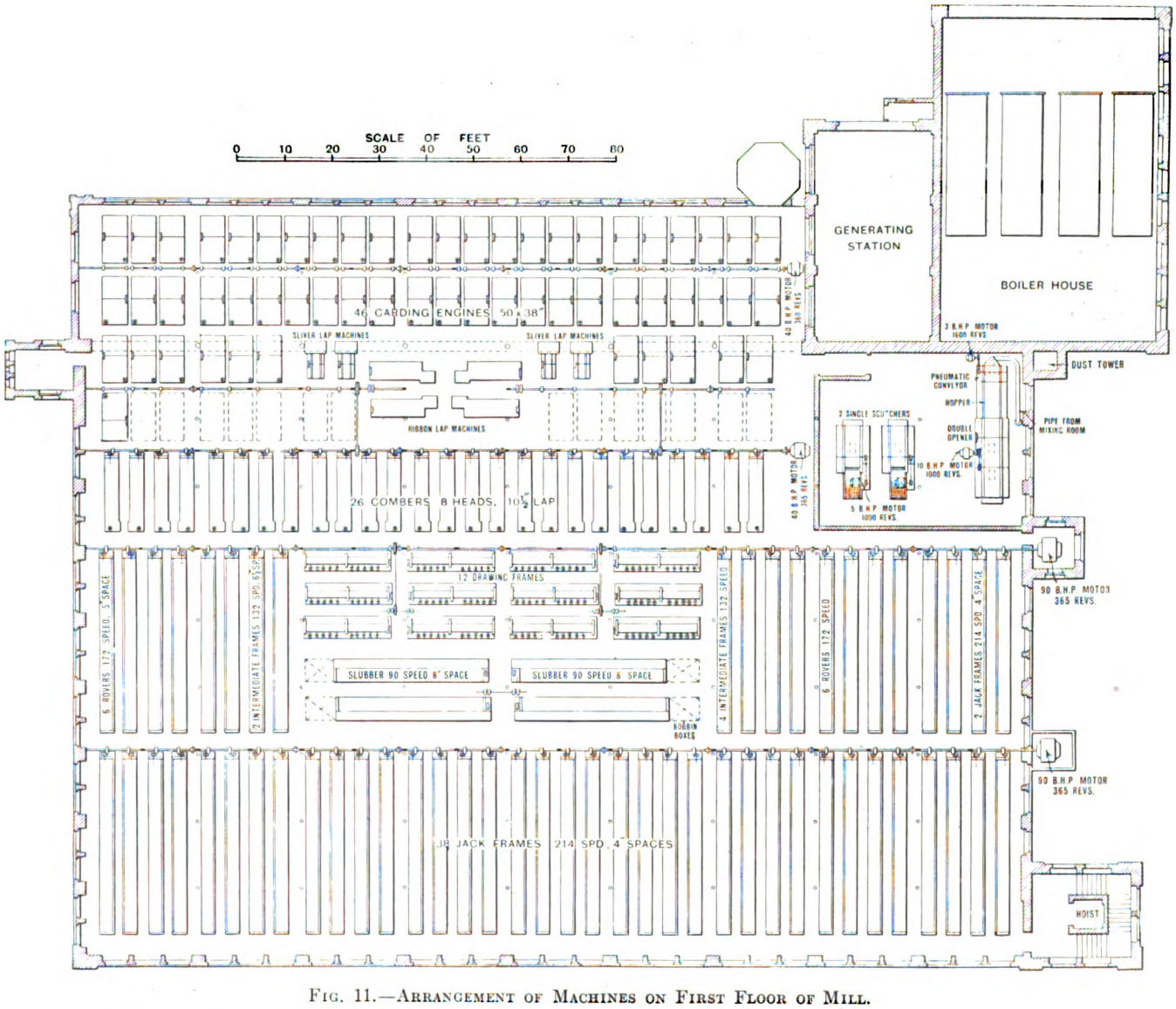

FIG. 11.—ARRANGEMENT OF MACHINES ON FIRST FLOOR OF MILL.

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r.p.m., and with star-delta switch control, drives 12 "roving frames," six "intermediate frames," 24 "combers," four 38-in. cards, two "jack" frames, and 12 "drawing" frames. Another similar 90-h.p. motor drives 38 "jack" frames, and four "slubbing" frames. The brushing and blowing process is longer in the case of a "superfine" mill than in a coarse mill, and the number of machines is greater. The "sliver laps" put the material into "laps," the "combers" take out the short lengths, and the "slubbing frames" or "slubbers" finally wind it into spools. From this point onwards the process practically consists of winding pairs of threads together and drawing

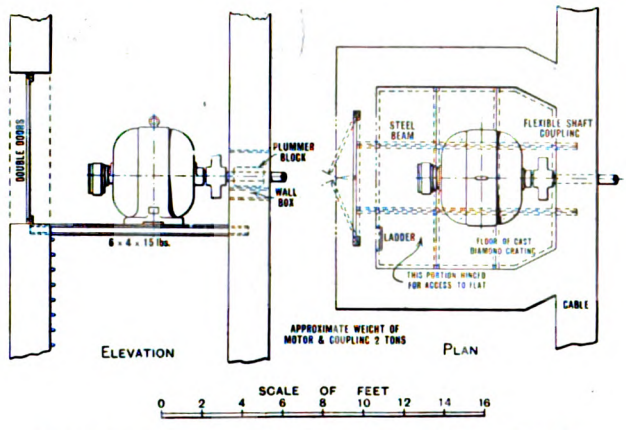

FIG. 12.—ONE OF THE MOTORS IN THE MOTOR TOWER.

out until the final fine thread is obtained of requisite strength and diameter.

On the second, third, and fourth floors are the "mule rooms," where the last stages in the process are carried out. The threads are wound off and stranded together. The spindles which wind off the thread from the spools are driven by thin cotton cords from tin rollers, which are in their turn driven through gearing in the centre of the room from the main shaft. This shaft is driven by the motor in the tower, as already explained, and the lines of mules are at right angles to this shaft. The motor on each floor is a 200-h.p. ventilated enclosed motor of the slip-ring type, running at 580 r.p.m., and the control is that already described

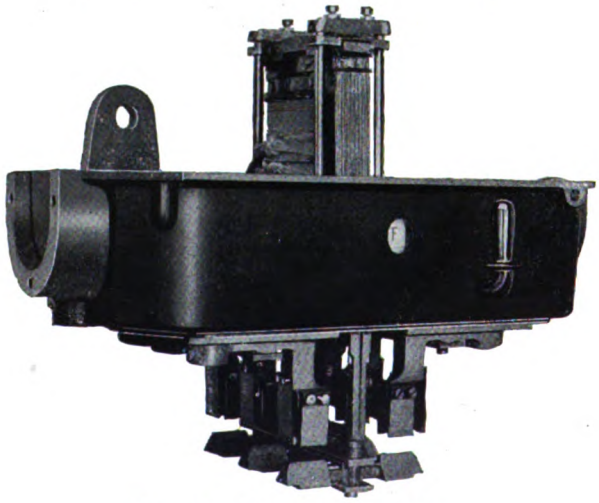

FIG. 13.—MOTOR SWITCH OPEN.

for slip-ring motors. These motors each drive 18 mules of 1,142 spindles each, 1¼ in. gauge. The spindle speed is between 7,000 and 8,000 r.p.m.

We are indebted to the Falcon Mill Co., Ltd., for permission to inspect the mill, and also to Messrs. John Musgrave & Sons, Ltd., and Messrs. Siemens Bros. Dynamo Works, Ltd., without whose ungrudging assistance the preparation of this article would have been impossible. For the very vague, and, we fear, unsatisfactory description of the spinning process itself, we alone are responsible, but our readers are naturally more

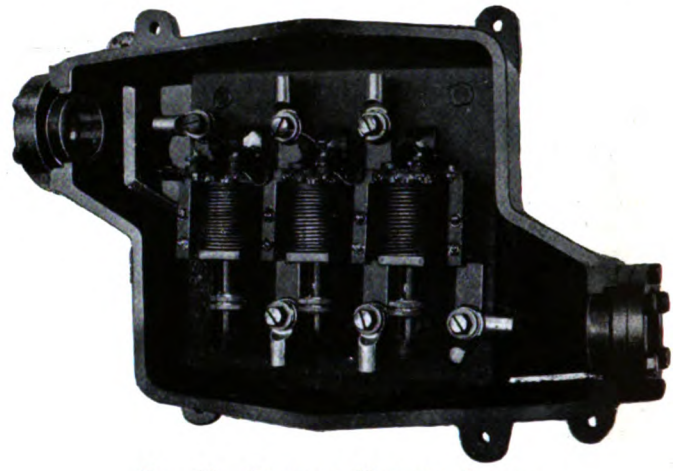

FIG. 14.—OVERLOAD TRIPPING DEVICE.

concerned with the applications of electric driving and the design of the new Zoelly turbine than with the precise methods employed in spinning cotton. Our thanks are also due to Messrs. George Temperly & Son, the architects, for lending us the drawing showing the section of the motor tower.

FIRE AT THE PARIS TELEPHONE EXCHANGE

A FIRE occurred at the main Paris Telephone Exchange between 8 and 9 o'clock on Sunday evening, which resulted in the whole of the centre of Paris, on the right bank of the river Seine, being cut off from telephonic communication. The fire was not overcome until nearly midnight. During the past few weeks the system in Paris has been undergoing conversion to the central battery system, and it was whilst the workmen had left the building for a short while that the fire was discovered in the basement. At the moment some 200 telephone operators were on the premises, but they were able to leave by the emergency doors without harm. As there is a fire-station only a very short distance away from the Telephone Exchange, some twenty engines were quickly at work, but just as it seemed that the fire on the first and second floors had been got under control, the third and fourth floors were suddenly seen to blaze, and eventually the whole of the building was completely destroyed.

It is estimated that material to the value of £800,000 has been burnt, in addition to the complete breakdown of the entire telephone service in Paris and between all provincial and foreign cities. No less than 19,000 subscribers are affected. The fire spread with extraordinary rapidity, and the frequent explosion of carboys of sulphuric acid made the work of the firemen particularly dangerous. According to the *Times* account the only part of the interior of the building which was not absolutely destroyed is a portion of the interurban switchboard; the books were also saved. Temporary arrangements were at once made to restore telephonic communication with other countries, but it is estimated that many weeks, if not months, must elapse before anything approaching a normal service will be resumed.

Institution of Engineers and Shipbuilders in Scotland.—The official address of this institution will be 3 Elmbank Crescent, Glasgow, until November 16th, 1908, when the new premises at 39 Elmbank Crescent (directly opposite 3 Elmbank Crescent) will be ready for occupation.

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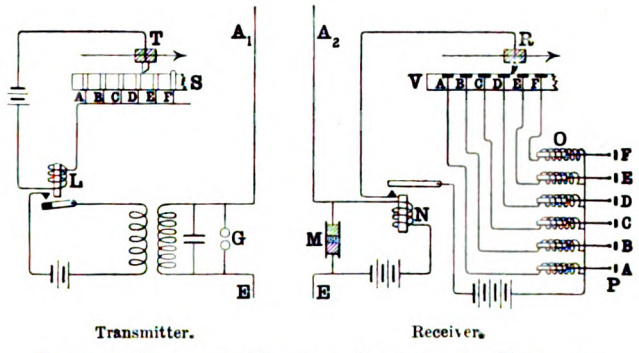
WIRELESS OPERATION OF LINOTYPE MACHINES

A DEMONSTRATION of a method of operating a Linotype machine, type-writer, or other keyboard apparatus by means of Hertzian waves was given by the inventor, Mr. Hans Knudsen, at the Hotel Cecil, London, on Thursday last. On page 648 of Vol. III. of ELECTRICAL ENGINEERING, we described the same inventor's system of transmitting photographs by means of Hertzian waves, and the present method of operating a keyboard is in some respects similar. The transmitting apparatus, a diagrammatic sketch of which is given below, consists essentially of a board S and a number of studs. The tops of these studs are normally flush with the surface of the board, but by depressing the keys of an ordinary keyboard, they are caused to project about $\frac{1}{4}$ in. above the surface. A travelling brush T makes contact with the projecting studs and at the same time depresses them to their original position. Whenever contact is made between a stud and the travelling brush T the relay L operates and a discharge takes place at the spark-gap G.

The resultant waves radiated from the aerial A_1 are received by the aerial A_2 and the coherer M responds,



KNUDSEN SYSTEM OF WIRELESS OPERATION OF KEYBOARDS.

thus causing the relay N to close the keyboard operating circuit. The receiving apparatus includes a board, V, on which are a series of contacts spaced the same distance apart as the studs on the transmitting board. These contacts are severally connected to electromagnets, O, each of which, when energised draws down a plunger and depresses a key on the keyboard of the type-writer or other machine which it is desired to operate. The key depressed will be that corresponding to the contact on which the travelling brush R rests, when the relay N closes the circuit. This travelling brush, however, is run synchronously with the travelling brush T of the transmitter, and consequently the key depressed will be that corresponding to the stud making contact at the transmitter. The method of working the travelling brushes synchronously was described in connection with the photograph transmitting apparatus; the chief point is that the transmitter sends out a series of waves at starting, and these waves affect a special coherer and relay circuit which starts the receiving apparatus. The machines are synchronised at very short intervals. In its present form the system, though interesting, can have no practical application, as it works extremely slowly. After printing a "d," for example, the brushes must travel over the whole alphabet of contacts before a "c" can be printed. Mr. Knudsen explained, however, that the apparatus exhibited was only meant to show the principle of the invention, and that a large number of modifications and improvements would have to be made before the system could be commercially applied.

A NEW DOUBLE SWITCH

THE accompanying illustrations show a novel form of double tumbler switch which has just been introduced by Messrs. A. P. Lundberg & Sons. This switch is a distinct novelty and should prove of considerable use for a variety of purposes where ordinarily two independent switches would be

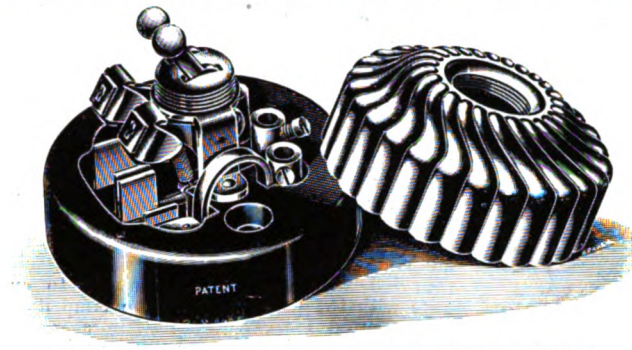


FIG. 1.—"TWINOB" SWITCH WITH FLUTED COVER.

used. The ordinary type combines, as shown in Fig. 1, on a circular base of standard diameter ($2\frac{1}{2}$ in.) two distinct switch movements of Messrs. Lundberg's well tried "pivot" type with a common terminal between them, arranged sufficiently close together to enable a standard cover interchangeable with other switches to be used. A small base type for flush work is also made, as shown in Fig. 2., and this is also of standard size. The construction embodies a new patented form of mica insulation for the attachment of the contact pieces to the arms, which is not only mechanically strong but cannot possibly be affected by heating of the contacts through overloading. The working of the switch is particularly easy and agreeable, and both arms can be depressed at once with no more trouble than in the case of an ordinary single switch. Any form of cover, locked or otherwise, can be fitted, and the visible metal parts can be supplied with several different styles of finish.

Among the various uses to which the switch can be put are the control of two groups of lamps, separately or together, and it will be readily seen that where a large number of combinations are required a great economy in the number of switches is obtained, and the distribution boards can be reduced to half the size. They can also be used with advantage for radiators with several lamps and in certain circumstances as two-way

FIG. 2.—"TWINOB" FLUSH SWITCH WITHOUR COVER.

switches, or in combination with two-way switches. It is also possible to connect them up with the two breaks in series and the contact arms pinned together for high voltages, and a further adaptation permits of their use as starting switches with one starting step for small motors. We are asked to state that these and other specialities of Messrs. Lundberg & Sons will be on exhibition at Manchester on the stand of their agents, the Sunbeam Lamp Co.

The Electrification of the Austrian Railways.—The work of securing the available water power for the electrification of the railways in the Alps is being continued by the State railway authorities in Austria. According to the *Elektrotechnischer Anzeiger* the water power of the rivers Oetz and Inn will be used for the power supply of the Arlberg Railway, the specifications for which have already been prepared. It is expected that tenders will be invited before the end of this year. An agreement has been made with the Austrian War Department whereby the railway authorities are obliged to keep the main lines in a condition suitable for steam traction, and also to keep in readiness the necessary steam locomotives, staff of drivers, and coal supply. The water power available in the south for the Brenner Railway is now being secured, and the engineering features of that line are being worked out. The electrification of this section, however, can only be proceeded with if the military authorities relinquish their demands with respect to the steam reserve. Conversion of the Vintschgau Railway and an extension to Landeck and the Engadin will probably be taken in hand before the Brenner line.

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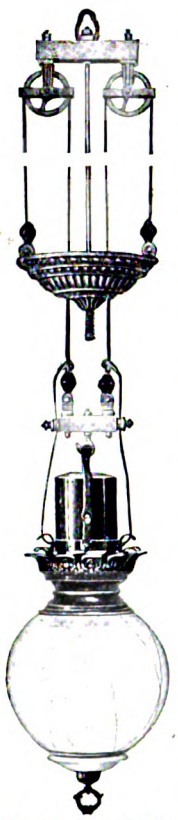
CATALOGUES AND PAMPHLETS RECEIVED

ARC LAMP ACCESSORIES.—Some new lists have been issued by the Union Electric Co. relating to arc lamp gear. One of these deals with guide attachments and cradles for outdoor lamps. In arc lamps hung on masts out of doors it is practically essential to steady the lamp between guide ropes or rods, so that wind pressure does not cause the lamp to swing, which would probably affect the burning of the lamp, or, when lowering, might lead to damage of the sleeve or breakage of the globe. The arrangements for this purpose comprise rope guides, on which by means of suitable attachments to the lamp framework, the lamp is guided up and down, and a special form of lamp cradle, in which the lamp is permanently fixed and the cradle provided with suitable attachments to engage with the guide ropes. The lamp itself is supported on two bell insulators in the cradle. A cable tension apparatus is used with lamps hung on high masts where arc lamp couplings are not employed. The object of this is to prevent the gradual breakdown of the insulation through the leads swaying in the wind; it can only be used with rope guides or cradle arrangement for the lamps. In one of the forms, the guide eyes are mounted on bell insulators, and therefore thoroughly insulate lamp from rope guides. The lamp is hung on the hoisting rope, through an insulating hanger, which encloses the porcelain insulator, and affords protection from wet.



UNION ARC LAMP COUNTERBALANCE GEAR.

The other list deals with hoisting gear, counterbalance weights, and other arc lamp accessories. The arrangement of one of the simpler patterns of counterbalance gear is shown in the accompanying illustration. As will be seen, the principal features are the use of a metallic suspension rope, which also conveys current to the lamp, and the provision of a counterbalance guide rod with spring buffer. Where greater travel is required, a double pulley arrangement can be used. Two forms of suspension rope are listed, one consisting of a plain flexible copper rope, and the other made up of tinned copper flexible rope to carry the current, and a steel wire suspension rope separately insulated, both cores laid up and braided together. The list also contains particulars of several of the more ordinary forms of winch and counterweight lower gear, strain releases, and arc lamp couplings.

Another list to hand from the company during the week deals with arc lamp resistance, of which a great variety, suitable for various patterns of lamps, are included.

EXTENSIBLE AND NON-SLIPPING LADDERS.—Messrs. J H. Heathman & Co., Parsons Green, Fulham, London, have sent a pamphlet of their well-known ladders, steps, trestles, scaffolds, trucks, &c. Important extensions are contemplated at the Fulham Works.

TIME SWITCHES.—Messrs. Venner & Co., of 6 Old Queen Street, Westminster, are issuing a new section of their catalogue relating to the "Venner" time switch, which, we are informed, has the distinction of being the only time switch approved by the Board of Trade. This particular section of the list contains particulars of the "B" type switch for currents up to 1½ amperes. A general description of the action of these switches was given in ELECTRICAL ENGINEERING, Vol. 1, page 730. The various forms which the switch can take include a simple make and break switch, a single pole change-over switch, and a five terminal change-over switch for two and three-phase circuits. These switches are particularly suitable for controlling double tariff meters, and are already in use on 70 or 80 different supply systems.

NAME PLATES.—Illustrated leaflets and cards from the Endolithic Manufacturing Co., of Pomona Buildings, Fore Street, E.C., represent a number of patterns of name plates for electrical purposes in ivory, ivorine, bone, and metal.

METAL FILAMENT LAMPS AND ELECTRIC LIGHTING SUPPLIES.—Several new pamphlets dealing with metal filament lamps and various electric lighting supplies have been issued by Messrs. Drake & Gorham, Ltd., 766 Victoria Street, S.W. The tantalum lamp section gives full particulars of the various standard sizes of these well-known lamps, from 16 to 50 c.p., for voltages from 65 to 160 volts, as well as the newer 25-volt tantalum lamps for train lighting or house lighting with small transformers. A large number of special fittings, adapters, and shades for these lamps are also listed, including a long series of special halophane shades and globes, outside lanterns, &c. Another section deals equally fully with Osram lamps in candle-powers from 25 to 400, and voltages from 100 to 250, as well as 25-volt, 10, 16, and 25 c.p. lamps, and several forms of miniature battery Osram lamps. A number of patterns of special shades and fittings for these lamps are included, and also small auto-transformers for running low-voltage lamps or ordinary alternating supply voltages. Further pamphlets deal with switchgear, fuse boards, &c., a special two-part porcelain insulator for surface wiring, steel callipers with dial reading, and a parallel motion drawing machine, replacing the use of tee and set squares.

DISTRIBUTION BOARDS.—A comprehensive new list of distribution boards, switches, and fuses, has been issued by Simplex Conduits, Ltd., embracing a considerable range of fuse-boards in various sizes in wood and iron cases, with and without switches to each circuit. Although all the boards can be supplied with ordinary open bridge fuses, it is noticeable that, in accordance with the prevailing tendency, especially with the higher voltages, all except some of the cheapest patterns are adapted

SIMPLEX DISTRIBUTION BOARD WITH ENCLOSED FUSES.

for use with enclosed fuses, of which several patterns are listed. The accompanying illustration represents a board of this nature in iron case, for six five-ampere ways, with D.P. enclosed fuses and S.P. switches. As an indication of the variety of boards included, we may mention that the prices range from 2s. 3d. for D.P. way, to 12s. for D.P. way in the case of iron-clad board switches for colliery and similar work. Other items dealt with in this catalogue are open and enclosed main switches, fuses, and fuse-boxes, &c.

TANTALUM LAMP FITTINGS.—Messrs. Siemens Brothers Dynamo Works, Ltd., are issuing a new leaflet relating to a

"SOLAR" FITTING.

series of "Solar" fittings suitable for tantalum "sun," and other spherical bulb lamps. The arrangement is shown in the

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accompanying illustration, and can be used for single lamps, or a number of such fittings can be combined for the formation of very effective multiple light fittings suitable for public buildings, hotels, churches, &c.

IRON-CLAD FUSES.—Messrs. Tetley & Co., of Falcon Electrical Works, Bedford Street, Greengate, Salford, send us particulars of a special design of iron-clad fuses for voltages up to 600 volts. The body of this is of cast iron lined with a vitreous enamel, which prevents any possibility of earthing during rupture. The bases are of oiled slate, and all the sizes have a six-inch breaks. The list includes fuses for currents from 25 to 500 amperes.

OSRAM LAMPS.—A leaflet from the General Electric Co., forming an addition to the large Osram lamp catalogue, decsribes two new types of Osram lamp. They include a series of large lamps of 200, 300, and 400 c.p., for voltages from 100 to 260, which are of particular interest, owing to the fact that, not only are they cheaper in first cost than enclosed arc lamps of similar candle-power, but also cost less to run and maintain. There should thus be a considerable field for their use. The other new Osram lamps are at the other end of the scale, and are candle lamps with flame bulbs for running in any position. These are made for 10 and 16 c.p., not only in what is becoming the standard voltage for small transformers and independent plants, but also for 33 volts, so that they can be run three in series on 100-volt circuits in the often-used three-light candle fittings. Some 25-volt lamps in round bulbs are also listed.

ELECTRIC BELLS.—A new miniature catalogue of electric bells and accessories of a size suitable for the pocket, is being issued by the General Electric Co. The contents are very complete, and include a long series of bells, buzzers, relays, indicators, complete portable sets, pushes, batteries and other accessories. Some useful diagrams showing various methods of connecting up are also given.

ENCLOSED FUSES.—A card from the I.T.E. Electric Co, of 70 Finsbury Pavement, gives particulars of the "Shawmut" extended terminal lug type enclosed fuse, in which one terminal lug is extended and provided with a long slot, so that the same fuse can be employed in boards with screw clamp terminals of a variety of distances apart.

HOUSE-SERVICE BOXES.—British Insulated and Helsby Cables, Ltd., are sending out a collection of leaflets dealing with house-service boxes, &c. The patterns include boxes for a concentric main and two concentric services of the solid non-disconnecting type with plummer or ring clamps and two four-way disconnecting boxes with pavement frames and covers for single or three-core cables. Other house boxes are for a concentric main and two twin services, a triple concentric main and one three-core service, and a triple concentric main and one twin service. Another leaflet announces a new size of the well-known Downe patent "Prescot" feeder-pillar.

FUSE WIRES.—A list is to hand from British Insulated and Helsby Cables, Ltd., of aluminium copper lead tin and special "Prescot" alloy fuse wires supplied on reels in tin boxes, which can conveniently be carried in the pocket or in a wireman's tool-bag. These range from 1 to 300 amperes fusing current.

TRAMWAY BRAKES.—An illustrated brochure has been issued by the Electromechanical Brake Co., of West Bromwich, describing the Maley patent electromechanical rail brake. A full description of the working of this brake and of tests made with it on a car belonging to the Leeds Corporation, was given in Electrical Engineering, Vol. II., page 851. It will be remembered that its principal feature is the use of mechanical track brake-shoes, which can either be applied by hand or by means of the drag of an electromagnetic brake-shoe. Its action is in no way dependent on wheel-brakes, and it is intended for use equally as a service brake and an emergency brake.

THE NEW ENGINEERING LABORATORIES AT THE HERIOT-WATT COLLEGE, EDINBURGH

THE new engineering laboratories of the Heriot-Watt College, Edinburgh, have been erected on a site immediately behind the main building of the college, and occupy a ground area of nearly 12,000 square feet. They were formally opened on Wednesday, September 16th, by Lord Rosebery, who, after referring to the small number of day students attending the college, as compared with the large attendances of evening students, suggested that it would be to the benefit to both employers and apprentices if the latter were allowed to attend a few of the day classes as well as the evening classes.

An engineering laboratory and workshop was first instituted at the Heriot-Watt College in 1888, and it has since then done excellent service in the practical teaching of the principles of engineering. The Governors of George Heriot's Trust, assisted by the School of Arts, the Watt Institution, the Scottish Board of Education, and private subscribers, have been able to erect the present buildings and equip them with the most modern appliances. The teaching of practical engineering or handicraft is carried out in three workshops devoted to pattern making and working in wood, fitting, turning, all kinds of machine work, welding, forging, brazing, &c. These workshops are provided with various kinds of modern machine tools driven by electric motors. The design and arrangement of the experimental plant in the engineering laboratories has been carried out by Prof. Stanfield, Mr. A. R. Horne, and the other members of the staff of the Engineering Department. In the principal engineering laboratory, which is mainly devoted to the experimental study of heat engines, part of the space has been excavated to a depth of 8 ft. below the ordinary floor level upon which the engines are erected. The boilers, superheater, and measuring tanks have been placed in this space or pit, and all the water and condensed steam to be measured in connection with the various engines, &c., gravitates to these tanks, most of which are placed on platform weighing machines. The floors of the laboratories are intersected with wide pipe tracks covered with steel plates; these pipe tracks carry the water and other pipes from the various engines to the tanks or to the main drain which is below the floor of the boiler pit.

The outstanding feature in the new laboratory is the experimental steam engine which has been specially built by Messrs. Marshall, Sons and Co. At full load this engine is capable of developing about 90 h.p. It can be run condensing or non-condensing as required. The high and low pressure cylinders are 7 in. and 13 in. diameter respectively, with a stroke of 20 in., the normal speed being 120 revolutions per minute. The flywheel is placed midway in the space between the two cylinders, and the crankshaft is provided with flanged couplings on either side of the flywheel, so that by disconnecting one or the other of these couplings, either side of the engine may be run as a separate unit. Two governors of different types are fitted—one to each side of the engine, and a suitable reducing valve is provided to be used when the steam is supplied to the low-pressure cylinder direct from the boiler. Both cylinders and the receiver are completely jacketed, and can be supplied with either saturated or superheated steam; this supply is quite independent of the main supply to the engine. Suitable appliances are provided for measuring the steam condensed in the jackets. The surface condenser was made by the Worthington Pump Co., and is connected to an Edwards air-pump driven by an electric motor. The circulating water is measured by means of a Kennedy water meter. The power is absorbed by a rope brake, and suitable indicating gear is fitted to both cylinders. The temperature of the steam at various points will be taken by means of electric thermometers manipulated from a central switchboard.

Special attention is to be devoted to the experimental study of internal combustion engines, and this section of the laboratory includes a 8½-b.h.p. gas engine supplied by the Campbell Gas Engine Co., and arranged to work with either town or producer gas. The generator of the suction gas plant, from which the producer gas to supply the above gas engine is obtained, is mounted on a large platform weighing machine so that the consumption of fuel may be measured with accuracy; the connection between the generator and scrubber is made through telescopic pipe joints with water seals.

The laboratory is provided with complete apparatus for analysing flue and exhaust gases, also for determining the calorific power of coal, gas and oils. The applied mechanics laboratory is fully equipped with various kinds of apparatus and machines for illustrating and verifying the laws of mechanics and hydrostatics. A small hydraulic plant is provided for experiments on the flow of water through orifices and notches; also a small centrifugal pump driven by an electric motor. The strength of materials laboratory is provided with a 50-ton horizontal testing machine supplied by Messrs. Greenwood & Batley, and arranged for tensile, compressive, transverse, and shearing tests; also a Wicksteed torsion testing machine, and a complete cement testing plant. It is proposed to add later a 5-ton vertical testing machine. The smith's shop, which is not yet completed, will be provided with six hearths, and the usual tools for instructing the students in the principles and practice of forging and welding.

Proposed Electrification of the Russian Main Line Railways.—It is stated in *Elektrotechnik und Maschinenbau* that, according to the *Rus*, a congress of the Russian railway authorities will be held in St. Petersburg at the end of this month in order to consider the introduction of electric traction on the following main lines: St. Petersburg-Moscow, Kharkov-Sevastopol, St. Petersburg-Warsaw, and St. Petersburg-Wilna-Kiev-Odessa.

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THE FIRE ON THE CITY AND SOUTH LONDON RAILWAY

Board of Trade Report

THE report of Col. H. A. Yorke and Mr. A. P. Trotter on the fire that occurred at about 5.40 p.m. on July 16th, about 40 yards south of Moorgate Street Station, on the City and South London Railway, has now been issued.

At the portion of the line upon which the fire occurred the permanent way is constructed with flat bottom rails weighing 80 lbs. per yard, which are attached to the sleepers partly by means of dog spikes, and partly by fang bolts and clips. The sleepers in the small tunnels are 7 ft. long, 12 ins. wide, and 6 ins. deep. They rest for a distance of about 12 ins. at each end upon concrete, which is built up from the iron lining of the "tube." The sleepers in the big tunnel are about 22 ft. in length, 12 ins. wide, and 9 ins. deep, and they extend right across from the up to the down line. They are supported at the ends and at two intermediate places on concrete pillars, built up from the lining of the tunnel. All the sleepers are of pitch pine "burnettized." The depth between the top of the sleepers and the lowest portion of the tunnel is, in the small tunnels, 1 ft. 3 ins., and in the large tunnel from 8 to 9 ft. The conductor rails are laid in the four-foot way at a distance of about 3 ft. from the running face of one of the rails, and there is a pathway through the tunnels consisting of two 9-in planks laid side by side between these two rails; the spaces between the rails at the cross-over road being covered with a similar planking as far as possible. When Moorgate Street was a terminal station, a signal-box, constructed of wood, was erected upon steel girders above the scissors crossing, close to the spot where the small tunnels join the big tunnel. When, however, the line was extended to Islington a new signal-box was built at the north end of and between the station platforms, and the old box in the tunnel was put out of use, but was not dismantled.

In 1900, when the extension from the Borough to Moorgate Street was constructed, the Board of Trade requirements in regard to prevention of fire upon tube railways were not in existence, nor did the Act authorising that extension contain any clause, such as is inserted in all modern Bills relating to "tube" railways, making it obligatory upon the railway company to submit all their plans and details of construction to the Board of Trade for approval before commencing work. Under the present regulations of the Board of Trade, issued in 1904, no wooden signal-box or other wooden structure is permitted to be erected underground on any "tube" railway, and the pathway between the rails is required to be formed of granolithic slabs or of similar material.

The fire appears to have been observed by the officials at Moorgate Street at about 5.40 p.m. As far as can be ascertained the driver of the down train, which left Moorgate Street for the Bank at 5.36 p.m., was the first person to notice it. When this man arrived at Bank Station he told the signalman what he had seen, and this man telephoned to Moorgate Street. About the same time the fire was observed by P. Kelly, who had shortly before come on duty at Moorgate Street to take charge of the lift machinery. He found flames issuing from the sleepers of the down road, and fetched some sand, with which he and others endeavoured to put out the fire. Although they did not succeed in completely extinguishing the fire, station-master Knowles considered that they had subdued it sufficiently to allow some trains to pass.

After the departure of the third train the fire broke out again, and Kelly, by direction of the station-master, switched off the current between Moorgate Street and the Bank. After the arrival of the next train at Moorgate Street it was evident that the fire could not be extinguished with the appliances available. Station-master Knowles therefore called upon the passengers, of whom there were about 120, to leave the train and ascend to the surface by the lifts. Knowles then ordered the station staff to go to the surface, and about the same time a telephone message was sent to the power house to cut off the current from the whole line. Before this was done, however, one of the cables "blew out." All traffic on the line was then stopped. As soon as the above steps had been taken the station-master sent the alarm to the fire brigade. The smoke was then very dense. The firemen descended to the platform, but were unable to proceed any further owing to the smoke. A second attempt made with the aid of smoke helmets, also failed. At 6.55 p.m. an attempt was made to enter the tunnel from Old Street Station, but by that time the smoke had reached this place, and was too dense to permit the firemen to enter. The firemen then went to Bank Station, where they had no difficulty in descending. They then proceeded along the down tunnel and reached the seat of the fire about 8.30 p.m. The water by means of which the fire was eventually extinguished was conveyed by hose along the tunnel from Bank Station to Moorgate Street.

It would seem that after the discovery of the fire at Moorgate Street Station some seven or eight minutes were occupied in the endeavour to extinguish it, during which time two trains had been allowed to pass over the spot where the fire had started, and no attempt was made to render the section dead between Moorgate Street and the Bank. And it was not until 26 minutes after the first alarm, that notice was given to the fire brigade, the result of this delay being that the smoke became so dense that the firemen, in spite of repeated efforts, were unable to reach the fire until 2 hours 50 minutes had elapsed after the outbreak. By this time the disused signal-box was completely destroyed, and there was then little difficulty in extinguishing the fire.

The report continues:—"It is not possible to say with certainty what was the actual origin of the fire. From the evidence given at our inquiry by Mr. McMahon, the electrical engineer of the company, it would appear that leakage of electric current has been known to occur between the power rail and the running rails, due to an accumulation of iron dust and carbon dust on the sleepers and insulators, the leakage being sufficient to set this dust and the upper surface of the sleepers on fire. It is possible that the present fire was caused in some such manner, or it might have happened that this dust was ignited by sparks from the shoes of a locomotive. The fire seems to have started between the last sleeper in the mouth of the down tunnel and the first of the long sleepers which span the cross-over. In the space between the two sleepers several electric cables were carried in a wooden trough, namely, a 0·125 square inch lighting cable, a cable connecting the conductor rail with a balancing dynamo, and a 20 circuit telephone cable. The depth below the sleepers in the tunnel, that is, as already stated, the distance between the upper side of a sleeper and the iron segments of the tunnel is about 15 inches; the depth below the sleepers in the cross-over is some eight feet. Having regard to the considerable time which elapsed between the discovery of the fire and any signs of electric arc on the spot, or opening of circuit breakers at the works, it seems probable that the fire did not originate from any defect in the insulation or in the continuity of the electricity cables, but began with a smouldering which may have developed into flames by the draught of passing trains. Although permanent way men walk through the tunnels every night, clearing away rubbish, the tunnels are extremely dirty, and some of the dirt is of a dangerous character, namely, that which consists of iron dust and carbon dust, the former from the brake shoes, wheels, and rails, the latter from the carbon brushes of the motors. In addition to this there is in some places a good deal of oil drippings. The insulators are said to be cleaned once in three or four months. This dust is inflammable. The coating of dust on a wire will burn with a smouldering glow, if ignited, and will, if fanned, say by the draught of a passing train, burst into flames. The sides of the tunnels and the wires carried along them are covered with it. When dust accumulates on an insulator it sometimes forms a path for an electric leak, which ignites it, and this may set fire to a sleeper. Such small fires have been experienced. When a driver sees one, he informs the station-master of the next station, who telephones back, and the driver of another train being warned, stops and extinguishes it with a brush. Pieces of waste have also been found on fire. Each locomotive carries a bucket of sand and a ten-gallon tank of water, which is connected with the compressed air tank, enabling a jet to be thrown. The dust to which reference has been made probably lay on the top and the sides of the trough carrying the cables, and on the sleepers, and became ignited either by an electric leak or by sparks from the shoes of the locomotives."

Repeated efforts were made to extinguish the fire by means of sand. This may have been effectual wherever it could reach, but the fire seems to have caught the sides and underside of the sleepers, and this could not be reached by sand or any other means. The fire was rendered less accessible by the planks which are fastened to the sleepers to form a footway.

About ten minutes after Mr. McMahon arrived at the engine-house the circuit-breaker came out on the lighting circuit. Linesman Nicholls says that as he approached the fire with a bucket of sand one of the cables "blew out." It is considered probable that this was a secondary effect, due to the burning of the cable, and that, as already suggested, the fire was not due to an excess of electric current. Had the large space in the invert below the cross-over, some 20 ft. wide, by 64 ft. long, and 8 ft. deep at the middle, been filled in and flush with the sleepers, it seems likely that the fire, confined to the surface, could have been extinguished by sand.

The fire spread laterally in both directions, but lengthwise only for a few feet. The electric lighting cable went to earth on a disused air pipe, on the east side of the down road, fusing a hole in it, and becoming itself severed. This was probably due to the burning away of the insulation. Two sleepers of pitch pine on this side were charred for about ¾ in. deep. The fire spread across the 25-foot tunnel, and four long sleepers were burned on the top and sides, but not sufficiently to render them unsafe. They were still in the road when the Inspectors visited the spot. The planking on the top of the sleepers over an area of 4 ft. by 20 ft. was also burned. Two new short sleepers had been added on this (the west) side since the fire. The insulation of a number of cables, both high and low pressure, and some large telephone cables between the two lines, had been burnt away

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for some four or five feet, but the wires remained unsevered. As the flames and heat increased, the disused signal cabin above the cross-over road took fire, and was completely burned out. This probably helped the fire to spread, and was the cause of much of the smoke.

With a view to reducing the risk of fire, or, what is worse than fire, of smoke, the following recommendations are made:—(1) Considerably greater attention should be given to cleanliness; dust should be more carefully removed. (2) A liberal use of whitewash would enable any accumulation of dust to be detected. (3) The filling up of the inverts, particularly of the large tunnels, should be carried out. (4) No electric wires or cables should be carried below or between the sleepers, but should be neatly arranged along the sides of the tunnels, and all crossing of cables should be overhead. (5) The use of wood should be eliminated as far as possible; the planking and the wooden platforms should be replaced by slate or granolithic slabs. (6) On discovery of a fire, all traffic should be stopped in that section until the fire is completely extinguished. (7) Prompt notice should be given to the fire brigade."

THE BOURNEMOUTH TRAMWAY ACCIDENT

Board of Trade Report

MAJOR J. W. PRINGLE'S report on the accident which occurred on the Bournemouth Corporation Tramways on May 1st, in circumstances already reported in ELECTRICAL ENGINEERING, has now been issued.

In this case, a car was descending the incline from St. Michael's Church, Poole Road, into Bournemouth Square, viâ Poole Hill, The Triangle, and Avenue Road, when the driver (Wilton) lost control. The car attained a dangerously high speed, and eventually left the rails at the right-hand curve in Avenue Road, near the School of Cookery. It then crossed the left-hand footpath, and plunged down a bank into the private garden of Fairlight Glen House, where it came to rest on the steep wooded slope, lying on its right side. There were at the time from 35 to 40 passengers on the car. Of these, seven were killed, or died very shortly afterwards, and 26 were injured. The driver, who remained at his post, was also injured.

Car No. 72 was a double-deck (without top cover) bogie car, with eight wheels, and maximum traction trucks (large wheels leading). It weighed about twelve tons unloaded. The braking equipment included hand brakes and electro-magnetic track brakes.

The tramways in Bournemouth have the 3 ft. 6 in. gauge. Through the centre of the town, the lines are worked by electric traction on the underground conduit (side slot) system; outside the centre, overhead conductors with trolley arm connection was used. From the conduit pit in Poole Road to the scene of the accident is a distance of about 460 yards. The route winds considerably, and has continuous falling gradients.

It appears that on the day of the accident the car was driven by several different men. One of them (Copelin) took charge at 1.14 p.m., and at 3 p.m., in trying to reverse from No. 1 end, he locked the controller, and was unable to drive any further from that end. Eventually, by cutting out one of the motors, he was able to drive the car from the rear (No. 2) end into Parkstone Depôt. He reported that No. 1 controller was out of gear, and he could not use power from that end. Inspector Rushton examined the controller, and found the motor barrel out of position. He threw it out of gear, re-adjusted the barrel, and replaced the pinion gear, which had overridden. He then tested the controller by means of the handles, and found it worked properly. At 3.30 p.m. Copelin again took out the car. He had previously taken it twice down Poole Hill, and on both occasions he found the magnetic brake working properly. At 5.20 p.m. driver Wilton took charge of the car. He drove it from No. 1 end westward to the terminus at Poole, where he arrived about 6.8 p.m. He used the magnetic brake on this journey in descending Constitution Hill, and found it worked perfectly. About 50 yards from the terminus he shut off power by moving the large controller handle into the "off" or neutral position. After coming to a standstill, he brought his small handle or reversing key at No. 1 end from the forward into the "off" position. He then removed both handles, and took them to No. 2 end. He had no difficulty in doing this, and noticed nothing unusual in the movement of the handles. It is not possible, owing to the interlocking, to remove either of the handles until the pointers of both have been brought round into the "off" position as indicated on their respective dials. Wilton left the terminus at Poole, on his eastward journey to Bournemouth, about 6.10 p.m., driving from No. 2 end. As far as the conduit pit in Poole Road, about 4½ miles from the terminus, the journey was uneventful. No emergency stops were made, and there is no steep decline, so that Wilton is certain that he did not use the magnetic brake on this return journey. The car was brought to rest at the conduit pit, and the plough attached to the underground conductor. Wilton re-started the car, by using one or two notches of power, until a speed of three or four miles an hour was attained. Power was then shut off, and the car allowed to run a little distance. He applied three notches of magnetic brake about 65 yards from the conduit pit. There was no effect. He worked further notches on the brake side, and used sand, but there was still no effect. By this time the car was close to the usual stopping place at Par's Corner, and had attained a speed of ten or twelve miles an hour. He realised that the brake had failed, but was so confident that it was only a temporary failure that he brought his controller handle from the brake into the "off" position, and allowed the car to run freely round Par's Corner. He then re-applied the magnetic brake in the same manner, notch by notch, but again without effect. A little more than half way between Par's and Robson's corners, *i.e.*, about 280 yards from the top of the hill, Wilton applied his reversing power, by bringing his controller handle into the "off" position, moving the reversing key into the backward position, and then using power, notch by notch, as far as the fifth. This had no retarding effect, although the automatic canopy switch was blown, and the car had attained a speed of 20 to 25 miles an hour at Robson's Corner. Wilton then used his hand-brake, which he had held in position ready to apply it all down the hill, but the speed was so great that there was little or no retardation, and the car left the rails on the curve above Fairlight Glen House, as has been described, about 460 yards from the starting point at the top of the hill. Wilton's explanation for relying so long upon his magnetic brake was that on another occasion, about a year previous, the magnetic brake failed the first time he tried it, but worked beautifully on the second attempt. If he had known that the magnetic brake was not to be relied on, he could have taken the car down the hill in safety with the hand brake only.

Sections of the rails at the point of derailment show that the wear on the running edge of the left-hand rail amounted to about one-half of the original vertical distance between the head of the rail and the bottom of the groove. There were clear indications also that the flanges of the left-hand wheels, owing to the check on the inner rails, and the wearing down of the head of the outer rail, were riding on the bottom of the groove, two very clear scores being apparent. On May 14th certain trials were made on this particular curve, and speeds up to twelve to thirteen miles an hour attained by different cars without derailment. These trials prove at all events that, notwithstanding the large amount of wear on the rails in proximity to the site of the accident, as regards speed, there was a considerable margin of safety beyond the authorised limit of six miles an hour, provided the wheel flanges were in fair condition. At the same time, it is not possible, thinks Major Pringle, to avoid the conclusion that the worn condition of the rails at the point of derailment and of the flanges was to some extent a contributory factor in the case.

Major Pringle continues:—"I examined car No. 72 on the afternoon of May 2nd, before it had been moved from the position it occupied after the accident. It was then lying on its right side on the embankment. The hand brake was applied, and the sand valves and sand pipes were in order. At No. 2 (leading) end both handles were in position on the controller, the reversing key being in the "backward" position, and the large handle at the last (seventh) brake notch. No. 2 controller as regards contacts, fingers, mechanism, &c., was in good condition, and the movements of the large handle and reversing key actuated the barrels, and made contacts with the fingers in the proper manner. I found one of the leads attached to the coil of the off rear magnetic brake shoe broken, the brake being of old standing; the insulation of the other lead to the same coil was damaged. Inside the car the leads to this shoe were disconnected. Only three out of the four magnetic shoes were, therefore, available for use. So far as I could judge, the adjustment of the shoes was correct, and the release springs were in working order. There was some indication of 'flats' on the treads of some of the wheels, but the marks were all so slight that it was evident that the wheels could not have skidded for any appreciable distance on the journey down the hill. At my request all the electrical and magnetic circuits and earth connections were tested for continuity by Mr. Bulfin, Borough Electrical Engineer. All were found correct with the following exceptions:—Rear (No. 1 end) off magnetic shoe coil, the lead to which (as described above) was found broken; the earth cable to the case of No. 1 motor was found torn away from its socket, the severance in this case being clearly the result of the overturning of the car.

"To make these tests, the cover of No. 1 controller was removed by Mr. Lait, Depôt Superintendent, and foreman Robinson, on the evening of May 2nd. They found the reversing or motor barrel of this controller was not in its proper

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'off' position, but midway between 'off' and 'reverse,' and that there was contact made with several of the reversing fingers. The fact that, when Wilton lost control of the car, the reversing barrel at No. 1 end was making contact with the reversing fingers, explains the failure of both the magnetic brake and the reversing power. The effect of this contact (with this type of controller), whilst the car was being driven from No. 2 end, would be to short circuit the armatures of the motors, and prevent the generation of current by the motors. Similarly there would be no retardation when the reversing key was placed in the backward position, and the controller handle used in the highest power notches." This was confirmed by experiments with another car.

"Mr. Turner, electrical engineer to the British Westinghouse Electric Co., gave evidence to the effect that, when he examined, at the request of the Corporation, the controllers of car No. 72, there was a marked difference in their condition. The gearing and motor barrels of No. 2 were in good order, and no slack movement was observable beyond that which is always to be found in similar gearing. The mechanism of No. 1 controller was in a very slack condition, one of the motor barrels was so loose on its spindle that contact could be made with two or three fingers on either side by moving it with the hand. Granted contact with two fingers on the reverse side at No. 1 controller, the brake effect and reversing power when applied at No. 2 controller would be neutralised. It was possible, by sharply swinging round the controller handle at No. 1 end into the off position, to make contact on the reverse side, without any overriding of the teeth in the gearing, and this could occur without the knowledge of the driver.

The looseness in the working of No. 1 controller may be accounted for by the fact that the original reversing barrel, supplied with the controller in 1906, had been replaced by another and older barrel, which had seen previous service. This barrel, besides having been subject to more wear and tear, may possibly have fitted the new controller with less accuracy."

The report contains the following general conclusions on the whole case :—

(1) The initial cause of the car getting out of control on this occasion was the incorrect position of the reversing barrel of No. 1 controller at the rear end, which rendered useless all the electrical braking equipment whilst the car was being driven from No. 2 controller. (2) Consequently the only available means of checking the speed of the car down the hill was the hand brake with its wheel blocks. These were in good order, and if Wilton had recognised at an earlier moment—say, when he was rounding Par's Corner—that the magnetic brake and reversing power were useless, he could, by careful management of the hand brake, and the use of sand, have negotiated the remainder of the decline in safety. (3) The incorrect position of the reversing barrel was not, in my opinion, due to mismanagement of the handles by the driver, but to looseness in the mechanism of the controller, due to wear and tear and want of proper maintenance.

Wilton's failure to recognise more quickly that his electric brakes were useless does not, in my opinion, amount to more than an error of judgment; and he deserves credit for remaining at his post till the last moment. To fairly apportion the responsibility for permitting the car to go on service in such an unreliable condition is a difficult matter. The system of stabling cars indiscriminately at any of the four depôts, is largely at fault. The particular controller must for some time past have been in an unreliable condition. That its condition was not discovered by any of the controllermen, foremen, or Inspector Rushton, argues either insufficient examination or want of knowledge.

Major Pringle also calls the attention of the Corporation to the following matters :—

(*a*) No cars should be permitted to be on service without their full brake equipment. Mr. Barber has had trials made to show that the stopping effect on a large car with four magnetic brake shoes in use is but little better than with three only. This may be admitted, but public safety demands the highest possible efficiency, and not the second best. It is only on the understanding that the full equipment is available that the Board of Trade license working. In this particular case there were no magnet coils in store, and there was no evidence to show how long the shortage existed. But if the Corporation had given the necessary authority for keeping such necessary articles in store, the responsibility rests with the Depôt Superintendent and his staff.

(*b*) The position of the sand pipes in the large cars can be improved. On No. 72 they were placed 24 inches from the wheel contact. Dry sand delivered at such a distance will of necessity fall clear of the rails on a curve, and even on a straight road be more liable to be blown away from the desired spot by any current of air. The distance should be reduced by one-half at least.

(*c*) The rails on the curve where derailment took place require to be renewed, preferably with a wider groove than that originally used. I have referred to the worn condition of these rails, and recognised that there was sufficient margin of safety for the speed authorised. But all curves at the foot of long steep declines are danger points, and for this reason it is of importance that the rails on such curves should be carefully watched and replaced when they show considerable signs of wear.

(*d*) As regards the magnetic brake, it is now generally recognised that it should not be reserved only for emergency purposes, and for descending steep gradients, but should be in common use. When used for coasting gradients, the common practice, as set forth in the Instructions to Motormen issued by the British Westinghouse Company, is to set the controller handle immediately to the last braking notch, and move it back as may be required. I see no reason why the practice in Bournemouth should be otherwise.

(*e*) The training of drivers is not given the attention it deserves. At most tramway centres a regular school is maintained for the training of men, which contains full scale models of all the electrical equipment and wiring on a car. Batches of selected men are put through a regular course, first in technical education, and afterwards of practical driving under a qualified instructor, and the men are examined, both in theory and practice. The method at Bournemouth of giving a conductor a permit to learn driving, during his spare time, from any permanent driver is not a satisfactory substitute.

(*f*) The organisation of the tramway department is open to criticism. So far there has been no regular manager at Bournemouth. The control seems to have been divided between the Borough Engineer, the Traffic Manager, and others. No one officer is responsible to the Corporation for the administration of the whole undertaking. This cannot be a satisfactory arrangement. I strongly advise the Corporation to make a change in the organisation, by selecting in open competition a properly qualified general manager, and giving him control over the whole department. The critical period for tramways is not during the first three or four years, when equipments, &c., are comparatively new. It is later on, when mechanism begins to wear out, and renewals have to be made. Previous experience of some length is then of first importance.

Finally, the following alterations and additions to the regulations now in force are recommended :—(1) The compulsory stopping-place in Pool Hill on the downward journey should be at the arc lamp-post before reaching the Pembroke Hotel. (2) So long as the magnetic or other track brake is not used for ordinary stops, it shall be applied, to test its effectiveness, before reaching any steep gradient down which the brake is used for coasting. (3) All controllers at every terminus, before the handles are removed, shall be opened and the barrels examined for their proper "off" position.

We have received copies of several communications from officials of the Bournemouth tramways commenting upon the report which have been submitted to the Board of Trade.

Mr. F. W. LACEY, M.Inst.C.E., writes as follows regarding the curve where the derailment took place :—The authorised speed round this curve is six miles per hour, and the track as laid is capable of taking any car in fair working condition safely round at a speed of from 12 to 16 miles per hour. I do not attach so much importance to the actual wear of the outer rail, as the grinding effect of the flange of the wheel so alters the original section of the head of the rail in such a very short time and in such a manner as to render the flange of the wheel practically ineffective as a means for keeping the car on the line after the first few weeks, and especially is this the case where the groove of the rail is narrow. Major Pringle now recommends a wider groove than that orignially used, and in this connection I should like to call the committee's attention to the correspondence between myself and the Board of Trade previous to the construction of these curves. This correspondence proves that on behalf of the Corporation I pressed the Board of Trade to allow an extra width of groove round all sharp curves. The Board, however, notwithstanding my repeated appeal, insisted that the groove in the rails should not exceed 1¼ in., and the conduit slot 1 in. It is only fair to add, however, that it is practically impossible to construct this curve so as to make it safe for a run-away car to negotiate, because to do so the levels of the road would have to be altered so as to make it hardly safe for slow and ordinary traffic.

The use of magnetic brakes.

The cars were originally fitted with hand brakes and usual electrical brakes, but after the inspection of the line by Major Pringle in December, 1902, the Board insisted that the cars to be used in service on the Poole Hill should be fitted with track brakes (as I then understood the matter, because a very small length of that line exceeded a gradient of 1 in 14). As the trucks of the cars were so hampered with gear owing to the conduit system, it was impossible to fix a mechanical track brake, and the Committee were compelled to have recourse to an electrical track (or magnetic) brake as fitted, which the Board of Trade approved of.

Mr. Lacey also contends that electromagnetic track brakes are unnecessary in the service in question, and points out that they were added owing to the insistence of the Board of Trade. The service on Poole Hill was worked with the hand brake only, for a period of six months, with very satisfactory results.

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Mr. Lacey continues :—The organisation of the Tramway Department is seriously criticised by Major Pringle, but I would point out that he took little or no evidence on this point. Mr. Barber, the traffic manager, has the sole control of the whole system, so far as the public safety may be said to be concerned, with the single exception of the maintenance of the track, which is in my charge. Mr. Barber reports direct to the Tramway Committee, and receives his instructions direct from that Committee on all matters affecting the stores, maintenance of rolling stock, overhead equipment, traffic management, and working generally.

The Borough Electrical Engineer is responsible for the supply of the current in exactly the same way as the Electricity Company is responsible for the supply of current on the Poole and Christchurch lines. I cannot see why it is necessary for the Traffic or General Manager to have control over the tramway generating station any more than he should have control over the company's stations at Branksome and Christchurch, and I am of opinion that it would be inadvisable to increase his responsibilities in that direction. Wth regard to the maintenance of the track, I am of opinion that if for no other reason than to avoid dual control of the highway it is advisable for the Borough Engineer to maintain the track. It is obviously his duty to construct it, and with all due respect to electrical engineers, I think that the life-long experience of borough engineers should be at least as valuable as the comparatively recent exprience of electrical engineers or tramway managers in such matters. At the same time I admit the necessity for carefully considering any suggestion of the Traffic Manager as to repairs, and especially so in connection with all danger points.

Major Pringle states that the critical period for tramways does not come until three or four years. I do not think any practical tramway manager would agree with this statement, as it is common knowledge that the equipment, &c., commence to wear out, and renewals have to be made well within the first six months. I cannot refrain from stating that I think, quite unjustifiably and perhaps unintentionally, Major Pringle's observations are calculated to give the impression that the tramway system of Bournemouth is not a satisfactory one. The fact remains, however, that until the unfortunate accident in question, and notwithstanding the very difficult nature of the track and complications arising by reason of the combined overhead and conduit systems, no serious accident had happened during the previous six years in which the tramways had been in operation.

Mr. I. BULFIN, Borough Electrical Engineer, writes :—The permanent way was laid in 1902, and new conduit guard rails were laid round the curve of Fairlight Glen in 1906, and the outer track rail was raised from one to two inches. The usual life of a permanent way is from 11 to 15 years, and it was considered that the rails round this curve were in a satisfactory running condition.

Mr. C. BARBER, Engineer and Traffic Manager, writes as follows :—With regard to the condition of the controller, I regret that I cannot agree with Major Pringle's suggestion that it must have been in an unreliable condition for some time past. I, myself, on the Sunday after the removal of the controllers from the disabled car to the depôt, closely examined both of them for this very matter of slackness, and found that, with the exception of one finger which was bent (during removal), I could not make the reversing barrels come into contact in the manner suggested at the inquiry. I am convinced that the incorrect position of the reversing barrel was due solely to the straining in the afternoon, inadvertently it may be, of the mechanism of the gear which connects the main and reversing barrels.

The Westinghouse Company's representative at the inquiry admitted that some of the rocker arms (malleable castings) which formed part of this gear were, during the making of the controllers in the works, knocked into shape, if they did not happen to be of the correct shape to fit a particular jig. This original bending into shape would undoubtedly have the effect of making them more liable to bend again in use when subjected to strains such as those to which they are subject when the controller is worked quickly. That the particular casting in question has been dealt with as above-mentioned may be inferred from the fact that it bears marks indicating that it has been hammered. I think it to be regretted that the Westinghouse Company in the controllers made at Manchester, of which this particular controller is one, have made a radical alteration in the shape of the tooth of the gear. The American made controllers which are fitted to the original cars have proper mechanically shaped teeth, but those supplied with the last ten cars have the top corners of the teeth rounded off. The natural result is, with rounded teeth, that the gears are more liable to ride over one another, and so cause the reversing barrel to be placed in an incorrect position with the contacts touching when the main handle is in the "off" position. This is what, according to Inspector Rushton's evidence, happened in the afternoon, and, in my opinion, was repeated before the accident.

It is a matter of regret that Major Pringle did not make any examination of this controller while on the car at the time of his inspection on the day after the accident, when he could have satisfied himself as to its exact condition then and there, as it had not then been touched.

I would state that the defects in this controller were matters which I personally pointed out to Major Pringle in private conversation previous to the public inquiry, explaining to him the electrical results arising from the incorrect position of the reversing barrel of the rear controller when the car was being driven from the other end.

Further, I practically demonstrated to him the effects resulting by driving a similar car with the rear controller made similarly defective.

Major Pringle, in the course of his inquiry, referred to a printed card issued by the Westinghouse Company, headed "Rules for the care of Westinghouse Magnetic Brake Equipments."

This card has been hanging up in the depôt.

Under the heading of "Controllers" the Westinghouse Company have not a word to say upon the importance of making sure that the contacts of the reversing barrel do not touch when the barrel is in the "off" position.

Mr. Barber calls attention to the fact that, in a special notice displayed on each depôt notice board in June, 1906, as the result of disasters in other towns, he called attention to the necessity of every precaution being taken to avoid such an occurrence happening here, detailing the parts of the equipments requiring especial attention. In this notice are the words : "Every care must be taken that the reversing drum does not make 'contact' when in the 'off' position."

He also calls attention to Col. Yorke's report of the Glasgow accident in April (ELECTRICAL ENGINEERING, Vol. III., p. 973), due to a similar cause, and suggests that the Board of Trade be asked to advise the Westinghouse Company to notify the various tramway systems concerned of the danger which is present with this particular type of controller, resulting from contact inadvertently being made.

He then explains the arrangements adopted for the "stabling" of the cars, which is claimed to have the advantage of flexibility and to lend itself readily to traffic requirements. In order to adopt the method advocated of the same cars always being attached to the same depôts, a much more rigid and less economical system, from the traffic point of view, would be necessary.

With regard to the maintenance of equipments, he continues :—The course adopted for the maintenance of the cars has been that, when the cars are stabled in each depôt for the night, a staff of men is employed to regularly and systematically examine and attend to the many and various details of the car equipments. Each driver gives particulars of any defect noticed in the behaviour of his car upon a report sheet carried by him. These sheets the foreman at each depôt receives, and he, himself, examines any such defect reported. Each man in the depôt staff has his appointed part or parts of the equipment assigned to him. For example, the various parts of the brake gear are nightly attended to by the same man, the sand gear by another, the ploughs by another, and so on. Twice a week the controllers are examined, the commutators cleaned or armature bushes attended to, each by regular men. Each night the depôt foreman fills in upon a special report sheet (on which are printed suggestively the regular routine details to be attended to), all particulars of the work done upon the various cars. The various report sheets are daily examined by the depôt superintendent, who is thus kept advised of the work done and matters reported requiring attention. Periodically cars have to be taken to the central depôt, where the various details of the equipment are overhauled and all repairs and renewals beyond the ordinary everyday adjustments, and small replacements are carried out.

Mr. Barber also remarks that with regard to the car being in service with only three brake shoes in action, that a stock of spare magnets was usually kept in reserve, but owing to a period of wet weather and an unprecedented fall of snow just previous to the disaster, this stock had been exhausted by replacements.

With regard to the manner of using magnetic brake, Mr. Barber writes as follows :—The magnetic brake has not been kept for emergency purposes only, but has been in common use for service stops. As to the method of using it when about to descend a hill, I would remark that I was aware of the printed card of the Westinghouse Company relating to its use. As the result of failures on previous occasions, the London manager of the Westinghouse Company himself came down to me, but never took exception to the manner of using it nor mentioned the method of application now recommended, nor did their representative who followed him, although he spent some days in Bournemouth watching the drivers applying it. I find that the largest system and the system that is generally considered to be the most efficient in the country, namely, Glasgow, follows the same practice as is in use in Bournemouth.

Mr. Barber continues :—Major Pringle's description of the method adopted in Bournemouth for training drivers is not complete. I would point out that after learning to drive in the charge of an experienced driver on the road, the learner driver is tutored by the Chief Inspector on the roads adjoining the car sheds in the method of using his brakes and making emergency stops. In addition to this, the men gain a practical

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knowledge of the various parts of the equipments through acting as assistants to the regular depôt staff engaged upon the overhaul and repair of the equipments when on relief duties. With regard to technical schools, it appears that the largest systems in the country, namely, Glasgow, London, Leeds, &c., have lately adopted some such system for the training of drivers, but in the case of the great majority of systems it does not appear to be adopted.

With regard to Major Pringle's statement that "the critical period of tramways is not during the first three or four years, when equipments, &c., are comparatively new. It is later on when mechanism begins to wear out and renewals have to be made." I would remark that my experience goes to prove far different to this, as from the very commencement mechanism requires attention and adjustment, and many parts of the equipment require renewal within the first six months.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN the Editorial Notes of the September number of *Electrochemical and Metallurgical Industry* the question of cheap water power against steam power for electrochemical processes is discussed. It is pointed out that although cheap power is a very important factor, it is not all-important. Cheap power in an inaccessible region where labour is difficult to obtain and where there are no transport facilities, would not be a sufficient incentive to put down an electrochemical plant. The majority of the large electrolytic copper refineries of the United States have been established near to New York City, and are operated by steam power. What the electrochemist requires is cheap power and good freight and labour conditions. Central stations have serious load depressions during a great part of the day, and only in the evening under normal conditions do they have a peak load. If these depressions can be filled in so that the power curve is a straight line their prosperity would be very materially increased. But if they are to fill in their gaps by supplying power to electrochemical works, it follows as a necessary corollary that during times of peak load the electrochemical works must go without power, or must take very much less than at other times. Now most electrochemical processes require to be carried on continuously, and would not pay when worked intermittently. It is pointed out, however, that certain furnace processes, such as carbide, carborundum, graphite, &c., can quite easily be, and often are, worked intermittently. It would thus require careful organisation and a certain amount of give and take between the central stations and the electrochemical works in order to work profitably. Electrolytic industries, such as copper refining, manufacture of chlorate, and so on would find it more difficult to manage, because for economy's sake it is necessary to work continuously. One hardly likes to suggest that during peak loads they should fall back upon accumulators to supply the deficiency, because a large storage battery is a very expensive item, and the repair item is considerable. But at the same time it is good that the subject should be kept forward, for, as the Editor remarks, "Central station men and electrochemists have not yet come to a sufficient understanding of their mutual needs."

In the same number there is an interesting article by R. L. Whitehead upon Electrolytic Refining of Gold, Silver, and Copper at the United States Mint in San Francisco. All the American Mints have gradually been equipped with electrolytic refining plant. Philadelphia was the first, then Denver, and now the sulphuric acid process which has been used for 30 years at San Francisco has been completely replaced by the most modern and up-to-date plant installed in any mint. Both at Philadelphia and Denver the electrolytic process has been found more cleanly and economical than the older methods.

In the Tank Room thirty specially designed Royal Berlin porcelain tanks, 18 in. long, 13 in. wide, and 12 in. deep, are arranged on a stone table. The tanks are arranged in two rows of fifteen each. The circulation is obtained from a porcelain trough, supplied by a special jar, which receives the discharge from a porcelain plunger pump, especially made to withstand the chemical action of the gold chloride solution containing free hydrochloric acid. The tanks are so constructed that the solution enters at the back and is drawn from the bottom. By this means the heavy gold chloride which sinks to the bottom from the anodes is constantly removed, and is carried to the pump tank to be again circulated. This method of circulation is in striking contrast to the propeller circulation employed in the other mint refineries. There are many objections to the propeller system. The violent agitation is practically confined to one place, leaving the ends of the tank with very little circulation, the chloride of silver formed at the anode is dislodged and floats about in the tank. Some may adhere to the cathode and become covered up with fresh gold deposit. The slimes swirl about in the tank, and consequently more frequent stoppages for cleaning are necessary. The anodes and cathodes are placed ¾ in. apart, and only 1 volt is required per tank to maintain a current of 450 amperes. This represents a current density of 105 amp. per square foot of cathode surface, which gives a gold output in 24 hours of 650 to 675 oz. The best run for one week with 20 tanks was 13,500 oz. per day. The fineness of the melted cathodes averages 999·5. The purity of the anodes varies from 880 to 960 in gold. Anodes containing as much as 100 parts of silver have been worked successfully and have yielded gold of 999. The silver tanks are 24 in number, and are made of German earthenware, the circulating system being similar to that employed in the gold tanks. These tanks are 39½ in. long, 19½ in. wide, and 12 in. deep, arranged upon a stone platform supported by enamelled pillars. The anodes contain 300 to 333 parts of gold and not more than 100 parts base metals, the rest being silver. The electrolyte contains from 1 to 2 per cent. of free nitric acid, 3½ to 4½ per cent. silver, and small quantities of lead, copper, bismuth, and zinc. Owing to the anodes being very base, about 5 per cent. by volume of the electrolyte is drawn off every 24 hours, and an equal volume of solution rich in silver is added. The current density employed is about 50 amperes per square foot. The anode contact piece is cast into the anode slab, thereby ensuring good contact.

The foul solution drawn off daily is freed from silver by means of copper plates, and the silver thus recovered is made into silver nitrate for replenishing the electrolyte. The waste coppery solution is worked up for copper. The silver deposit runs uniformly about 999·5 fineness. The anode residue, mainly gold, is washed free from silver, melted, and cast into anodes varying in fineness from 920 to 950. In most refineries the foul silver solution is purified by precipitating the silver as chloride, and the copper present is run to waste. By precipitating the silver with copper plates, both copper and silver are saved.

For making gold chloride, anodes 990 fine are employed, and are hung in a solution of strong hydrochloric acid. The cathodes are of rolled gold, and are suspended in a porous pot containing hydrochloric acid, the whole being placed in the anode cell. A pressure of 5 volts is used, and a current of about 200 amperes is forced through the bath. Consequent on the cathode plates being of small surface for so high a current, considerable heat is evolved. This causes evaporation of the electrolyte, which therefore requires the addition of fresh electrolyte from time to time. Owing to the acid fumes the cells are placed beneath an acid-proof hood by means of which they are conveyed away. The copper recovered from the various solutions contains gold, silver, and platinum metals. It is treated electrolytically to obtain copper sufficiently pure for purposes of alloy, the platinum, silver and gold being obtained in the slimes. The gold is precipitated out with ferrous sulphate, and the platinum is thrown out together with the copper by means of scrap iron.

During three months' working of the refinery, 500lb. of copper was recovered from the gold operated upon. From this copper 112 oz. of platinum and iridium were recovered. The copper slimes produced a bar assaying 83 parts of platinum per 1,000 oz. This represents a concentration from 1,073,000 standard ounces of gold, which, supposing the platinum to be evenly distributed, would make less than one-tenth of an ounce of platinum per 1,000 oz. By ordinary methods this platinum would not be recovered. But here, by the mere refining of the gold and with very little extra expense, a metal worth about 90s. per oz. is recovered. The rest of the article, which is to be continued, is taken up with a description of the electrical plant, switchboards, &c.

Improved Services on the London Underground Railways.—Some improvements in the services on both the Metropolitan and District Railways are announced for October 1st. Instead of only Metropolitan trains making the complete journey of the "Inner Circle," the service is to be augmented by the addition of District trains. The new arrangement will obviate the necessity for sometimes changing at South Kensington between 8 a.m. and 9 p.m. From 30 to 34 trains per hour are to be run between Gloucester Road and the Mansion House during the busy hours of the day. The three-car trains now in use during the "slack" hours, which are often badly overcrowded, are to be changed to four-car trains, and an additional car will be placed on the five-car trains. Some further non-stop trains are to be run in the morning and the evening, and the 7.33 a.m. nine-car train from Barking, which is said to be the longest electric multiple unit train in the world, is to be further increased to ten cars. A similar train is also to be run from East Ham at 7.59 a.m. The length of these ten-car trains is approximately 500 ft. The improved services on the Metropolitan Railway include a ten-minute service to Harrow, and a six-minute service to Hammersmith. On Monday last, improved services were commenced on the Piccadilly, Bakerloo, and Hampstead Tubes. On the Piccadilly Railway the service during the busiest hours is every two minutes; on the Bakerloo it is every 1¾ minute. Every precaution is being taken to prevent delay; tickets can be obtained in strips of six, and the lifts are run as far as possible in connection with the trains.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Sept. 17th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.
Names in brackets indicate communicators of inventions from abroad.

1907 Patents

12,072. **Electrical Marine Propulsion.** H. A. MAVOR and MAVOR & COULSON, LTD. A proposal to build the frames of the polyphase motors, used on ships for propulsion, as a part of the structure of the ship. For example, the stator stampings may be built up inside a special bulkhead having stiffening pieces extending to the deck and frame of the ship. This arrangement is said to reduce the weight of the motors, and to permit of the use of small air-gaps in consequence of the great rigidity obtained. Two claims, three figures.

16,781. **Train Lighting System.** O. SCHALLER. A method of obtaining a constant pressure from a generator driven at a variable speed. Two sets of machines, or two machines with double armature windings, are used, the one coupled to the variable speed shaft, the other driven electrically. The connections are such that the sum of the speeds of the two machines or sets of machines is constant. Two of the armature windings, one of each set, are connected in series across a battery, and the other two are connected in series across the load. The fields of the machines are also connected in series respectively, and are across the battery terminals. The speed of the free running set automatically adjusts itself so as to maintain a constant load pressure. Six claims, five figures.

19,562. **Suspension of Metal Filaments.** DEUTSCHE GASGLÜHLICHT ATK. GES. (AUER GES.). The filaments of metal filament lamps are generally made in the form of a loop, and are supported at the bend of the loop. Trouble has been experienced owing to the adjacent sides of the loop coming in contact, and thus short-circuiting a portion of the filament. To remedy this defect, double suspending hooks are proposed. These are so constructed that they prevent too sharp a bend by giving two points of support at the bend. Four claims, four figures.

20,068. **Combined Wall-plug and Switch.** J. W. HUNTINGTON. An improvement in that type of wall-plug in which the operation of inserting the plug pins is caused to close a double-pole switch contained in the socket. A separate push-rod is provided on the plug, and this rod closes the switch as the plug is pushed home. The switch contacts are not made before the pins are some distance in the socket. A quick break of the switch is obtained, which is independent of the speed of withdrawal of the plug. Three claims, three figures.

20,495. **Centrifugal Governor for Single-phase Motor.** H. C. E. JACOBY. The centrifugal governor mentioned in the description of the Jacoby variable-speed single-phase motor given in ELECTRICAL ENGINEERING, Sept. 10th, page 383. Six claims, three figures.

22,211. **Cases for Accumulator Cells.** E. L. OPPERMANN. (X. ELECTRIC ACCUMULATOR CO., LTD.) A container or casing for the cells of a secondary battery, consisting of a sheet steel body about 1/16-in. thick, lined with ebonite. Such a case is said to be cheaper and stronger than an all-ebonite case. A special form of construction and a ventilated lid are also described in the specification. Six claims, six figures.

22,526. **Armature Winding for Single-phase Motor.** H. C. E. JACOBY. The armature winding of the variable-speed single-phase motor described in ELECTRICAL ENGINEERING, Sept. 10th, page 383. A winding pitch of approximately seven-tenths of the pole pitch is adopted, and the brushes are so fixed that the algebraical sum of the alternating fluxes passing through the coils under commutation is practically zero. This prevents the generation of heavy currents in the short-circuited coils. It is further stated that by the above arrangement there are zones on the armature in which the current is flowing in opposite directions in adjacent conductors, and that the reactance of the coil under commutation is thereby considerably reduced. The speed of such a motor can be varied by shifting the brush position, as sparkless computation is said to be attained over a wide range of brush position. Three claims, four figures.

24,992. **Armature Winding for High-speed Direct-current Generators.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). In large direct-current high-speed generators, the induced voltage per coil of the armature winding may be too high to impress on adjacent commutator segments if good commutation is to be obtained. According to the present invention, a number of armature windings connected to successive commutator segments are employed, and connections from each end of each coil of each winding are made to the opposite end of a coil of another winding, these points being at an equal potential. It is claimed that the connections may be carried beneath the armature core without introducing detrimental self-induction, as the adjacent connections neutralise each other. By this means the voltage between adjacent segments can be reduced to a fraction of the voltage per coil. Three claims, three figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.
Names in brackets indicate communicators of inventions from abroad.
Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

12,342, BURRY. Printing telegraph receivers.
12,386, MAVOR, MAVOR & COULSON, LTD., & BILES. Electrical propulsion of marine vessels.
13,073, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Alternating-current motors of the repulsion type.
17,474, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Alternating-current commutator motors.
19,282, POLLAK. Apparatus for strengthening weak current impulses, applicable to telegraphy and telephony.
19,570, GARRARD, & FERRANTI, LTD. Electricity control relays.
19,672, GES. FÜR VERWERTUNG CHEMISCHER PRODUKTE. Manufacture of metal filaments.
19,699, ALLGEMEINE ELEKTRICITÄTS-GES. Signalling systems.
19,883, BRITISH THOMSON-HOUSTON CO., CLINKER, WEDMORE, & WOODBRIDGE. Protective devices for alternating-current distribution systems.
20,227, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Manufacture of refractory bodies.
22,285A, SILVER. Supporting or carrying of electrical machines.
22,728, JUSTICE (*Rowland Telegraphic Co.*). Balancing the lines of electric circuits in duplex systems of telegraphy.
23,311, CLARK. Electro-mechanical means for controlling belt gearing.
24,103, LAKE (*Auto Pump Co.*). Electrical indicators for indicating water levels.
25,752, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Electric cooking apparatus.
25,922, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Manufacture of insulated electric conductors.
27,278, MAGLIETTA. Automatic signalling apparatus for trains.
27,936, LÜTHI. Time switches.

1908 Patents

327, LERTOURNÉ. Apparatus for comparing the speed of two or more machines.
2,685, FESSENDEN. Receivers for wireless telegraphy.
4,368, SYKES. Electrical operation of railway points.
5,317, COWPER-COLES. Apparatus for electrolytically etching or depositing metals upon metallic surfaces.
5,374, DAVIDSON. Portable electric resistance for use with surgical lamps.
8,286, BOULT (*Voigt & Haeffner Akt.-Ges.*). Automatic switching devices.
8,771, SIEMENS SCHUCKERTWERKE GES. Energy storing arrangements, applicable to hydraulic systems for the transmission of power.
9,449, FRIED. KRUPP AKT.-GES. GERMANIAWERFT. Electrically-operated heating devices.
10,851, SHEPPEE. Motors.
12,630, BOURGEOIS & BOURGEOIS. Pocket electric lamp.
12,968, KUZEL. Manufacture of filaments from refractory materials in the colloidal state.
14,805, FREEL. Antiseptic attachment for telephone mouthpieces.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

16,164, SIEMENS & HALSKE AKT.-GES. Spring switches for electrically setting railway points and signals.
17,533, TRIN. Electrical accumulators.
17,752, LULING. Electric switches.
17,852, DUPONT & HARLÉ & CIE. Continuous-current motors.
17,858, WILSON & CLAFLIN. Signalling systems.
18,120, DUCROS. Sparking-plugs for internal-combustion engines.
18,184, STEYNIS & CHAUMET. Production of ozone.

Expiring Patent

The following patent expires during the current week after a life of fourteen years :—

18,215, of September 25th, 1894. **Railway Signalling Apparatus.** H. H. LAKE. (*The Hall Signal Co., U.S.A.*) A motor-operated signal with a magnetic brake. The signal rises to the danger position by gravity, after the train, by coming on to the section, has shunted the relay magnet. Before reaching the final position the signal is retarded by the magnetic brake to prevent shock. When the train leaves the section the motor operates to lower the signal. Instead of using the magnetic brake in the first instance, the motor may be driven by the signal as a generator, thus producing a braking effect.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. * = Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5%*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½%	9½—10	
Do. 6% Cum. Second Pref.	10	6	6%	10⅝—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—104	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5¼	—	4⅛—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	96—99	+2
Brompton & Kensington E. S. Co.,Ld.	5	10	5%*	6¾—7⅜	
Do. 7% Cum. Pref.	5	7	7%	6½—7½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½%*	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3½—4	
Chelsea Electric Supply Co., Ltd.	5	4½	2½%*	2¾—3¼ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10¼	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4½	
County of London Elect. Sup. Co. Ld.	10	5	—	7⅜—8½	
Do. 6% Cum. Pref.	10	6	6%	10⅝—10⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7¾—8¾	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E.L. Cos. Db.Rd.	Stock	4	4%	98—102	
London Electric Supply Corporation	3	2½	—	⅞—1⅛	
Do. 6% Pref.	5	6	6%	4½—4⅝	−¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4½—4¾	
Do. 4½% Cum. Pref.	5	4	4½%	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. D	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	5⅛—5⅜	
Do. £2 Paid	5	8	2½%	3¼—3⅜	
Do. 5% Pref. (fully paid)	5	5	2½%	5¼—5¾	
Do. £2 Paid	5	5	2½%	3¼—3¾	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅜—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5%*	7—8	
Do. 7% Non-Cum. Pref.	5	7	7%	6¼—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—¾	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅝	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	—	¼—1	
Do. 5% Cum. Pref.	5	5	5%	1⅜—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	7½—8½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	−⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	+1
Central London	Stock	3	3%*	68—70	+1
Do. 4% Preferred	Stock	4	4%	84—86	
Do. Deferred	Stock	2	—	49—52	+1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	84—86	+2
City and South London Cons.	Stock	4½	1½%	32—33	
Do. 4% Perp. Deb.	Stock	4	4%	101—104	+1
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	⅜—1	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	7¼—7⅝	+¼
Do. 4% Perp. Deb.	Stock	4	4%	92—94	+1
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	¼	¼%	37—38	+1
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	73—76	
Do. 3½% Convertible Pref.	Stock	3½	3½%	72—75	+2
Metropolitan District	Stock	—	—	12¾—13½	
Do. 6% Perp. Deb.	Stock	6	6%	116—119	
Do. 4% Deb.	Stock	4	4%	71—76	
Do. Perp. Extension Pref. (5%)	Stock	—	—	20—24	+2
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	48—52	
Underground Elec. Railways Co of London 5% Profit Shg. Sec. Notes	Various	5	5%	42—46	+3
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	½—¾	
Do. 4½% Deb. Red.	Stock	4½	—	85—90	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅝	
Do. 6% Cum. Pref.	10	6	6	3¾—4¼	−⅛
Do. 5% Perp. Deb.	Stock	5	5%	9 ½—99½	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. * = Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	¾—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	
London Street Tramways Co.	4	4/6	2½%	⅞—1¼	
London United Trs., Ld., Cm. Pf.	10	5	—	5¼—6¼	−½
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	75—80	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	¼—⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	92—95	−1
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅝—5¼	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	78—82	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	3—3½	−⅛
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½ *	58—61	
Do. 6% Pref. Crd.	Stock	6	6%*	104—105	
Do. Def. Ord.	Stock	1	—	16¾—17¼	−¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	89—91	
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13¼—13⅜	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—101½	
Do. do. (Mauritius Sub.)	25	4	—	101½—103½	
Eastern Ext. Australasia & China	10	7	6%	12⅞—13¼	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100⅜—102½	
Eastern Telegraph Co.	Stock	7	1½%*	135½—138½	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	28—30	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6%*	118—120	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	−¼
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	−¼
Do. 5% 3rd Pref.	5	5	2½%	5⅞—5¹¹⁄₁₆	−1/16
Do. 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red.	Stock	4	4%	102½—104½	
Western Telegraph Co., Ltd.	10	7	6½*	13⅜—14½	+¼
Do. 4% Deb.	Stock	4	4%	101½—103½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	7%	⅞—1⅛	
Babcock & Wilcox, Ord.	1	20	—	3⅛—4 1/16	+1/16
Do. 6% Pref.	1	6	—	1½—1⅝	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6½—6⅝ xd	
Do. 6% Cum. Pref.	5	6	—	6—6⅛	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—⅜	
Do. 4% Mort. Deb. Red.	Stock	4	4%	41—46	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9⅞—10⅜	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅛—1⅛	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	+3
Dick, Kerr & Co., Ltd.	1	10	—	1¼—1½	
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
Edison & Swan United "A." £3 paid	5	2/6	—	¼—⅜	
Do. do. (fully paid)	5	4/2	—	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	—	1½—2	
Do. 4% 1st Mort. Deb.	Stock	4	4%	66—71	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	86—90	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10¼—11¼	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	15½—16½	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	10%*	32½—34½	
Do. 4% Deb. Bds. Red	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	—	—	¾—1¼	
Do. 6% Cum. Pref.	5	6	6%	2½—3	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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LOCAL NOTES

ARGENTINA: *Electric Supply.*—The *Review of the River Plate* states that a Mr. Glynn has applied to the Minister of Interior for a concession for 20 years for an electric light station in Gallegos. A capital of $100,000 will be employed.

AUSTRALIA (MELBOURNE).—The *Australian Mining Standard* states that after 14 years' service, the old Thomson-Houston street lighting plant in the Council's generating station, consisting of 24 small dynamos, driven by four horizontal engines, has been displaced by two Westinghouse-Parsons turbo-generators, having a combined capacity of 650 KW.

AYR: *Electricity Accounts.*—The annual report of the Electrical Engineer, Mr. R. Marshall, shows an output of 1,375,192 units, an increase of 107,171 over the previous year. The total revenue amounted to £13,029, and the expenditure to £8,619. After meeting interest and sinking fund charges, there is a deficiency of £1,039 against a surplus of £926 last year. The deficiency is attributed to the high price of coal and the reduction in price to private consumers from 4½d. to 3½d. per unit. The Council has decided to raise the price to private consumers to 4d. per unit from November 1st.

Tramway Accounts.—The tramway accounts for the past year show capital expenditure to date of £82,030. The total revenue for the year amounted to £15,322, and the sum of £717 has been transferred to the relief of rates from the profits. The number of passengers carried was 3,660,038, which is an increase of 56,249 over the number carried last year.

BARROW-IN-FURNESS: *The New Walney Bridge.*—The electrical work in connection with the operation of the new bridge over the river Walney has now been completed, in addition to the electric lighting of the structure.

BELFAST: *Municipal Tramways Conference.*—In consequence of the Local Government Board having surcharged the expenses of the Corporation delegates to the Municipal Electrical Association this year, it has been decided not to send any official delegates to the Municipal Tramways Conference, now being held in Nottingham.

BERLIN: *Underground Railway Litigation.*—It is stated that the Berlin General Tramway Co. will apply for an injunction to prevent the construction of the projected electric underground railway from Schoneberg to the centre of Berlin, on the ground that this project infringes the company's privileges. It is recalled that the same tramway company, some time ago, successfully fought a proposal to construct an underground railway from north to south of Berlin.

BIRMINGHAM: *Tramway Extensions.*—Two memorials have been presented to the Corporation in respect of tramway extensions in the Bordesley district.

BRAY: *Electric Lighting Committee.*—Mr. T. Picton Bradshaw has resigned the chairmanship of the Electric Lighting Committee, for the reason that he could not be responsible for the working of the concern, owing to the lack of interest taken in it by other members of the Council.

BRECHIN: *Electricity Works Assessment.*—The North of Scotland Electric Light & Power Co. recently appealed against the assessment of £660 per annum upon their electric light station in Brechin. The Valuation Appeal Court, before whom the case was heard, has fixed the valuation at £400, but the company has intimated its intention of appealing against this.

BRUNSWICK: *Electric Lighting.*—The report of the Brunswick (V.) Electric Lighting Committee upon the proposal of a private syndicate to supply lighting and electric tramways to Brunswick and Coburg has been presented to the Brunswick Town Council. The report was as follows:—"That the committee recommend the Council to invite applications of tenders for an electric expert to prepare estimate, scheme, plans, and all information for installing electricity for lighting, power and other purposes throughout the city, and that Mr. Maxwell (the representative of a syndicate who had offered to install electric light in Brunswick and Coburg and electric trams for Coburg) be notified accordingly." After a good deal of discussion the report was adopted on the casting vote of the Mayor, although not all the councillors were present. On this being objected to, it was resolved to call a special meeting of the whole Council to discuss and determine the question of electric lighting.

BURY: *Gas Generating Plant.*—Mr. S. J. Watson, the Borough Electrical Engineer, has recently paid a visit to Germany to inspect some gas plant and its application to the generation of electrical energy. He has reported to his Committee on the matter.

CARDIFF: *Electric Lighting & Tramway Accounts.*—The annual statement of accounts dealing with the various trading departments of the Corporation shows that since its inception the electric lighting undertaking has paid £31,479 towards redemption of stock, and £4,400 towards loan repayments. There is also a reserve fund of £1,572, and a sinking fund of £4,107, which is being retained towards liquidation of bank overdraft. At March 31st last there was a revenue deficiency since the commencement of the undertaking of £3,338. Since its inception, the tramway undertaking has provided out of revenue £96,078 towards loan repayments, and has contributed from the reserve fund £3,857 towards outlay of a capital nature; in addition, the following funds have been accumulated out of revenue loan fund: Suspense account, £7,559; suspense account *re* mortgages, £4,448; reserve fund, £9,620; sinking fund suspense account, £7,262; and depreciation fund, £12,616. The profits on the undertaking to date amount to £12,616.

CLACTON: *Public Lighting.*—The Council has negatived a recommendation to instal public electric lighting, on the ground that this would be too expensive an experiment.

CROYDON: *Electricity Charges.*—The charge to ordinary consumers for electricity has been reduced from 5d. to 4½d. per unit.

DUMFRIES: *Electricity Supply.*—Mr. W. W. Lackie, Chief Electrical Engineer to the Glasgow Corporation, has been granted permission to advise the burgh of Dumfries as to the purchase of the electrical undertaking in that district, now operated by a company.

DUNDEE: *Trolley Omnibuses.*—In reply to an inquiry, the Board of Trade have intimated that they have no *prima facie* objection to electrical trolley omnibuses, which the Town Council have been recommended to adopt.

FELIXSTOWE: *Purchase of Electrical Undertaking.*—At the monthly meeting of the Council last week a recommendation that the undertaking of the Suffolk Electricity Supply Co. should be purchased at £8,000 was carried. We gave particulars of the purchase arrangement in our issue for September 10th.

ILFORD: *Advertising Electricity.*—The Council has adopted the method of advertising the advantages of electric power for various purposes upon the backs of the tramway tickets issued upon their tramway system. It is interesting to note that the gas company advertises on the windows of the tramcars.

IPSWICH: *Electric Lighting Accounts.*—The accounts for the year ended March 31st show a gross profit of £994, but after meeting capital charges, &c, there is a deficit of £1,789. The average price received was 3·75d. per unit against 4·18d. per unit for the previous year, but there is an increase of 2½ per cent. in the revenue per unit from power supply. The units sold for lighting show an increase of 22·34 per cent., and amounted to 317,417, and the number of consumers have increased by 25 per cent.—namely, 466—whilst the equivalent of 8-c.p. lamps connected has increased by 30 per cent.—namely, 56,420. A satisfactory feature is that the total supply for power purposes has increased by 56 per cent., the number of units being 230,712. Coal has cost £650 more than in the previous year. The total number of units sold for all purposes was 1,261,614.

Tramway Accounts.—The tramway accounts for the same period show a deficit of £1,450, which is ascribed to the wet summer, and also to the depression in trade. The total revenue amounted to £20,002, and the working expenses to £16,112, whilst interest on capital absorbed £4,109, and repayment of loans £1,805. The number of passengers carried was 4,979,253. The percentage of working expenses to receipts is 78·30 per cent.

KILMARNOCK: *Electric Lighting Accounts.*—The Electrical Engineer's report for the past year shows that the number of consumers has increased from 171 to 229, and the number of lamps connected from 15,495 to 19,680. The number of motors has increased from 23 to 34, and the horse-power from 94 to 201. The total units sold for the year has risen from 569,389 to 679,233. The total income from all sources was £5,513, and the working expenses £3,050. From the gross profit of £2,463, interest on loans, sinking fund, &c., has to be deducted, amounting to £2,840, leaving a net loss of £358, against £831 last year. The total works costs per unit sold has dropped from 1·17d. to 1·025d., and in comparison of the costs of a similar size the Electrical Engineer finds that there are only three which have lower working costs, and in each case the undertaking pays from £150 to £250 less for rates and taxes, which accounts for the difference.

Tramway Accounts.—During the past year the car miles run amounted to 306,170, against 328,829 for the previous year, whilst the passengers carried numbered 2,296,261, against 2,331,277 for the preceding year; the receipts from passengers amounted to £8,007, compared with £8,245 for the previous year. This reduction in the number of passengers is attributed to the very bad state of trade at the present time. The average fare per passenger has remained constant at 0·84d., and the manager points out that until the average fare per passenger and the total number of passengers rise very considerably, it is quite impossible to expect better financial returns. The fact that the receipts per car mile this year have risen from 6d. to 6·33d. is due to fewer miles having been run. This year for the first time there is a full year's sinking fund debited against the tramway accounts, with the result that there is a total net deficit of £1,652, which includes the sum of £610 towards the cost of obtaining the Tramways Provisional Order, and £250 for depreciation. The whole of the cars and overhead equip-

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ment have been maintained during the year out of revenue, and all car wheels have been re-tyred. There is, however, a considerable amount of repair work to the permanent way still to be undertaken.

LEEDS: *Tramways Receipts.*—During the twenty-four weeks of the present financial year, the total receipts from the Corporation tramways amount to £161,474, compared with £157,586 in the corresponding period of last year.

LIVERPOOL: *Further Decrease in Tramway Receipts.*—The traffic returns for the fortnight ended September 12th show a decrease of £981 compared with the corresponding period of last year, and the passengers carried, a decrease of 195,567. The Chairman of the Tramways Committee again attributed these decreases to the bad state of trade.

LONDON: *Southwark: Electric Power Bill.*—A recommendation by the General Purposes Committee that the Council should petition against the London Electric Supply Bill, has been adopted. The Council has already petitioned against the London & District Electricity Supply Bill.

Wandsworth: New Tramways.—The London County Council and the Board of Trade have been informed that subject to certain conditions, the Borough Council will not object to the overhead trolley system of electric traction for the tramways from Hammersmith Broadway, over Putney Bridge, to Lower Richmond Road, Putney, the construction of which it is proposed to proceed with at an early date. The Borough Council has expressed the opinion that the whole width of the carriageway, including the part between the tramway rails, should be paved with wood.

MANCHESTER: *New Car Shed.*—The foundation stone of a new tramway car shed at Princess Road, Moss Side, was laid last week by the Deputy Chairman of the Tramways Committee. A piece of land 6½ acres in extent has been acquired from Lord Egerton, of which 3½ acres will be utilised for the sheds, and one acre for stabling and buildings of the permanent way department, the remainder being left available for future extensions. The sheds will accommodate 250 cars. In laying the stone Alderman Bowes stated that since the inauguration of the tramway undertaking in 1891, they had handed over in relief of rates the sum of £30,700, in addition to paying to the sinking fund £108,912, and putting aside for renewals and depreciation £382,327.

MORECAMBE: *Tramway Purchase.*—The Council has decided to take the necessary steps to obtain the consent of the Board of Trade to the purchase of the portion of the undertaking of the Morecambe Tramways Co. within the district. An offer by the Hastings Corporation to loan £7,762 for tramway purchase at 3¾ per cent. per annum, repayable in 30 years, has been accepted.

NEW SOUTH WALES: *Tramways.*—According to the *Australian Mining Standard*, the Colonial Treasurer has given the following information regarding the tramways of the city and suburbs:—"There were 54 miles of lines open in Sydney and the suburbs in 1899, and the distance covered by these services had increased to 103 miles in 1906. In 1899 the earnings were £324,101, in 1906 £795,228, and in the latter year Broken Hill and Newcastle trams added £56,256 to the earnings; while last year the total earnings were £1,011,994. The interest paid was £4 0s. 1d. per cent. in 1899, £5 1s. 7d. in 1906, and £4 18s. 8d. in 1907." In reply to a further question the following interesting particulars were supplied:—"There are three power houses within the area vested in the Sydney Harbour Trust Commissioners, situated at Napoleon Street, Circular Quay, and Cowper Wharf. Electricity is generated at these stations for the lighting of the wharfs at Woolloomooloo Bay, Circular Quay, and Darling Harbour. The cost of production is, approximately, £3,034 per annum. The Railway Department has one power-house, which is situated at Ultimo, and the cost of producing power for traction, lighting, and all other purposes for the financial year ended June 30th, was £56,304.

RAWTENSTALL: *Tramways Agreement.*—An agreement has been arrived at between the Rawtenstall and Bacup Corporations with regard to the purchase of the Rossendale tramways within the two boroughs. The price to be paid by the two Corporations to the company is roughly £33,000. The Rawtenstall Corporation are to construct the lines in the two boroughs, and to work the steam tramways until the electrification is accomplished, taking all the receipts meanwhile. The sum necessary for the purchase of the tramways in Bacup will be lent by Rawtenstall.

SMETHWICK: *Electric Lighting Provisional Order.*—The Council has finally sealed an agreement to transfer the Smethwick Electric Light Order from the Birmingham and Midland Tramways, Ltd., to the Shropshire, Worcester, and Stafford Electric Power Co.

SOUTH AFRICA (CAPE TOWN): *Electrical Finances.*—For the six months ended June 30th, the municipal electric light works at Cape Town sold 1,028,325 units, the figure for the corresponding period of last year being 939,655. The revenue for the two years was £26,519 and £24,601 respectively.

SOUTH SHIELDS: *(Rural) Overhead Wires.*—The County of Durham Electrical Power Distribution Co. has made an application to the Board of Trade for the consent to place an extra high tension transmission line between South Shields and Marsden and Whitburn Colliery Railway. The whole of the proposed line will be laid on private land, except at one spot where it crosses the public road.

WEALDSTONE: *Euston-Watford Electric Railway.*—Plans were submitted at the last meeting of the District Council by the London & North-Western Railway Co., showing bridges, &c., proposed to be constructed in connection with the Euston-Watford electric railway. Objection was raised as to one of the projected bridges, which, it was contended, would lower the width of the road, and the Surveyor and the Clerk are to interview the company's officials on the matter.

WEDNESBURY: *Electric Power Supply.*—In connection with our note last week that the Midland Electric Corporation for Power Distribution had decided not to supply any further electrical energy in Wednesbury, we understand that this is not so, but that the notice recently served upon the Council was the ordinary notice served prior to the company opening the streets to lay mains.

WEST HAM: *L.G.B. Inquiry.*—In connection with the recent Local Government Board inquiry into the application of the Council for sanction to a loan for the purposes of the electricity undertaking, when it was suggested that the Council supplied current to some of its largest consumers at less than cost price, the production of contracts showing the prices charged was requested, and although these prices were offered to be given to the Inspector privately, the officials of the Corporation declined to assent to the production of the particulars publicly. The Town Clerk has now submitted to the Electric Lighting and Tramways Committee letters from two of the customers in question, strongly objecting to the terms of their contracts being made public. In this connection the committee have considered a suggestion by the Electrical Engineer that the services of an expert should be engaged to examine the contracts with a view to supporting him in his evidence at the adjourned inquiry, and also advising the Committee on the sufficiency or otherwise of the charges made for the supply of current. They have also had before them a letter from the Town Clerk on the subject, and having considered the whole matter, they have instructed the Town Clerk and the Electrical Engineer to engage the services of an expert, and have authorised the Town Clerk to lay the whole position before the Local Government Board, should he consider it desirable.

Bulk Supply.—A bulk supply for lighting and power combined is to be given to the Lamson Paragon Works at 1¼d. per unit net.

YORK: *Light Railway Order.*—The Board of Trade have intimated that they cannot agree to the insertion in the Corporation's Light Railway Order of a clause giving power to the Corporation to sell the undertaking. The chairman of the Tramways Committee and the Town Clerk have had an interview with the Board of Trade, with the object of inducing the Board to retain the clause in question, but without result, and the clause will consequently be struck out.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA.—Particulars of tenders for the supply and erection of a power plant at the General Post Office, Adelaide, can be obtained from the Commonwealth Offices in London.

BEXHILL.—The Local Government Board has sanctioned the borrowing of £830 for the provision of mechanical stokers, &c.

CLACTON.—A travelling crane is to be erected in the generating station.

A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £500 for extensions to the electric light undertaking.

The recommendation of the Consulting Electrical Engineer that the Council should instal a gas-producer plant at the Electricity Works has been adopted.

EPSOM.—Estimates in connection with a scheme for the complete renewal of the battery have been prepared, and a sufficient sum is to be included in the next estimates.

FARNWORTH (BOLTON).—We understand that Messrs. Jackson, of the Plodder Lane, Farnworth, Bolton, laundry, contemplate putting down electrical plant in their laundry at an early date.

HOLYHEAD.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £3,000 for the purposes of the electrical undertaking. Of this, £1,216 are required to clear off an overdraft caused by expenditure in excess of previous loans, and £1,000 for new services.

LIVERPOOL.—The Corporation has decided to carry out several important tramway extensions.

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LONDON: *London County Council.*—Tenders are invited for the supply, delivery, and erection of (*a*) six fuel economisers, each with 320 tubes with driving gear; (*b*) three electrically-driven feed pumps with capacity of 9,000 gins. per hour each; (*c*) two 5,000-kw. horizontal steam turbo-generators at a speed of 750 revs. per min. Full particulars from the Clerk to the Council, fee £2 each specification (returnable), and tenders by October 13th (see an advertisement this week).

MAIDSTONE.—A Local Government Board inquiry has been held into the application by the Corporation for sanction to borrow £18,440 for the purposes of the electricity works.

MOUNTAIN ASH.—Tenders are invited for the erection of an electrical sub-station, the supply and erection of switchgear and transforming apparatus and overhead mains. Particulars from the Surveyor, fee £1 1s., returnable, and tenders to the Clerk to the Council by October 5th.

PENDLETON.—We understand that Messrs. A. Knowles & Sons, Ltd., the well-known colliery proprietors, are contemplating putting down electrical plant at certain of their collieries in Pendleton and Pendlebury districts, near Manchester.

RADCLIFFE.—The Electrical Engineer recommends the immediate installation of an additional switchgear, together with the purchase of meters, &c.

STOKE.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £15,365 for the purpose of the electricity undertaking. During the course of the inquiry the application was amended as follows: Excess expenditure to March 31st, 1908, £1,975; additional plant, £4,450; mains, £1,600; house services, £250; extensions to Fenton, £17,555.

WATFORD.—The Urban District Council has decided that tenders be invited for the extension work necessary to meet the winter's load of 1909-10. At the last meeting of the Council, Mr. Goodrich said he believed the total cost of the work involved would be about £6,000, and would be likely to obviate the necessity of further expenditure until 1912.

Tenders are invited for the following plant: (1) 500-kw. turbo-alternator. (2) Surface condenser with steam-driven pumps. (3) Switchboard panel. (4) Economiser. (5) High-speed fan engine. Specifications, &c., from the Electrical Engineer, fee £1 returnable, and tenders to the Town Clerk by October 6th.

Miscellaneous

AUSTRALIA.—Tender forms and specifications in connection with the supply and erection of wireless telegraph installations at Launceston, Melbourne, King's Island (Bass Straits), and Flinders Island (Furneaux Group) may be obtained at the Australian Commonwealth offices in London.

Tenders are invited at the Commonwealth Offices in London by October 19th for the supply and delivery there of four complete sets of instruments (signalling and protecting) for direct duplex cable working.

BIRMINGHAM.—The Birmingham Tams and Rea District Drainage Board invite tenders for the supply and erection in their pumping station at Saltley of a three-phase induction motor of about 200-h.p. capacity for direct coupling to centrifugal pump. Full particulars from the Engineer to the Board, Tyburn, near Birmingham, and tenders by 25th inst.

Tenders are invited for the supply of 60,000 tons of coal for the generating station for delivery between October, 1908, and October, 1909. Tenders to the City Electrical Engineer by October 1st.

HARROGATE.—Tenders are invited for the supply of 26 two-arm and two four-arm fittings to carry high candle-power incandescent lamps (see advertisement this week).

ILFORD.—Tenders are invited for 1,000 tons of Welsh coal for the electricity works during the six months ended March 31st, 1909. Particulars from the Electrical Engineer, and tenders to the Clerk to the Council by October 6th.

METROPOLITAN RAILWAY CO.—Tenders are invited for stores, including the following: Electric wires and cables; electric lamps, carbons, fuses, ebonite, battery jars, zincs, &c.; steel conduits; signal and telegraph work insulators, &c. Particulars from the Secretary, to whom tenders by October 5th.

RUSSIA.—The municipality of Windau contemplates the construction of tramways; public lighting is also to be undertaken.

YORK.—Tenders will shortly be invited by the Corporation for (*a*) the construction of tramways, or (*b*) for the construction and working of tramways.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations, and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—New store, Union Castle premises, Orchard Place, Poplar. Builders, Mark Patrick & Son, 28 Westminster Bridge Road, S.W.

Additions to Clarnico Works, Carpenters Road, Poplar. J. C. Mathieson.

Additions to Salvation Army Barracks, Kirby Street, Poplar. A. Oswald.

N.E.—Factory in Sach Road, Upper Clapton. Builders, W. J. Fryer & Co., 14 Nile Street, Hoxton.

N.W.—Buildings in Tudor Place, St. Pancras. Architect, Peter Dollar, Clock House, Arundel Street, Strand, W.C.

S.E.—Addition, St. Paul's Church, Bermondsey. Architect, J. M. Kennard, 13 Railway Approach, London Bridge.

Additions to Guy's Hospital, Southwark. Architects, Wood & Ainslie, Broad Sanctuary Chambers, Westminster.

Stables, &c. (£2,000), for Greenwich Borough Council. E. J. Heward, Borough Surveyor.

New factories for Spillers & Baker, biscuit manufacturers, Jacob Street, Dockhead, S.E.

S.W.—Mission Hall, Wandsworth Bridge Road, Fulham. Architects, Z. King & Sons, 171 Victoria Street, S.W.

Additions, High School for Girls, Streatham High Road.

Additions, St. Mary's Schools, Putney. Builder, W. R. Williams, 98 High Street, Putney.

Workshops, Tooting. Swain & Selley, Furzedown Farm, Streatham.

Addition to Convent of St. Andrew, Streatham. Architect, E. Goldie, 31 Upper Phillimore Place, Kensington.

Alterations and additions to Southfields Club and Institute, Standen Road.

PROVINCES.

AVEBURY (WILTS).—House (£2,570). Architect, Harold Brakspear, Corsham.

BERKHAMSTED.—Adaptation of premises, High Street, for Council offices (£1,000). Surveyor, E. H. Adey, District Council.

BLACKPOOL.—Central Public Library. T. Loftos, Town Clerk (architect not yet appointed).

BOLTON.—Three Branch Libraries (£15,000). Samuel Parker, Town Clerk, Bolton.

BOXMOOR.—House (£2,150). Architect, Albert Bullock, 43 Chancery Lane, W.C

BRADFORD.—Addition to Assembly Rooms, Manchester Road. Wm. Dracup.

Addition to Institute, Clayton Road. Vicar and Wardens, St. Wilfred's, Church.

School, Back Lane, Buttershaw. Bradford Education Committee.

CARLISLE.—Turkish Baths (£2,290). Engineer and Surveyor, H. C. Marks, 36 Fisher Street, Carlisle.

CHELTENHAM.—Alterations and additions, St. Mark's Schools, Alstone Lane. The Managers.

Two new laundries, Fairfield Walk. F. E. Jenkins.

Two new laundries, Asquith Road. T. W. Smith.

CORNWALL.—New County Offices, Christopher L. Cowlard, Clerk to County Council, Bodmin.

CROYDON.—Additions to workhouse, and erection of new children's home. Architect, Henry Berney, 104 George Street, Croydon.

Extension (£7,500), Croydon Isolation Hospital. R. M. Chart, Surveyor, Croydon Rural District Council.

New Street, Roke Lodge, Croydon. J. P. Oldaker, Wilburn Lodge, Purley.

FINCHLEY.—34 houses and shops. Builder, G. Ball, 144 Fortress Road, N.W.

Five houses. Surveyor, F. E. Halford, 8 Southampton Street, Bloomsbury, W.C.

Five houses. Builders, Halliday & Son, 74-76 High Street, North Finchley.

Two houses. Surveyor, A. W. Wheeler, Woodside Park Station, North Finchley.

Four houses. Finchley Co-partnership Society, Ltd.

Additions to convent, East End Road. Rev. Mother Superior.

Three houses, Granville Road, for Northern Suburban Land Co.

GLOUCESTERSHIRE.—School at Sydbrook (£3,430), for County Council. Architects, Medland & Pryer, 15 Clarence Street, Gloucester.

GODREAMAN.—New Boys' School (£9,387) for Aberdare Urban District Council Education Committee. Builder, J. Morgan & Son, Ltd., Aberdare.

GREENFORD (MIDDLESEX).—Power house in connection with new works at Perivale of Purex Lead Co.

GUERNSEY.—New asylum (£16,000). Architect, G. T. Hine & Co., 35 Parliament Street, S.W.

ILFORD.—Additions, 1 to 97, and 18 to 96, Vaughan Gardens. Architect, G. Verlyck, Adelaide Chambers.

Six shops and house premises. Architect, A. W. Hudson, 87 Finsbury Pavement, E.C.

Unitarian Church, High Road.

Motor house and store, The Laurels, Aldborough Road. Builder and contractor, G. Sharpe, Gibbins Road.

Six houses, Clarissa Road. Surveyor, P. G. Ashton, Station Approach.

Store, Newbury Gardens. Architect, E. T. Dunn, 7 Roden Street.

LLANDUDNO.—New library. Alf. Conolly, Town Clerk.

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ROTHERHAM.—Alterations and extensions at Grammar School (£5,120). Architect, J. E. Knight, College Street, Rotherham.

SALFORD.—The Education Committee require tenders for the electric wiring in the Halton Bank Council School, Pendleton. Specification from the Borough Electrical Engineer, Frederick Road, Pendleton (fee £1 1s. returnable), and tenders by October 5th.

SHEERNESS.—Masonic Hall (£1,780). Architect, Ernest J. Hammond, Gillingham, Kent. Builder, West Bros., Rochester.

SMETHWICK.—Ten houses, Vicarage Road. Architect, T. Richards & Son, Lichfield Street, Wolverhampton.

STOKE NEWINGTON.—Adapting 36 and 38, Milton Road to public slipper baths for Borough Council. Surveyor, W. F. Loveday, Town Hall, Milton Road, N.

SWANSEA.—Cottage Exhibition. Town Clerk.

Proposed hall for Territorial Forces (£20,000).

TIPTON.—Offices for Urban District Council. Engineer and Surveyor, W. H. Jukes, Public Offices, Tipton.

WATFORD.—Additions, Silverdale Laundry. Builder, W. Judge, 14 The Parade, High Street, Watford.

New offices for London & North-Western Railway Co., Euston Station, N.W.

Vagrant accommodation, Union Workhouse, Watford Board of Guardians.

New Vicarage, Mildred Avenue, Watford. Rev. W. H. Littlebury.

WEST HAM.—Alterations, Nurses' Home, Custom House. Builder, E. Beasley, 295 Victoria Dock Road, E.

Additions (packing warehouse and dining hall) to Co-operative Wholesale Society's premises, Silvertown.

Petrol store at 124 Romford Road, Stratford, for R. B. Godfree.

Addition (pattern shop) to premises at Silvertown of India Rubber, Gutta Percha, and Telegraph Works Co., Ltd.

WREXHAM.—Church extension. Architects, Prothero, Phillott, & Barnard, 13 Promenade, Cheltenham.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Hampden Shire Council (Victoria) has accepted the following tenders: Messrs. Hornsby & Co., Melbourne, electric lighting and suction gas plant, £1,128; A. H. Wood, Melbourne, dynamo and electric appliances, £1,575; British Insulated & Helsby Cables, Melbourne, cables and wires, £350.

The Electric Supply Committee of the City of Melbourne has accepted the tender of Messrs. Davy Shepherd & Co. for the supply of a water meter for the new boilers.

The South Australian Postmaster-General's department has accepted the following tenders, says the *Australian Mining Standard*: For telephones, switchboards, and cable, 300 telephones, magneto, wall sets, at 52s. 10d. each—J. Bartram & Son, King-street, Melbourne; three switchboards, each for 100 metallic circuit lines, at £52 6s. 2d. each; 5½ miles cable, 208 pair, lead covered (12½ lb. conductors), at £486 per mile; 5 miles cable, 13 pair, lead covered (20 lb. conductors), at £81 per mile; 900 yards cable, 104 pair, light lead covered, for the sum of £184 12s.—British Insulated & Helsby Cables, Ltd., Collins Street, Melbourne; 3½ miles cable, 156 pair, lead covered (12½ lb. conductors), at £389 per mile; 3¼ miles cable, 104 pair, lead covered (12½ lb. conductors), at £284 10s. per mile —The Western Electric Co. (Australia), Ltd., Pitt Street, Sydney; 2 miles cable, 78 pair, lead covered (12½ lb. conductors), at £229 per mile; 4 miles cable, 52 pair, lead covered (12½ lb. conductors), at £175 per mile; 2 miles cable, 26 pair, lead covered (20 lb. conductors), on ¼-mile drums, at £132 per mile —W. T. Henley's Telegraph Works Co., Ltd., Flinders-lane, Melbourne.

FINCHLEY.—The District Council has accepted the tender of Whipp & Bourne, at £336 10s., for the switchgear extensions.

HECKMONDWIKE.—The tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., for the supply and laying of cable in connection with the Co-operative Wholesale Society's premises, has been accepted.

LONDON: *Hammersmith.*—The Electricity and Lighting Committee of the Borough Council has accepted the tender of the Improved Wood Pavement Co., Ltd., at £42, for oak block flooring required for a new switchboard.

The Electrical Engineer has presented a report with regard to the contract placed with the British Thomson-Houston Co., in July, 1904, for a Curtis turbine, for £9,145. The machine was first put into commission in September, 1906, and has been in almost constant use since January, 1907, having run 9,118 nours, and generated 6,546,210 units during that time. In one or two details, however, the Engineer says that it is not quite in accordance with the specification. Since the machine was designed, adds the Engineer, improvements have been made in these alternators, and the company are now in a position to offer increased output from this machine if advantage is taken of the additional experience when the machine is being reconstructed. The Borough Council Electricity and Lighting Committee has resolved that the offer of the British Thomson-Houston Co. to increase the output of the Curtis turbine from 1,500 kw. to 2,000 kw., when they are rebuilding the machine, for £550, and to supply the spare parts required for £136 be accepted.

MANCHESTER.—Messrs. A. Reyrolle & Co., have received the contract for two years' supply, from the Corporation, for semi-enclosed and totally-enclosed motor starters of the following sizes:—15, 20, and 30 h.p. This contract is for their well-known "Wait on the first stop until the motor starts" type.

ORIENT STEAM NAVIGATION CO.—The contract for the electrical equipment of three of the five new liners of this company now under construction has been placed with W. C. Martin & Co., of Glasgow. It is stated that the installation will be on the lines of that fitted by the same company on the Cunard liner *Mauretania*, and will comprise about 2,000 lights, ventilating fans, heating apparatus, telephones, and searchlights for navigating the Suez Canal at night.

RICHMOND (DUBLIN).—In competition with an offer from the local gas company, the Dublin Corporation have put in a tender for the electric lighting of the District Lunatic Asylum. The matter has been referred to a sub-committee, the opinion being expressed that if there is no great difference between the two tenders, preference shall be given to the Corporation.

TASMANIA.—The following tenders have been received by the Postmaster-General's department:—200 common battery wall telephones, International Electric Co., London, £417 10s.; extensions to common battery switchboard at Hobart, Western Electric Co., £2,186; 800 double-pole receivers and cords, The North Electric Co., Cleveland, U.S.A., £196.

WATFORD.—The Council has accepted the following tenders:—Condensing plant, the Worthington Pump Co., £620; extension of cooling water supply, L. R. Ensor, £696; superheaters to two boilers, Babcock & Wilcox, £260. It has been found necessary also to lay a new suction and new delivery pipe for the new condenser, at an estimated cost of £180. For new links to a stoker the tender of Babcock & Wilcox, at £38, has been accepted, and that of Clifford & Gough, at £34 19s., for re-arrangement of stores, additional office accommodation, and new windows in boiler house. The Council has accepted the tender of Stephenson, Clarke & Co., for the supply until March 31st, 1909, of Gedling top hard nuts at 15s. per ton delivered.

WIMBLEDON.—An order has been placed with the General Electric Co. for 1,300 high-voltage Osram lamps for street lighting.

COMPANIES' MEETINGS AND REPORTS

ANGLO-ARGENTINE TRAMWAYS CO.—Meetings of shareholders of the various classes of this company were held last week, when the following resolution was passed:—"That, notwithstanding anything contained in the resolution passed at the general meeting of the company held on July 26th, 1907, the directors be, and they are hereby authorised to apply the company's debentures or debenture stock which may be issued under the powers conferred by such resolution or the proceeds thereof, not only for acquiring the debentures or debenture stock of any company or companies carrying on any other tramway undertaking or undertakings in the City of Buenos Ayres, the interest on which shall not at the date of such acquisition be in arrear, but also to the redemption of the debenture stocks of the Buenos Ayres Electric Tramways Co. (1901), Ltd., and of the debentures or debenture stock (the interest on which shall not at the date of acquisition or redemption be in arrear) of any other company carrying on a tramway undertaking in the City of Buenos Ayres or its vicinity in which this company may be or shall become interested, and to the repayment of any loan which may be made to this company for the purpose of acquiring or redeeming any such debentures or debenture stock."

DICK, KERR & CO.—The report for the year ended June 30th shows that the profits earned during the twelve months amounted to £59,558. Out of this has had to be paid debenture interest and trustees' fees, and there has been reserved the sum required to provide for the premium payable on the redemption of the present debenture stock. These items absorb £12,831, leaving a balance of £46,726, to which must be added the profits brought forward from last year, viz., £79,140, making a total of £125,867, available for distribution as follows:—Dividend of 6 per cent. per annum on the preference shares, £18,300; dividend of 10 per cent. on the ordinary shares, less income

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tax, £26,600; the balance of £81,566 being carried forward. The dividend on the preference shares will be paid on October 1st, 1908, as usual, and the dividend recommended on the ordinary shares will be paid when approved by the shareholders. In view of the continued severe competition in all departments, the directors consider the result of the year's trading not altogether unsatisfactory. Mr. R. H. Prestwich and Mr. Thos. D. Lingard retire from the Board, but offer themselves for re-election. The meeting is on Tuesday.

DIRECT WEST INDIA CABLE CO. The report for the year to June 30th, shows a net profit of £6,149, against £2,090 for the previous year. The difference between the two sums is accounted for by interruptions last year owing to the earthquake, when traffic was suspended for about nine weeks. An interim dividend of 3 per cent. has already been paid, and it is proposed to make a further equal demand free of income tax, leaving £4,349 to be carried forward. This increases the amount to the credit of revenue account to £33,495. Debentures have been paid off during the year to the amount of £6,100, leaving £50,900 outstanding. At the meeting on Thursday the report and accounts were adopted.

DUNDEE BROUGHTY FERRY & DISTRICT TRAMWAY CO.—At the annual meeting on Thursday, the report and accounts given in our issue for September 10th were adopted. The Chairman pointed out that during the year they had had nine months of very bad weather, yet their receipts were £200 better than the previous year. At the same time, the Board were quite unable to say when it was likely that a dividend would be paid upon the ordinary shares.

HALIFAX & BERMUDAS CABLE CO.—The accounts for the year to June 30th, show a net profit of £3,095, against £3,182 for the previous year. An interim dividend of 2½ per cent has already been paid, and after making a further equal payment, free of income tax, the sum of £595 is carried forward. The amount outstanding to the credit of revenue account is thus increased to £17,192. Debentures were paid off during the year to the amount of £9,300, leaving £19,600 outstanding. At the meeting on Thursday the report and accounts were adopted.

UNITED ELECTRIC CAR CO.—At the annual meeting last week, the report and accounts given in our last issue were adopted. The Deputy Chairman, Mr. R. H. Prestwich, who presided, stated that it was with much regret that the directors found themselves unable to recommend a dividend upon the ordinary shares. Those who were present at the previous meeting would remember that a fall in the profits had been foreshadowed, owing to the stagnation in electric traction, which was affecting all car builders as well as electrical equipment manufacturers. He was sorry to say that instead of improving, matters had got worse, with the result that their output was less than one-half than what it was for the preceding year. Fortunately there has been a considerable reduction in the expenses without adversely affecting the interests of the company. With regard to the future, he regretted he could not say there were any signs of immediate improvement. A shareholder suggested that instead of transferring the amount shown by the accounts to the reserve fund, this should be dealt with to enable a dividend of 2½ per cent. to be declared on the ordinary shares, but this resolution was ruled out of order.

Tramcar Accidents.—Early on Friday morning the driver of a tramcar in Huddersfield lost control of it, and the car dashed down a hill at a great speed, colliding with another tramcar at the bottom. Both vehicles were thrown off the rails and badly damaged, and the driver of the runaway car had his left ankle broken. No passengers were injured.

On Sunday a London County Council tramcar in Old Street ran into two others which were standing at the stopping place near the corner of City Road, owing, it is said, to the failure of the magnetic brakes to pull the car up in time. At this particular spot a speed of sixteen miles per hour is permitted by the Board of Trade regulations. All the cars carried passengers, and nine had to be taken to the hospital with various injuries, but only one was detained.

A collision took place between two tramcars belonging to the Bournemouth Corporation at Tuckton Bridge, near Christchurch, on Thursday. The accident occurred upon a loop line, but nobody was injured.

Telegraph Traffic.—The Lagos-Kotonon cable was restored on the 15th inst., while on the following day communication between Pontianac and Saigon became interrupted. The cables between St. Vincent and Barbados, which failed on the 15th inst., were restored on the 16th inst. The cable connecting Sitia and Rhodes failed on the 17th inst. This was followed by the breaking of the cable between the Dardanelles and Constantinople on the 20th. As the land lines between Constantinople and Smyrna are overloaded, telegrams via the Tenedos cable are subject to delay. The lines of the Neva European Telegraph Co. were down between Djoulfa and Tauris on the 21st inst., but were repaired on the following day. The French Cable Co. have also succeeded in repairing the cable between Paramaribo and Cayenne, which was again open for traffic on the 21st inst.

APPOINTMENTS AND PERSONAL NOTES

Mr. R. Nelson, of the firm of Messrs. Merz and McLellan, has been appointed to the newly-created post of H.M. Electrical Inspector of Mines. Mr. Nelson has incidently been appointed an Inspector for the purpose of the Metalliferous Mines Regulation Acts, 1872 and 1875, and of the Quarries Act, 1894, and has further been appointed an Inspector of Factories for the purposes of the Factory and Workshops Act, 1901.

The Rangoon Electric & Tramway Supply Co. require an experienced jointer, accustomed to high tension work. Apply, 14 Dale Street, Liverpool.

The Handsworth Council have adopted the recommendation of the Electricity Committee to increase the salary of the Electrical Engineer, Mr. F. A. Nixon, from £350 to £400 per annum.

The Electricity and Street Lighting Committee of Bermondsey Borough Council received 126 applications for the post of engineer-in-charge to fill the vacancy caused by the promotion of Mr. Hogarth, at a salary of £110 per annum, without pension. Mr. Cragg, of Putney, has been appointed to the position.

Mr. J. Milton has resigned his appointment as shift engineer at the Battersea Borough Council electricity works, to take up an appointment as chief assistant engineer to the Wycombe (Borough) Electric Light & Power Co., Ltd.—The Battersea Lighting Committee has resolved that Mr. W. H. Healy, at present engaged as draughtsman at the central station, be appointed shift engineer on probation for three months, at a salary of £120 per annum, and that the Electrical Engineer be authorised to engage a person temporarily to take the place of Mr. Healy.

Mr. G. Shaw Scott, M.Sc., of Sutton Coldfield, has been appointed permanent Secretary to the Institute of Metals.

MISCELLANEOUS CITY NOTES

ANGLO-ARGENTINE TRAMWAYS.—The directors announce an interim dividend to June 30th for 5s. per share on the non-cumulative second preference shares which is at the rate of 10 per cent. per annum, less income tax.

ARMSTRONG WHITWORTH & CO.—An interim dividend at the rate of 10 per cent. per annum is declared upon the ordinary shares for the past half year.

BABCOCK & WILCOX.—An interim dividend of 1s. 7 1 5d. per share, free of tax, is announced for the half-year to June 30th.

DIRECT SPANISH TELEGRAPH CO.—An interim dividend of 4 per cent., free of tax, is announced upon the ordinary shares for the half-year to June 30th.

FOLKESTONE ELECTRICITY SUPPLY CO.—An interim dividend of 4 per cent. per annum (2s. per share) upon the ordinary shares is announced for the June half-year.

MELBOURNE TRAMWAYS & OMNIBUS.—A dividend of 4½d. per share, being at the rate of 15 per cent. per annum, is announced.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £62 to £62 10s. per ton (last week, £63 to £63 10s. per ton).

CHANGE OF ADDRESS.—The Electrical Apparatus Co., of Caxton House, Westminster, London, have now removed to their new premises, Milford Works, Queen's Road, Battersea, London, where all correspondence should be addressed in future.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The trustee in the bankruptcy of G. Collier, trading as H. Collier & Co., electrical engineer, 89 Long Acre, London, W.C., has been released.

LONDON PRIVATE FIRE BRIGADES.—The London Private Fire Brigades Association, which now comprises 850 members, held its fourth annual competition at the Guildhall on Saturday, the 19th inst. At the conclusion of the competition it was announced that the challenge shield had been won by the Robertson Electric Lamps Co.'s brigade for the second time. The three first times were as follows: (1) Robertson Electric Lamps, Ltd., Brook Green, 360 2/5 sec. (2) Bradbury, Wilkinson & Co., Ltd., Farringdon Road, 403 3/5 sec. (3) R. H. & S. Rogers, Cliftonville Works, Rotherhithe, 410 3/5 sec.

Mishap on L.C.C. Tramway System.—In consequence of what is reported to be an accident at the Greenwich power house, practically the whole of the London County Council tramway was at a standstill for about an hour on Tuesday evening.

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NEW COMPANIES

BASTIAN QUARTZ LAMPS, LTD.—This company was registered on September 8th, by W. T. Hick, 2 Church Court, Clement's Lane, E.C. Capital, £6,100, in 6,000 preference shares of £1 each and 2,000 deferred shares of 1s. each. Objects: To acquire from C. O. Bastian certain British patents relating to vapour electric apparatus; to grant licences in respect thereof (and particularly a licence to the Brush Electrical Engineering Company, Ltd.), and to carry on the business of electricians, manufacturers of electrical lamps and apparatus, &c. Minimum cash subscription, 5 per cent. of any shares or debentures offered to the public. The first directors (to number not less than two nor more than six) are to be appointed by the signatories. Remuneration, not more than £50 per annum for the chairman and not more than £25 each for the others (including managing director).

BINKS BROS.—This company has been registered with a capital of £15,000 in £1 shares to acquire the business of wire rope manufacturers and galvanisers carried on by J. Binks, A. W. Binks, and T. W. Graham at Strafford Street, Millwall, London, E., as Bink Bros. No initial public issue. Registered offices, 15 Strafford Street, Millwall, London, E.

BRAZILIAN RAILWAYS TRUST.—This company was registered on September 14th, with a capital of £10,000 in 9,750 ordinary shares of £1 each, and 5,000 deferred shares of 1s. each. Objects as indicated by the title. Private company. The number of directors is not to be less than two, nor more than five; the subscribers are to appoint the first. Registered office, 50 Cannon Street, E.C.

COMMERCIAL & CONSTRUCTION SYNDICATE.—This company was registered on September 16th, with a capital of £2,000 in 1,900 ordinary shares of £1 each, and 2,000 deference shares of 1s. each, to carry on the business of financiers, manufacturers, mechants, property owners, and dealers, miners, contractors for public and other works (including steam, electric, and other railways and tramways), &c. Minimum cash subscription, £7. The first directors are the Hon. Herbert Stanhope, F. Brady, and N. Lye. Qualification, 10 deference shares. Remuneration, £100 each per annum (£200 for the chairman). Registered office, 60 Cheapside, E.C.

ECONOMIC FURNACES.—This company has been registered, with a capital of £5,000, to take over the business carried on at 38 Baldwin Street, Bristol, as engineers and manufacturers of patent stokers and furnaces.

ELECTRICAL & ENGINEERING SUPPLIES CO.—This company was registered on September 5th, with a capital of £1,000 in 950 preferred ordinary shares of £1 each, and 1,000 founders' shares of 1s. each, to carry on the business of manufacturers of and dealers in electric light apparatus, conduits, dynamo machines, lamps, fittings, and accessories, electric accumulators, motors, batteries, &c. The subscribers are:—J. A. Nones, W. D. Taylor, and G. Wingfield. Private company. The number of directors is not to be less than two nor more than five; the first are J. A. Nones and W. H. Taylor. Qualification, £10.

JOHN SHAW & SONS (Salford).—This company has been registered, with a capital of £50,000 in £1 shares, to adopt an agreement with Joseph Shaw, of Wellington Street Works, and to take over the business of steam, hydraulic, chemical, and electrical engineers previously carried on as J. Shaw, Sons & Co. No initial public issue. Registered offices, Wellington Street Works, Salford, Lancs.

MIDLAND ELECTRIC LAUNDRIES.—This company was registered on September 16th, with a capital of £3,000 in £1 shares (500 preference), to take over the laundry business carried on at 117 Sherbourne Road, Birmingham, by F. Allbutt. Private company. The number of directors is not to be less than two, nor more than five; the first are F. Allbutt and A. O. G. M. Grove. Qualification, £50. Remuneration, £20 per annum, dividend. Registered office, 117 Sherbourne Road, Birmingham.

RADIO AND ELECTRIC POWER CO.—This company was registered on September 16th, with a capital of £10,000 in £1 shares, to carry on the business of electricians, workers of radio-telegraphy, engineers, suppliers of electricity, manufacturers of and dealers in apparatus for automatic telegraphy and telephony, &c. The subscribers are:—Lieut. J. H. Hills, R.N.R., 51 Burton Court, Lower Sloane Street, S.W.; A. C. Grover, F.S.A.A., St Davids, 53 Mount Nod Road, Streatham, S.W., accountant; G. L. Bullock, 86 Forburg Road, Clapton Common, N., electrician; A. Simkins, Parel, Holden Road, Woodside Park, N., electrical engineer; A. Gray, 42 Clovelly Road, Ealing, W., engineer; E. H. Neville, 55 Gresham Road, Brixton, S.W., clerk; P. F. Haynes, Belmont, York Road, Southend-on-Sea clerk. Private company. Table "A" mainly applies. Registered office: 102 Fenchurch Street, E.C.

RAILWAY & TRAMWAY DEVELOPMENT CO.—This company was registered on September 16th, with a capital of £50,000 in £1 shares, to acquire any decrees, concessions, contracts, privileges, rights, guarantees, and benefits for the construction, leasing, working, or dealing with railways, tramways, light railways, or other public works, to construct, establish, maintain, and work any roads, electric lines, electric power and supply, mining, land improvement, and other operations, &c. Minimum cash subscription, seven shares. The number of directors is not to be less than two, nor more than seven; the first are Rt. Hon. Lord Teynham, Ravensdale House, Ascot, and A. Docker, 9 Grays Inn Square, W.C. Qualification, £100. Remuneration, £100 each per annum (chairman, £150), and 10 per cent. of the net profits after 10 per cent. is paid, dividend (maximum additional remuneration, £1,000). Registered office, 5 London Wall Buildings, E.C.

STATE OF BAHIA SOUTH-WESTERN RAILWAY.—This company has been registered, with a capital of £200,000 in £1 shares, to adopt an agreement with B. B. de Oliviera and Messrs. Fry, Meyers & Co., to carry on the business of constructors and workers of railways, tramways, telegraph and telephone lines, &c., in Bahia or elsewhere in Brazil, to generate, accumulate, supply, and use electricity for light, heat, power, or other purposes, &c. Minimum cash subscription, 10 per cent. of the shares offered to the public. First directors (not less than three nor more than seven) to be appointed by signatories. £250. £175 each per annum (£75 extra for the chairman) and 10 per cent. of the distributed profits, divisible. (99,497).

COMPANY MORTGAGES

AMALGAMATED RADIO-TELEGRAPH CO.—Particulars of charges, dated 1907 and 1908, securing £22,474.

W. H. ALLEN, SONS & CO.—Particulars have been registered of a trust deed dated July 22nd, 1900, securing £28,000.

CALMONT KING & CO., LTD.—Particulars have been filed of £2,000 debentures, created by resolution of August 7th, 1908, pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £500. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

DURHAM COLLIERIES ELECTRIC POWER CO.—Particulars have been filed of an agreement dated August 15th, 1908, to secure £21 annual remuneration to trustees (supplemental to agreement of July 15th, securing £2,500 and interest). Property charged, the general assets of the company.

EDMUNDSON'S ELECTRICITY CORPORATION.—Trust deed September 3rd, for securing £100,000 five per cent. prior lien debenture stock, and trust deed September 3rd supplemental to trust deeds dated July 10th, 1899, and December 19th, 1905, and seven indentures dated from April 27th, 1900, to January 19th, 1906, for securing an addition to the rate of interest of ½ per cent. per annum, and, in certain events, a premium of 5 per cent., in respect of £472,000, the amount now outstanding of an issue of £480,000 first mortgage debenture stock; trustees: Electric & General Investment Co., Ltd., and Sir J. Bailey & The Anglo-American Debenture Corporation, Ltd. (£76,900 first mortgage debentures, and £5,800 first mortgages debenture stock of various subsidiary undertakings and debentures of certain electric light, power, and supply companies, undertakings, and other assets and property, present and future).

GLOUCESTER RAILWAY CARRIAGE AND WAGON CO.—Issue on August 12th of £850 Debentures, part of a series of which particulars have already been filed.

LISBON ELECTRIC TRAMWAYS.—A statement has been filed showing the total amount outstanding on July 1st, in respect of mortgages and charges created prior to that date, and not required to be registered under Section 14 of the Companies Act of 1900. This gives particulars of a mortgage dated November 22nd, 1890, securing £345,000.

"X" SYNDICATE, LTD.—Particulars of £3,700 Debentures created by resolution of July 23rd, 1908, have been filed pursuant to Section 10 (3) of the Companies Act, 1907, the whole amount being issued on same date. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

NEW PUBLICATIONS

The British and Foreign Guide to the Engineering, Steel, and Hardware Trades. (London: Adolphe Francis.) 10s.

Electric Furnaces. By Wilhelm Borchers, translated by Henry G. Solomon. (London: Longmans, Green & Co.) 7s. 6d.

"Power Railway Signalling." By H. Raynar Wilson. (London: "The Railway Engineer"), 18s.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. Part 8, Vol. xxiv., Session 1907-1908 (London: Andrew Reid & Co.)

Memorial to Lord Kelvin.—Mr. A. Bruce-Joy has been selected by the committee for the memorial to the late Lord Kelvin to execute the statue to be erected in Belfast.

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ELECTRICAL ENGINEERING

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☞ **Manchester Exhibition Supplements.** With this issue, No. 1 of a series of five supplements describing the Manchester Electrical Exhibition is given *Gratis*. All readers should see that this supplement is included in their copy of to-day's "Electrical Engineering."

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PUBLISHERS' ANNOUNCEMENT

The price of "Electrical Engineering" has been reduced to 1d.

The first number of "Electrical Engineering" was published on January 3rd, 1907, and the paper immediately took the leading position among the electrical newspapers. A thoroughly sound and practical technical paper, written and edited by men with long experience on the practical side of the electrical engineering industry, and illustrated with useful drawings to scale and well-printed photographs, was welcomed, and in spite of the comparatively high price of 6d., which it was necessary to charge for it, the paper scored an immediate success. The proprietors have been repeatedly urged to reduce the price in order to bring the paper within the reach of a wider circle of readers, and they are now in a position to make a concession in this direction that was not possible hitherto. They do not believe in half measures. From to-day onward, therefore, "Electrical Engineering" will be on sale throughout the United Kingdom at the popular price of 1d. weekly (post free 1½d.), and it will therefore appeal to everyone connected with the electrical engineering industry. The leading features of the Paper will remain unaltered. No change has been made in the Editorial Staff, the same high-class printing and illustrations will be maintained, and the proprietors rely absolutely on the enormous increase of circulation which is assured, to recompense them for the sacrifice they are making in decreasing the price.

We feel confident that our readers will assist us by bringing the paper to the notice of engineers engaged in kindred branches of the engineering industry. It will be unnecessary, moreover, that

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single copies of "Electrical Engineering" should circulate among 20 or 30 readers, as frequently happens at present; in future each reader will be able to buy and retain his own copy at 1d.

Arrangements have been made by which "Electrical Engineering" will be obtainable at all Messrs. W. H. Smith & Sons' and Messrs. Wyman's bookstalls, and through every newsagent in the United Kingdom. If any difficulty is experienced in obtaining it, complaint should at once be made to the Publishers. Readers who prefer to receive the paper through the post should order it direct from the Publishers (The Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, London, E.C.). The annual subscription rate, including postage, is 6s. 6d. for the United Kingdom, 8s. 8d. for Canada, and 13s. for other Colonies and abroad. (Subscriptions should be paid in advance.)

Existing subscribers will have the unexpired period of their subscriptions extended in proportion to the difference in price.

We regret to say that Messrs. Cassell and Co. Ltd., are issuing in sevenpenny fortnightly parts a publication entitled "Electrical Engineering," in spite of our protests that confusion is likely to arise in the newspaper trade owing to the title being the same as ours. There is no possibility of any of our present readers being misled, but to avoid mistakes by their newsagents, they are recommended to make it clear when ordering their copies that they require "Electrical Engineering," the weekly newspaper.

SUMMARY

We publish this week a supplement devoted to the Manchester Exhibition. It contains an article on the advantage of such exhibitions to the industry; a historical review of past electrical exhibitions and of all the steps taken in the promotion of the present one; photographs of the Consulting Electrical Engineers and of the Manager and Secretary; a preliminary notice of some of the exhibits; a map of Manchester showing the position of the Exhibition; a numbered plan of the building to assist in the finding of the various exhibits; and other information. The Incorporated Municipal Electrical Association will pay an official visit to the Exhibition on October 17 and 18, and visits will also be made by the Electrical Contractors' Association and the Rugby Engineering Society.

The sub-station at the Manchester Electrical Exhibition is described in detail. It has been erected by the Manchester Corporation, and plant is employed which will subsequently be transferred to their permanent sub-stations. Large machines have been put in, as the exhibition load is heavy. A Westinghouse rotary converter with a specially arranged booster on the same shaft, in order to give a very large range of voltage regulation, is one of the three machines put in. The detailed arrangements of the wiring of the exhibition are also described in the article. (Page 485.)

The following books are reviewed in this issue:—"Electrical Engineers' Pocket Book," by H. A. Foster; "Electric Lighting and Power Distribution," by W. Perren Maycock. (Page 488.)

One of the latest of the manufacturing firms to move out of London is Messrs. Arc Lamps, Ltd. A new works of modern design has been built especially for the firm at St. Albans. The chief work in hand at present is the manufacture of a new pattern of open-flame arc with converging carbons and gravity feed. A spring is substituted for the usual shunt coil, and by suitably shaping the series plunger an even and sensitive control is effected. To ensure that the arc is deflected downwards in a vertical position, a few series turns are wound on one limb of the iron frame above the economiser. (Page 489.)

The equipment of the power station for the London Post Office telegraph and telephone system near Blackfriars Bridge is to be proceeded with and a contract has been let for turbo-alternators, &c. The building has been complete for some time. (Page 490.)

A serious collision occurred on Saturday on the Berlin elevated electric railway, whereby a number of lives were lost. (Page 490.)

Under Electrometallurgy and Electrochemistry is an account of some experiments on the reduction of refractory oxides by carbon and some notes on the effects of temperature on the capacity of lead accumulators. (Page 490.)

At the annual meeting of the Municipal Tramways Association a paper was read by Messrs. R. G. and J. G. Cunliffe, Assistant Electrical Engineers to the Manchester Corporation, in which certain methods of economising in current consumption were suggested. Among the proposals is that the usual gauge of the trolley wire should be very much increased, and that the wire should be frequently renewed, as the authors think that the wear on the trolley wire increases the C^2R losses sufficiently to make this worth while. They also propose a modified arrangement of trolley wires, consisting of two bronze wires, one for each track, with a copper wire between. Other suggestions were for copper-faced fish-plates, a modification in the controller connections and an alteration in the design of cars. Mr. A. L. C. Fell (Chief Officer of the L.C.C. Tramways) has been elected President of the Association for the coming year. (Page 491.)

A description is given of a simple form of prepayment meter for use on small installations where charging is reckoned on the hours during which current is used irrespective of the number of lamps in use. (Page 495.)

Short articles describe an ingenious new lampholder in which the leads are attached without the use of screws, an electrical floor polisher, and an effective poster relating to tantalum lamps. (Page 496.)

In relation to the fire at the Paris Telephone Exchange last week, we now give some particulars as to the exchange equipment, and the very large use of paraffin cotton cable. Some remarks are also made as to the time that may be taken to restore the service. (Page 497.)

It is stated that the Board of Trade only requires to be satisfied on one matter before assenting to the transfer of the Bath Corporation Electricity Works to a company.—The consideration of an application by the London Electrobus Co. for a license to run six 'buses in Brighton has been deferred for three months.—Mr. Arthur Ellis, the Tramways Manager at Cardiff, and the City Engineer have been instructed to prepare a report upon the condition of the tramway track.—The Ipswich Corporation has leased a site to the Admiralty for a wireless telegraph station. A supply of electrical energy will be taken from the Corporation estimated to amount to £300 per annum.—A new telephone exchange has been completed at Kingston-on-Thames. (Pages 497 to 499.)

Electric lighting schemes are under consideration for Banbridge, Crayford, Fentona, and Castleblayney.

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A Local Government Board enquiry has been held at Elland (£3,000). The Limerick Corporation require two switchboard panels, and the Warrington Corporation flame arc lamps. (Pages 499 to 500.)

The report of Messrs. Willans & Robinson for the half-year to June 30th shows a profit of £18,472 after writing off £6,510 depreciation. After deducting a loss upon the Queensferry works there is a net profit of £15,685, in addition to £7,443 brought forward. A 10 per cent. dividend is announced upon the ordinary shares. At the meeting of Messrs. Dick, Kerr & Co., on Tuesday, it was stated that owing to the depression in the electrical industry at home, the Company has turned its attention to foreign and colonial trade with gratifying results. Mr. Arnold Lupton, at the annual meeting of the Yorkshire Electric Power Co., on Tuesday, referring to the cotton strike, said that textile factories accounted for 40 per cent. of their revenue. (Pages 501 to 502.)

Among the patent specifications published by the Patent Office on Thursday last is one by Dr. C. C. Garrard and Ferranti, Ltd., for an improved time limit relay for overload circuit-breakers. It is of the suspended weight class and provides for very easy adjustment. A specification by the British Thomson-Houston Co. and others relates to reverse-current circuit-breakers of the differential type for alternating-current systems. Special windings are provided for the purpose of neutralising the transformer action which takes place between the two main windings. The British Thomson-Houston Co. have another specification in which is described a process of manufacturing high resistance metal filaments from a mixture of tungsten and thorium oxide in various proportions; a paste for connecting such filaments to the leading-in wires is also included. For preventing the communication of disease through the medium of telephone mouth-pieces it is proposed in a specification by J. Freel to cover these with antiseptically treated silk. (Page 503.)

A paper was read yesterday by Mr. C. H. Merz at the Middlesbrough meeting of the Iron and Steel Institute on "Power Supply and its Effect on the North-east Coast Industries." The author gave some particulars of the growth of the undertaking of the Newcastle-upon-Tyne Electric Supply Co., which now works in connection with the Durham Electrical Power Distribution Co. and the Cleveland and Durham Electric Power Co., part of the plant of which has been altered to be of the same frequency. The whole scheme now combines eight generating stations aggregating 136,550 h.p. (including three waste heat stations), and three representing an additional 34,000 h.p. are under construction. The paper considered the questions of utilising the waste heat from coke ovens and blast furnaces, &c., and pointed out the advantages of co-operation with a power company in this direction. (Page 505.)

A paper was read at the Middlesbrough meeting of the Iron and Steel Institute by Mr. S. Cowper-Coles describing a process for the electrolytic production of finished iron sheets and tubes in one or two operations from crude or scrap iron or direct from the ore without smelting, rolling or drawing. (Page 507.)

The annual report of the Postmaster-General for the year to March 31, 1908, states that underground telegraph lines are under construction from Birmingham (southwards) and from Bristol (northwards), whilst progress is also being made with the line between Newcastle and Leeds. A committee of the London Chamber of Commerce has made an investigation into the method of metering calls and is satisfied that the percentage of error, which is very small, is in favour of subscribers. New subscribers are being connected to the London Post Office telephone system at the rate of about 160 per week. (Page 508.)

The report of the deputation appointed by the Manchester Corporation Tramways Committee to consider the merits of the trackless trolley system for developing traffic in outlying districts where the frequency of the service is not sufficient to warrant the laying of tramlines, puts the economic limit for tramways at about a fifteen-minute service. Where the traffic is less than this the trackless trolley system appears to offer great advantages over the self-contained motor omnibus. Some pioneer trackless lines in Germany are described, but a proposed form of vehicle more suited to English conditions is described. (Page 509.)

The introduction of petrol-electric motor coaches on the Arad-Csarras Railways in Hungary for the light traffic has resulted in a great financial improvement. Two sizes of car with 40 and 80 h.p. equipments are used, either alone or in combination with one or two trailers. (Page 510.)

In our Tenders columns will be found, under the heading Coventry, a short reference to the prevailing complaint that the cable "ring" in this country, *i.e.*, the Cable Makers' Association, are keeping up the prices of electric light and power cable to a figure far higher than that for which equally good cable can be obtained from abroad. This is not an isolated case of complaint, and the dissatisfaction seems to be general. That a group of manufacturers should combine to prevent the price of cable being reduced to a ruinous limit is but natural in the present state of the industry; but it would appear that the cable makers are rather overdoing things, with the result that several orders have been going abroad which should certainly not be lost to this country. We cannot think that the cable manufacturers here are so overwhelmed with orders at the present time that they actually wish to divert them to foreign manufacturers. A statement on this subject from the leading cable makers or from their Association would be welcome. A solution of the present difficulty would be certainly to their own interests, for on some sides it has even been suggested that the cable makers have brought matters to such a pitch that combined action on the part of cable users might be advisable in order to ensure that tenders for British-made cable should be really competitive. In the meantime the cable-makers outside the ring are reaping a harvest, which we certainly do not grudge them.

We publish in this week's issue the results of the investigation of the merits of the "trackless trolley" system made by a deputation appointed by the Manchester Corporation Tramways Committee, and on the whole it may be said that their conclusions are identical with those of the Dundee sub-committee who considered the same question some months ago. (See Electrical Engineering, July 30, page 184.) Both these reports clearly recognise the value of the steerable vehicle running on ordinary roads and taking power from an overhead line as feeders to tramway systems in suburban districts, where the traffic is not sufficient to warrant the laying of rails. As we have already had occasion to point out, it is useless to pretend that the trolley omnibus is a competitor with tramways for heavy traffic, but for use as feeders and for developing traffic their advantages over petrol or steam driven omnibuses appear very real. It is possible, too, that the system may prove of use in narrow streets unsuitable for tramways or for maintaining temporary service

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in case of breakdowns, blocks or track repairs. Granted, then, that from economic and traffic points of view there is a distinct, though perhaps limited, field for the trolley omnibus, it is of interest to look at the engineering side of the question. In the pioneering days of any form of traction difficulties occur which only experience can surmount and early forms are often discarded. The cumbersome looking front driven, iron-tyred machines on the lines in Germany appear to be a survival of designs evolved before "automobile engineers" existed, and we are pleased to see a design put forward which evidently is based upon the work of both the experienced builder of heavy mechanical vehicles and the electric tramway engineer. The seating capacity is considered by the Manchester committee to be somewhat small for the purpose they have in view, but it must be remembered that one of the chief lessons of modern traffic results has been that a frequent service of small vehicles develops traffic more rapidly than a larger vehicle running less often.

THE accident on Saturday on the Berlin electric elevated railway, better known by its German name, the *Hochbahn*, is one of the most serious of its class which has occurred. Its tragedy is all the more intensified by the fact that appliances exist, and are widely used on other railways handling similar traffic, whose direct object is the prevention of this form of disaster. More will doubtless be known of the circumstances which led the unfortunate driver to disregard the signals, but the occurrence emphasises the need for recognising possible mental as well as mechanical failures, as is done by the provision of the "automatic train stop" on the Underground Electric Railways of London, an appliance which, by tripping an air valve, applies the brake at once independently of the driver if a train passes a signal at danger.

THAT electric tramways have not come up to early anticipations as profit-earning concerns is a general complaint with the management of both municipally and company-owned undertakings. In most cases the complaint is that the cost of repairs and maintenance is excessive. The paper read by the Messrs. Cunliffe at the Nottingham meeting of the Municipal Tramways Association last week, suggesting that alterations in equipment and methods of working in certain directions will reduce working costs, will therefore be read with critical interest in tramway circles. The first point dealt with is the most economical size of trolley wire, which they put at a larger figure than is usually taken. It has been frequently stated, on the other hand, that the smallest sizes in use are generally the most economical, but the service on the line must be taken into account. Messrs. Cunliffe have probably disregarded the cost of the supporting structure, but this cannot be ignored in designing for minimum annual cost, including capital charges. Trolley wire, being a wearing part, should be chosen to give the most economical life, reckoning in the cost of renewal the difference between the value of the new wire, and the scrap copper recovered. To use a heavier trolley wire than is needed for mechanical reasons in order to reduce electrical losses is a mistake; it is better to use the additional copper as a feeder, either underground or overhead, as Messrs. Cunliffe suggest, when it will not have to bear the scrapping loss every few years. Their proposal to employ a better wearing material, such as silicium bronze, as the actual trolley wire, would be excellent, if the bronze really is better; but trolley wire does not fail, as a rule, from wear in the sense of attrition, but from severely localised stresses, and arcing, which will not be necessarily avoided by the use of a different metal. That the usual methods and materials of trolley insulation leave room for improvement is generally agreed, and Messrs. Cunliffe's desire to eliminate the insulated bolt will meet with much sympathy. The curious annual increase in power consumption per car mile on many tramways has excited a good deal of attention, and the author's endeavours to localise the causes should assist managers to put a stop to this feature. Generally speaking, it is due to a falling off of efficiency in many parts of the equipment, but mainly in the running and electrical gear on the cars. As a good deal of the wasted power is spent destructively, there is a double object in stopping the wastages. The suggestion to reduce the maximum demand by increasing the acceleration of cars on the series notches suggests poor driving, or unsuitable equipment of the cars considered. Both are common faults. The division of the rheostat between the notches is often unsuitable, and capable of improvement, but nothing will make up for unskilful driving, because the starting current needed to give a certain acceleration varies with gradients and loads. In practice it is the acceleration that varies, and the driver's skill is shown in recognising when the car has attained the speed corresponding to each notch, a speed that varies with both load and gradient, and one of Messrs. Cunliffe's proposals certainly seems to us of questionable expediency, but they will excite thought and discussion and will so do good.

Tramway Standards.—In his recent circular to local authorities upon motor-cars and highways, Mr. John Burns stated that the Board of Trade has written to him saying that it will not sanction any more central standards for tramway purposes, and he makes a suggestion to the Local Government Board that it should not approve loans for electric lighting in cases where it is proposed to instal lamps in the centre of roads.

Association of Engineers-in-Charge.—Mr. James Swinburne, F.R.S., has accepted the Presidency of this Association for the ensuing session, and will deliver his Presidential Address on "Smoke" on Wednesday, October 14th, at 8 p.m. at the St. Bride's Foundation Institute, Bride Lane, Fleet Street, London, when Mr. W. H. Patchell will be in the chair. On Saturday, October 3rd, the Association will pay a visit at 2.45 p.m. to the National Physical Laboratory. The train leaves Waterloo at 1.40 p.m.

Australian Trade and Shipping Conditions.—At a meeting of the Committee of the Manufacturers' Association of Great Britain held at Queen Anne's Chambers yesterday, some matters of considerable importance were dealt with concerning Australian trade. Mr. Ben. H. Morgan, who recently visited Australia, New Zealand, and Canada on a special mission of trade investigation on behalf of the Association, delivered an interesting statement on the results of his mission. In investigating the cause of the growth of foreign trade in these markets, he said he discovered that the operations of the shipping ring or conference, controlling all steamer freight from Great Britain, was to a substantial extent responsible for the diversion of British trade. He found numerous cases where this ring was carrying German and American goods at much lower rates than British goods. The difference in some cases being as wide as £2 per ton. Mr. Morgan reported that he had also arranged with the Australian Government for the establishment in London of a showroom where samples and patterns of goods will be kept, for which tenders will be invited from time to time from British firms. This will enable British firms to see exactly what they are tendering for, and so enable them to give closer prices.

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THE SUB-STATION AT THE MANCHESTER EXHIBITION

AN extremely large amount of electrical energy is required for the lighting and power at the Manchester Exhibition, and to provide for this a sub-station has been erected by the Manchester Corporation in approximately the centre of the building. The load will be heavy and continuous, for the building has purposely been erected without windows, so that it may be electrically lighted all day long, and the amount of light and power employed on the exhibitors' stands is naturally no small amount. By the courtesy of Mr. S. L. Pearce, who went through the details of the sub-station with us, we are able to describe its main points of interest and new features instead of giving a mere catalogue of the plant. The sub-station is open to the full view of the public, as it has not been enclosed in any way, and it thus forms one of the most interesting items in an exhibition at which very little can be considered uninteresting.

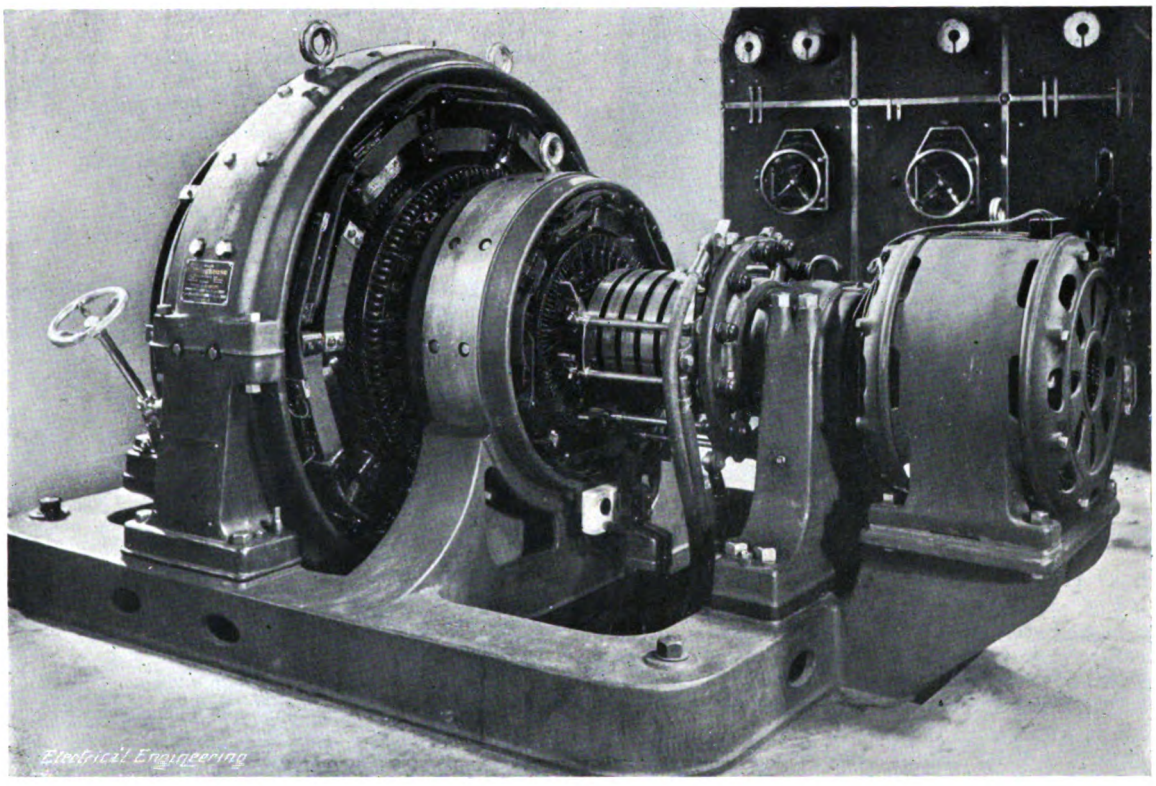

Fig. 1.—Westinghouse Rotary Converter with Special Booster and Starting Motor. An E.H.T. Feeder Panel is seen behind.

The maximum demand expected is 1,150 kw. of continuous current and 250 kw. alternating, and, as will be seen, ample margin has been left. The plant selected has been throughout of a type suitable for the Corporation's permanent sub-stations, and the Corporation have agreed to take it over from the makers within eighteen months of the close of the exhibition. It must have been a difficult task to arrange the lay-out of the plant in the limited space available, but this has been effected without undue cramping, as will be seen by the plan (Fig. 4).

Two 0·15 sq. in. mains from the Corporation's Stuart Street generating station have been diverted for the purpose of the exhibition supply, and they carry 6,500-volt three-phase current to the high-tension switchboard. This is a Ferranti board of the very latest design. It consists of vertical columns of reinforced concrete cubicles, in which various parts of the high-tension gear are effectively isolated from each other. The compartments are closed in front by $\frac{1}{8}$ in. planished steel sheets, and at the back by iron doors, and the switches are operated by handles projecting through the steel sheets in front of the switchboard. The potential transformers for the measuring instruments are enclosed at the left-hand end of the board, and the current transformers are at the top. On the feeder panels, in addition to the usual tripping device, is a "no-voltage" release. In the event of a fault occurring which brings down the supply pressure to such an extent that the converting machinery gets out of step, this release switches the sub-station off. All the switches are of the oil-break pattern.

Three converter sets are employed. Of these the most interesting is a new design supplied by the Westinghouse Co. This is a 700 kw. rotary converter supplied through an 800 kw. three-phase static transformer. The new point about the machine is the arrangement of an A.C. booster on the same shaft, in addition to which there is an induction motor which acts as starter. The booster is connected below the collector ends and the armature, and the voltage is varied by changing the excitation of this booster. The power factor can be varied independently of the voltage by adjusting the excitation of the main field magnet. Thus it is possible to run all day at a leading power factor and so compensate for lagging current taken by other apparatus. The rotary, which is of the six-phase type, is fitted with heavy amortisseurs. Without the booster it will give a range from 440 to 480 and from 500 to 575 volts, and with the booster from 400 to 550 volts. From an efficiency curve which the Westinghouse Co. have sent us, it appears that the combined efficiency of the rotary and transformer is 95¼ per cent. full load; 93½ per cent. half load; and 89 per cent. quarter load. The addition of the booster reduces the efficiency only by two-thirds of 1 per cent. at full load. The starting

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motor is of the squirrel cage type and is switched straight on to the 400-volt A.C. 'bus bars of the L.T. switchboard, which are supplied by the three transformers referred to below. It may be noted also that the cables from the L.T. side of the static transformers go straight to the slip rings of the motor

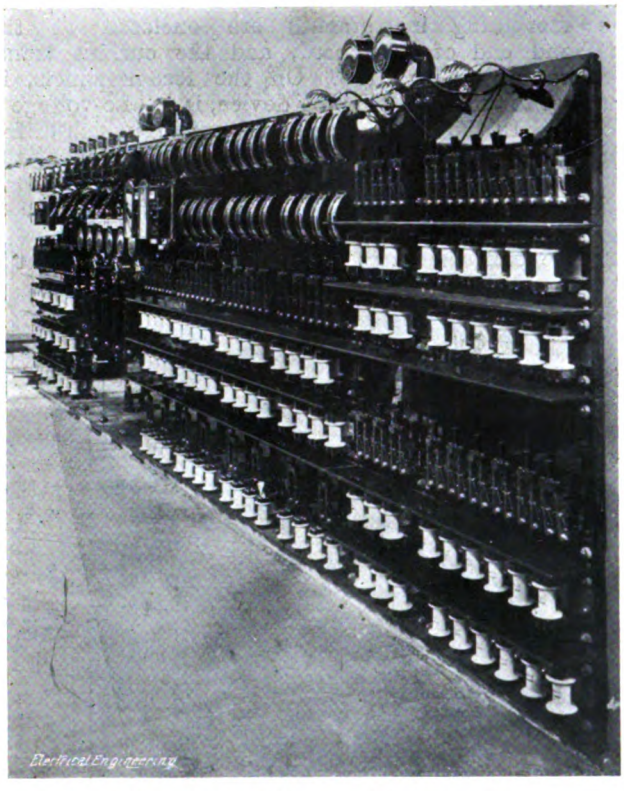

Fig. 2.—Low-Tension Switchboard.

generator, so that the switching is kept as simple as possible. Fig. 1 is from a photograph of this set which we have had taken at the exhibition.

The second set is a 500 kw. induction motor generator of the two-bearing type made by the General Electric Co., Ltd. Its design is generally on standard lines, but it is fitted with ball bearings. The third set is a 600 kw. La Cour motor converter, supplied by Messrs. Bruce Peebles & Co., Ltd. This machine is destined for the Polygon sub-station after the exhibition closes, and the General Electric motor generator will be transferred to the Sherborne Street sub-station. All three machines are three-wire machines and capable of supplying a considerable out-of-balance current to the 2 × 200-volt D.C. circuits. No balancing transformer is employed, and no battery.

For the A.C. supply, three 250 k.v.a. transformers have been put in, giving 400 volts on the secondary side on each phase. These are mesh connected on the secondary side, and in order to give a 230-volt lighting supply three inter-connected star balancing coils are provided. We may add that these transformers will be transferred to the Stuart Street station after the close of the exhibition, and will be employed for the auxiliary plant there.

The low-tension board, which has been supplied by Messrs. Ferranti, Ltd., is a well-designed board, presenting, however, no unusual features. As is seen by the illustration (Fig. 2), the arrangement and disposition of the switches and fuses has been well thought out, and the board is of the flat-back panel pattern. The arc lighting circuits for the general lighting of the building are on the right hand and the circuits to the exhibitors on the left. At the bottom is an emergency panel which enables the arc lighting circuits to be switched over, in the event of a breakdown, on to a small gas-driven set on Messrs. Crossley Bros.' stand. From the sub-station, twelve three-wire D.C. feeder circuits, each of 0·25 sq. in., 0·125 sq. in., 0·25 sq. in. section, are run underground before rising up to the distributing fuse boards (Fig. 3). These latter are of the ironclad and totally enclosed type, made by Messrs. Reyrolle & Co., and are mounted high up on the uprights of the building supporting the roof principals. Two D.P. boards are provided at each feeding point, the middle wire being split between the two. Twenty-four D.P. boards have been required in all therefore. Twelve ways are provided on each board, and each is capable of carrying 30/40 amperes. Each set of contacts and fuses is mounted on a separate slate base. The main feeders are coupled direct to the 'bus bars from the underside, and the branch feeders from both poles are led out at the top. The fittings are mounted on two different planes, in order to allow the cable connections for the bottom row to clear the top row.

In a somewhat similar manner, the A.C. feeder circuits, of 0·075 sq. in. section, and comprising four single conductors, are run to four points in the building, where the three-phase distribution fuse boards are fixed. These boards are of a similar type to the D.C. boards.

In addition, there are some eight circuits ranging in capacity from 25 to 150 amperes, in connection

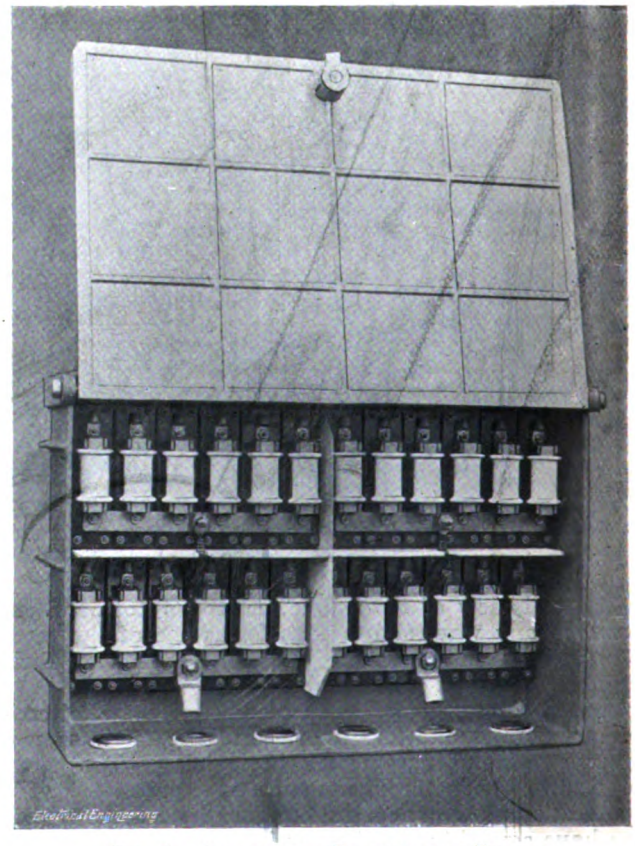

Fig. 3.—One of the Distribution Boards.

with the glow lamp illumination of the front, and the domestic lighting of the main building.

The service mains from the distribution boards to the stands are all run overhead as required, and the cables are brought down the building columns to the exhibitor's switchboard, on which the main switches and fuses and meters are mounted by the management. The whole of the main switchgear on the stands is of the "fool-proof" type supplied by Messrs. Berry, Skinner & Co.

In the case of some dozen exhibitors demanding a large supply, underground mains are laid direct to

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their respective stands, and are controlled directly from the sub-station distribution panels.

The whole of the wiring of the building as thus far described has been almost entirely carried out by the electricity department of the Corporation. It has not been deemed necessary to use rubber-covered cable, as the cables are simply cleated to the woodwork of the building. Hard-drawn copper wire is employed, insulated with two tapes which are impregnated with gutta percha compound, and then single braided and soaked in preservative compound. The material has been supplied by Messrs. Connolly Bros., Ltd.

Some 16 circuits control the general illumination of the building. For the interior, 44 flame magazine arc lamps have been erected, 28 of the Oliver pattern and 16 by the General Electric Co., and the Gilbert Arc Lamp Co. has supplied six enclosed arcs. There are also four General Electric shuntless arcs for the emergency exits. For the approach road lighting eight multiple carbon flame arcs have been supplied by the Gilbert Arc Lamp Co., who have also four single carbon lamps on the Wilmslow Road outside the exhibition, and high up over the front of the building are 12 Westinghouse flame arcs. Cooper-Hewitt lamps are fixed on the four ornamental towers.

The wiring contract in connection with the arc circuits, as well as the general domestic lighting, of the dining-room, tea-room, Welcome Club, &c., has been carried out by Mr. J. Lomax Kendall, of Manchester.

In addition to the arc lighting of the front of the building, nearly 2,000 coloured lamps on "Pixielite" strip will be used for the decoration and illumination of the front and the trees, which form an effective foreground to the site. This portion of the work was entrusted to Messrs. Pearson & Co., of Manchester.

The illuminated sign, "Electrical Exhibition," on the front of the building has been lent by the Blackburn Corporation Electricity Department.

The interior arc lighting of the building is arranged on 16 circuits, eight of which are connected to the "emergency" panel of the switchboard already mentioned. All the lamps are four in series, balanced across the three-wire system

The whole of the work incidental to the lighting and power supplies and general illumination of the building has been planned by and carried out under the supervision of Mr. S. L. Pearce, the Manchester City Electrical Engineer, with whom has been associated as joint Consulting Engineer to the Exhibition Management, Mr. V. A. H. McCowen, Borough Electrical Engineer of Salford.

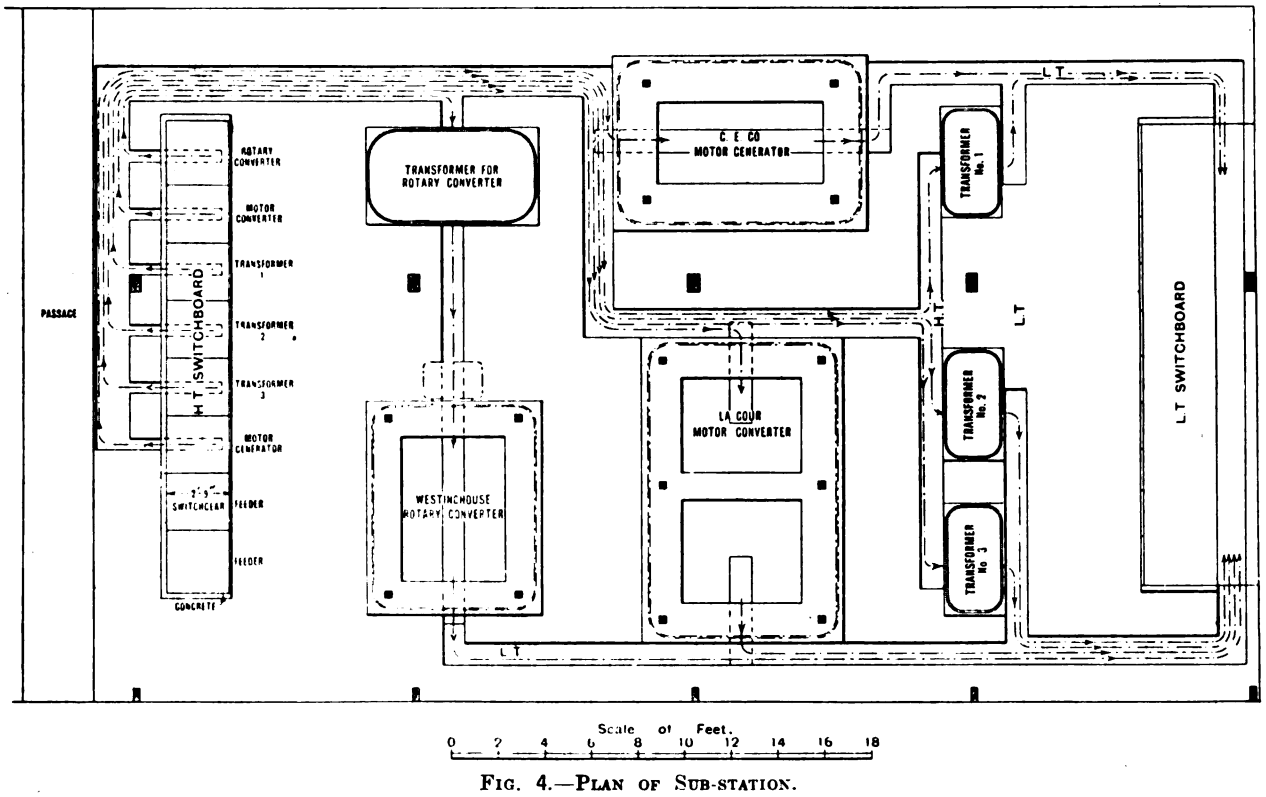

FIG. 4.—PLAN OF SUB-STATION.

International Telegraph and Telephone Congress.—A banquet was given last week in Budapest in honour of the International Telegraph and Telephone Congress. Major O'Meara, chief engineer to the General Post Office, gave the toast of Hungary.

Proposed Cable Factories in Japan.—An American consular report dealing with the imports of electric cables and wires into Japan states that the annual demand for electric wire in Japan amounted to about 8,000,000 yen (£797,000) in recent years. Statistics show that 5,000,000 yen (£498,000) worth of the same was imported the remainder being supplied by Japanese wire factories. In view of the growing demand for electric wire, a mining company is now contemplating establishing a wire factory, where copper is abundantly produced, under its own management. Not content with this, the company is reported to have approached a Yokohama electric-wire factory with a proposal to take up half the capital of the Yokohama establishment, and that the latter will thus be worked under joint management. The Yokohama company will convene an extraordinary general meeting, when the proposal will be fully discussed.

Railway Electrification in Germany.—The question of through-running on the main lines of the State railways in Germany has been brought up recently. As is well known, the Prussian railway authorities, as the result of their extensive experiments on the Spindersfeld line and the favourable results obtained with the single-phase equipment of the Blankenese-Hamburg-Ohlsdorf line, have decided to equip the main lines on that system, using a frequency of 25 cycles as in the above cases. On the other hand, the railway authorities of the State of Baden have decided to employ a frequency of 15 cycles. In commenting on this fact, the *Elektrotechnischer Anzeiger* points out that although in technical circles the relative merits of high and low frequency may be a matter of contention, it is highly desirable that one frequency only should be employed on the main lines of Germany, as otherwise through-running will be rendered extremely difficult. The *Kölnische Zeitung* insists that co-operative action of the various States is essential, as otherwise there will be so many differences in the equipment, both with regard to contact line and rolling stock, that through-running will be rendered impossible.

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REVIEWS OF BOOKS

Electrical Engineers' Pocket-Book. By Horatio A. Foster. Fifth edition. 1,600 pp. 36 illustrations. 6¾ in. by 4¼ in. (London: Archibald Constable & Co.) 21s.

The edition now before us of Mr. H. A. Foster's "Electrical Engineers' Pocket-Book," one of the best-known of such works having its origin across the Atlantic, shows clearly by its increase in size as compared with the earlier editions the extent to which additions have been found necessary. The number of pages has been increased by as much as 600, and, indeed, its size and weight, notwithstanding the title, already render it more fitted for the bookshelf than the pocket of the engineer. A study of the contents will, however, show that the revision by no means consists only of addition, as a good deal of the matter in the previous editions has been re-written. It is, we think, not too much to say that the main characteristic of the book is its completeness, which in some sections in particular lifts it out of the level of a pocket-book. It should be pointed out, however, that the descriptions relate almost exclusively to American practice. In a considerable part of the book this is no real disadvantage to British readers, although there are cases where its American origin has to be borne in mind to prevent a false impression being obtained. For example, in dealing with surface-traction systems, detailed descriptions are given of systems developed by the American General Electric Co. and the Westinghouse Co., although the systems better known and used in this country are not mentioned. In the greater part of the traction section, however, the information of American standard practice is of great interest, although the utility of a table such as is given on p. 831 of the relative positions of third rails on different railway systems would have been increased by the inclusion of British lines more recently equipped than the Central London Railway, the only example mentioned. The traction section is, however, one of the best parts of the book, and contains collected together a great deal of information which it would be difficult for the reader to bring together for himself. English engineers will also find some of the tables of conductors, &c., a little inconvenient where the Brown & Sharpe wire-gauge is used, and dimensions are given in circular mils; but we must say that these wire-tables are admirable in their profusion and variety of arrangement. The authoritative nature of the contents is shown by the representative list of American electrical writers who have contributed to the various sections.

It is unnecessary to give a list of the sections into which the book is divided, but to give an idea of the range covered it may be said that after a certain amount of general introductory matter, wires, cables, and other conductors are most exhaustively dealt with, after which there are sections on dynamos, motors, transformers, &c., lighting, traction, power transmission, storage batteries, and switchboards. Telegraphy and telephony dealt with to some extent, as well as the heavier branches of electrical engineering, and chapters are included on the uses of electricity in the United States Army and Navy, electrical automobiles, electrochemistry and electrometallury, X-rays, electric heating, &c. A short mechanical section is given at the end. Some of these sections are entirely new, and most have been considerably enlarged. Extensive revision has naturally been entailed in both the incandescent and arc lamp sections by the advent of methods of illumination of improved efficiency, but progress has been so rapid in this direction that further advances have already been made since the work went to press. The general aim in the compilation has been the provision of tables rather than mathematical formulæ, and except perhaps in the meter section, there is little that is reminiscent of the manufacturer's catalogue.

The value of such a vast collection of information largely depends on the completeness and clearness of the indexing, and we are pleased to see that since the last edition a long classified table of contents arranged in the order of the pages, and therefore according to subject matter, has been added at the beginning of the book, and that the alphabetical index at the end has been printed in much clearer style than formerly.

Electric Lighting and Power Distribution. By W. Perren Maycock. Vol. I. Seventh edition. Pp. 599; 7½ in. by 5 in.; 333 illustrations. (London: Whittaker & Co.) 6s.

The title of this book is somewhat misleading, as in the present volume there is nothing that could be classified under either Electric Lighting or Power Distribution. The sub-title, "An Elementary Manual of Electrical Engineering," would have been more suitable, as the first four chapters deal exhaustively with the principles of electricity and magnetism, and are followed with an excellent chapter on bells, and bell and indicator circuits. The contents of the remaining chapters, which deal with the magnetisation of iron, electrical instruments, and the elementary theory of electric generators respectively, have been thoroughly revised and brought up to date. Although much has been re-written and condensed in order to make room for the new matter, the volume now contains 167 more pages and over 100 more illustrations than in the previous edition. Several examples of modern continuous-current generators are illustrated and briefly described in the last chapter, and amongst these is an interpole compensated turbo-generator of the Westinghouse Co., with radial commutator. The diagrams and figures are on the whole very good; a few only reveal the fact that they originated some years ago, when methods of reproduction were not so perfect as they are now. With regard to the index, it is surprising that with the wide circulation this book has had no one has ventured to suggest an improvement in this direction. The figures refer to the numbered paragraphs and not to the pages; this system may have its advantages, but, if used, great care should be taken to ensure that the numbers of the paragraphs stand out well. In the book in question this precaution is not taken; the paragraph numbers are, as it were, let into the text, and are in the same type as the figures in the paragraphs. The result is that it is by no means easy to make use of the index, which is itself very complete without being too long. The separate index to the tables should be found useful.

THE MANCHESTER ELECTRICAL EXHIBITION

Although the Manchester Electrical Exhibition will open on Saturday, when the representatives of the Press will be entertained at luncheon in the dining-hall at the Exhibition at 1.30 p.m., it will not be officially opened until Monday, on which day the Lord Mayor of Manchester will pay an official visit at noon, and will afterwards lunch with the committee at 1.30 p.m. In a supplement to this issue we give some comments upon the value of trade exhibitions to an industry, followed by historical notes upon the previous electrical exhibitions which have been held in Great Britain. We also detail the circumstances which have led up to the present Exhibition, and print a list of the officers and council to whose exertions the prospective success of the venture is due. We are also able to publish a map of Manchester, showing the relation of the show ground to the principal railway termini, and the tramway routes, as well as a plan of the Exhibition building, giving the position of the various stands, corrected up to the moment of going to press, in conjunction with an alphabetical list and a numerical list of exhibitors duly revised. It will be seen that there are many additional names since the last list we published. As a guide to those visiting the Exhibition, we have also compiled some particulars of several principal exhibits, drawing attention to their leading features. An illustrated article, descriptive of the sub-station plant and electric supply arrangements, appears on p. 485 in the body of the paper.

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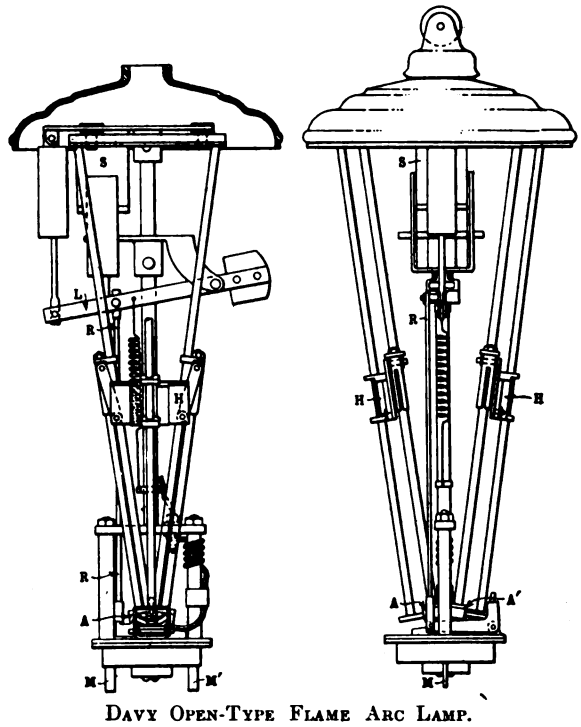
DAVY ARC LAMPS

SEVERAL of the principal manufacturing firms, whose works have been in London, have for many reasons found it advisable to transfer their factories twenty or thirty miles away from the city. The chief of these reasons is, of course, the enormous increase in the rates in all the London boroughs. The difficulty of making extensions and the uncertainty of skilled labour in London are other important reasons. Low rates and taxes are not, therefore, the only advantages to be gained by going into the country; the improved conditions as regards light and air have a beneficial effect on the workmen and, in consequence, on the work done; land is cheap, and there is thus no need for overcrowding; and it is found that the men are more contented and remain longer.

One of the latest of the firms who have left London is Messrs. Arc Lamps, Ltd., who moved last June from the old works in Camden Town to new and spacious premises at St. Albans, Herts. St. Albans is very favourably situated as regards transportation facilities, as it is served by three lines, namely, the Midland, the Great Northern, and the London & North Western Railways. The works, which have a floor-space area of 12,000 square feet, consist of four bays with the modern style of saw-tooth roof, and an adjoining bay of rather different design for the stores department. The whole of the works, with the exception of the offices, has a flooring of cement concrete. Two of the bays accommodate the various machine-tools, which number about one hundred, and include turret lathes, various drills, and a large press. At present these are all temporarily driven by shafting from a single gas engine, but one or more electric motors will soon be substituted for this, and power will be taken for both the motors and lighting from the new St. Albans generating station of the North Metropolitan Power Distribution Co., which is adjacent to the works. The arrangement of the works was carried out under the direction of Mr. W. J. Davy, the managing director, who informed our representative that he considered the above system of driving better than the individual drive system when a large number of small machines with very variable loads were under consideration. The remaining two bays contain the fitting benches. The whole of the shop is visible from the foreman's office, and as there is no floor above, supervision is simplified considerably. A portion of one of the bays is partitioned off to form a test-room, and another partition room accommodates the women workers, who do all the light work, which includes winding bobbins and resistance coils, making chains and globe-nets, and enamelling. There is accommodation at present for about 200 hands, but there is plenty of room for extending the works when necessary. The capacity of the works amounts to about 200 lamps per week, besides which there are the various accessories and the repair work. Owing to the extreme competition with foreign firms, it has been necessary to consider every detail with a view to reducing the labour on each part to a minimum. For this purpose a large number of special tools are used; these, although expensive, save a considerable amount of time and labour. One of the most interesting of these special tools is the jig for ensuring that the two holes in the brass blocks just above the "economiser" are bored at the right angle to one another, so that the converging carbons will feed regularly by gravity without jamming. The position of these blocks can be seen in the accompanying figure.

The lamp which we illustrate is a new type of open-flame arc which has just been put on the market. The mechanism of this lamp is extremely simple, the feed of the carbons being produced by gravity only. A series solenoid S acting on a plunger of special construction and opposed by a spring strikes and controls the length of the arc. This arrangement possesses the advantage that the increasing pull of the solenoid upon the plunger, as the latter enters therein, is balanced by the increasing pull of the stretched spring. The result is that the working stroke of the core can be much increased, with at the same time a more equable pull and an increased sensitiveness to current variations. The lever L is connected to an air dash-pot to prevent irregular and jerky movements. Attached



DAVY OPEN-TYPE FLAME ARC LAMP.

to the lever L is a rod R, which is fixed at its other end to the movable brass block A. This block rocks with the movement of the lever L, and thus varies the length of the arc. The other block A' is fixed. The two carbons of like sign converge and touch just below the economiser. As they burn away they are fed downwards by the action of the weight H, which, as can be seen from the figure, slides on a guiding rod. An important feature of the lamp is the magnetic control of the position of the arc. This is effected by means of a few series turns on one of the arms of the iron frame, as shown in the drawing above. One end of this series coil is soldered to the brass frame after passing through a clip, and the other end, shown loose, goes to the series solenoid S. The magnetic path is through the frame and across the air-gap between the projecting iron pieces M, M'. There is considerable leakage from this main path, and the fact that the flux emerging from M' is very slightly greater than that entering M ensures a vertically downward projection of the arc.

International Congress on Electrical Units and Standards.—It is announced that the Lord Mayor will give a luncheon at the Mansion House, on October 16th, to the delegates to the International Congress on Electrical Units and Standards. At the conference, which assembles on the 12th, Great Britain will be represented by Lord Rayleigh, Prof. J. J. Thomson, F.R.S., Dr. R. T. Glazebrook, F.R.S., Sir John Gavey, C.B., Mr. A. P. Trotter, Mr. G. R. Askwith, K.C., Major P. A. McMahon, and Major W. A. J. O'Meara, R.E., C.M.G., with Mr. W. Duddell, F.R.S., and Mr. M. J. Collins, of the Board of Trade, as secretaries. Mr. F. E. Smith and Mr. C. W. S. Crawley are assistant secretaries. We gave a full outline of the programme in our issue for June 11th.

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POWER STATION FOR THE GENERAL POST OFFICE IN LONDON

THE total amount of power required for the working of the London Post Office telegraphs and telephones reaches a very considerable figure and the matter of its economic supply has been the subject of a scheme which, although not yet complete, had its inception some time ago. As far back as 1903, after the consideration of offers from two supply companies, the Postmaster-General decided upon the erection of an entirely new power station for the purpose and the laying of the necessary network of mains to the General Post Office and certain of the Post Office telephone exchanges in the Metropolitan area. A convenient site as regards coal and water supply was accordingly acquired on the south bank of the Thames, a few hundred yards west of Blackfriars Bridge, and building operations were subsequently commenced. Although the building itself, with its tall chimney, has been complete for a good many months, the work of equipping the station has been in abeyance. We now learn, however, that this is being proceeded with and the Postmaster-General's decision has been given in regard to the equipment.

Tenders have accordingly been accepted from Messrs. Willans & Robinson, Ltd., of Rugby, who have been appointed main contractors for the plant at a contract price of £24,191. The station will be equipped with steam turbines and surface condensing plant of Messrs. Willans & Robinson's own manufacture and the alternators, water strainer, &c., are to be supplied by Messrs. Dick Kerr & Co., Ltd.

ELECTRIC RAILWAY DISASTER IN BERLIN

A SERIOUS accident occurred on Saturday on the Berlin Elevated Railway (Hochbahn), in which about 20 persons were killed and 18 seriously injured. It appears that one three-car train ran into another almost broadside on at a junction near the Potsdamer Bahnhof, causing one car to be knocked off the track and fall into the courtyard of a cold storage warehouse, some 20 ft. or 30 ft. beneath, and another to remain suspended from the viaduct. The car which fell alighted roof downwards and collapsed entirely. The third car remained on the metals. The train from the Leipziger Platz which ran into the other was comparatively undamaged, although the second of its three cars was derailed.

An official statement by the Administration of the Prussian State Railways states that the accident was due to the driver of the train from the Leipziger Platz disregarding both the home and distance signals, which stood against him. The track and signalling systems are reported to have been in perfect order. The man is uninjured, and, together with the guard of the train, has been arrested. Assistance in clearing the wreck and rescuing the injured was rendered by the fire brigade and the employees of the cold storage establishment into which the car fell.

The accident took place at one corner of a triangle, where the trains going into the loop to the Leipziger Platz branch off from the through line. These are very busy junctions, as about every third train passes along the further side of the triangle without going to the Leipziger Platz, but it would appear that no automatic appliance is used to stop the trains or even warn the driver in case of the signals being overrun. The signals are so interlocked that when the through road is signalled clear, the signals on the branch line are automatically placed at danger.

ELECTROMETALLURGY AND ELECTROCHEMISTRY

IN the August number of the *Journal of the Chemical Society* Mr. H. C. Greenwood contributes an article upon the "Reduction of Refractory Oxides by Carbon." The object of the research was to determine the temperatures at which carbon commences to reduce some of the more difficultly reducible metallic oxides. The knowledge of metallurgical reactions up to temperatures produced with ordinary fuel-heated furnaces is fairly complete. Also, thanks to the work of Moissan, we have also a very complete knowledge of reductions at extremely high temperatures, such as can be carried out in the electric arc, but not much work has been done in connection with reductions at intermediate stages. Mr. Greenwood has therefore studied the subject from this point of view. A graphite tube was employed which had perforations along the upper side to allow the escape of gases. Water-cooled brass tubes were soldered on to the ends of the graphite tube, which were previously copper plated. The brass tubes were fitted into the side arms of a glass globe, and an air-tight joint was made between the glass and the brass by means of special wax. The heating of the carbon tube was effected by the passage of a direct current up to 300 amperes, which was led on to the water-cooled tubes. Accurate control of the current was obtained by means of a rheostat. The neck of the globe was closed by a rubber stopper with a mercury seal, and connection was made by means of a side tube with a good vacuum pump, the pressure being reduced to half a millimetre. Special precautions were taken to insure absolute dryness of the gases. The temperature of the tube during the actual experiment was raised fairly quickly to a low red heat, and then increased by small steps. The temperature measurements were made by means of a Wanner optical pyrometer, which was used with an ammeter and rheostat in circuit. The temperature at which reduction commences was gauged by the commencement of the evolution of carbon monoxide from a mixture of oxide and carbon. Some difficulty was found in obtaining the exact temperature of reduction owing to occluded gas in the carbon tubes, which was given off as the temperature was raised. It was found, however, that the amount of gas given off from this cause was practically constant, for each temperature it was therefore possible to correct for it. Chromium sesquioxide commences to be reduced at about 1,200°. Manganous oxide showed irregularities. Thus three different samples give reductions at 1,200°, 1,100°, and 1,125°. This was probably due to the different physical state of the oxide employed. Uranium dioxide commences to be reduced at 1,500°; silicon dioxide appeared to form, at about 1,460°, a mixture of silicon carbide and silicon oxycarbide (silicon). Zirconium-oxide appears to form a carbide at 1,400°. Thorium oxide reduces at about 1,400° to a carbide. Tungsten oxide appears to be completely reduced just over 1,100°. Experiments were also carried out with chromium-oxide employing different varieties of carbon. Sugar charcoal causes a reduction at a rather higher temperature than the retort carbon, the lowest reducing carbon being acetylene black.

In the *Centralblatt für Accumulatoren und Galvanotechnik* of September 5th, there is a short note upon the effect of temperature upon the capacity of lead accumulators. Heim found that the capacity of an accumulator was decreased 2·6 to 3 per cent. by the rise of 1° in temperature. Gladstone and Hibbert found that from 15° to 37° the capacity decreased by 50 per cent. Schoop, on the other hand, could not find a greater difference per degree than about 1 per cent. These differences of various observers are difficult to account for, although, of course, the form of accumulator, its age, the thickness of the plates, the acid concentration, and so on will all help to cause differences. Otto Hilderbrand has now carried out experiments upon Planté and pasted plates. He finds that it is not possible to give a general rule which will explain the loss of capacity by rise in temperature. He finds, however, that the type of accumulator employed, the age, and the way in which it has been handled, also the height to which the temperature has been raised, all have their effects, and the higher the temperature is raised the greater the effect. Cells formed by the Planté method would appear to be less acted upon than those made by pasting. Continual increase in temperature lowers the capacity and life of accumulators. Slight increase over 15° did not lower the capacity more than 1 per cent. per degree.

Electric Driving in a Small Works.—We have received from the London Electric Firm of Croydon, whose specialities in arc lamp lowering gear we have several times had occasion to refer to, some particulars of the electric driving of their workshops. They send us a view of one of the shops, driven by a single 5-h.p. motor, installed on a bracket on the wall, and taking up no floor space. This motor drives about 15 machine tools, including universal milling machines, universal grinding machines, lathes, mostly 7-in. and 8-in. centres, and drilling machines, hack saws, &c. The cost for current for driving this particular motor has amounted to about £40 for the past 12 months, working on every week day during the whole year with current at 1½d. per unit, and 5d. during the peak hours.

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MUNICIPAL TRAMWAYS ASSOCIATION

SUGGESTED ECONOMIES IN TRAMWAY WORKING.

MESSRS. R. G. and J. G. Cunliffe (Assistant Electrical Engineers, Manchester Corporation Tramways), in a Paper read before the Municipal Tramways Association last Thursday, dealt with the economies which they thought could be effected generally in the working of tramway systems. Dealing first with the line equipment, they said that for mechanical requirements a small trolley wire only, say, 2/0 S.W.G., is required. This, they contended, is quite strong enough, and has better wearing properties than a larger wire, if of hard drawn copper, as the hardness lies in the skin, which is of approximately the same thickness for all sizes of wire, so that a small wire has a greater percentage of skin than has a large one. In Manchester, however, a 4/0 S.W.G. conductor was employed until recently, and now a 5/0 wire is generally installed. This larger diameter, they explained, is advisable because of the energy losses in smaller wires. While they are deferring a full treatment of their method of design for a Paper which they are submitting to the Institution of Electrical Engineers, they stated that they find it economical to allow three or five years, according to traffic density, for the life of the trolley wire, as against the usual allowance of seven years. They appended Fig. 1 to their Paper to demonstrate their point, but they did not offer sufficient data to show how the various curves are obtained. The diagram refers to a 7/0 S.W.G. conductor, the heaviest employed anywhere for tramway work to-day, and yet it will be observed that the heaviest individual loss is the electrical loss, and that it gives the most economical life as only four years. Their calculations, they added, have been carried out for city, urban and suburban lines, with the result that the wire should vary in size from 6/0 to 5/0 to 4/0 respectively, but, as in the city the feeding points are, as a rule, very close together, the difference between the 5/0 and 6/0 wires is only apparent on about two short sections; and so for the suburban lines 4/0 wires is employed, and everywhere else a 5/0 wire is installed. They have found that the same line fittings can be employed for both 4/0 and 5/0 S.W.G. wire, but not for 6/0 wire. The saving varies according to the length of the section and the traffic density, from £1 to £10 per mile of wire per annum, and as Manchester has over 200 miles of overhead line the matter becomes of importance. In addition, maintenance and emergency costs are diminished because the wire is never allowed to wear thin. An interesting side issue is raised in the conclusion that the anchoring of worn lines is a waste of money, as when a line is ready for anchoring it is ready for renewing.

In Manchester triple insulation is employed, the component parts being :—Primary : Insulator bolts in hangers; secondary : globe strain insulators; and tertiary : Brooklyn strains. The primary insulation, they say, is the weakest and least necessary. Experiments carried out in the test room at Manchester have

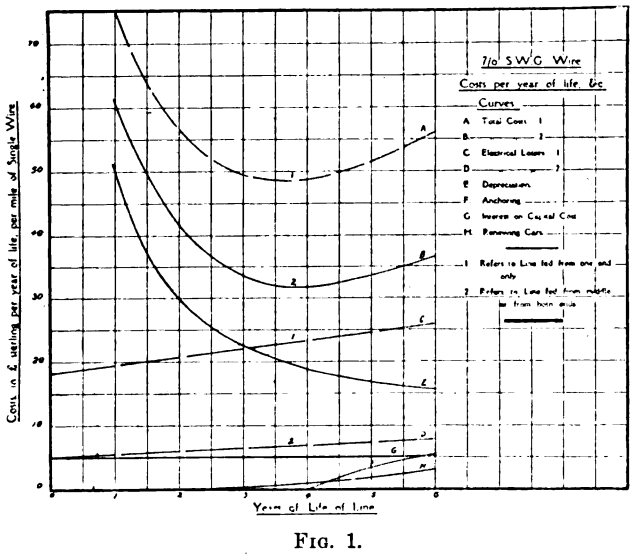

FIG. 1.

shown that, under the influence of capillary attraction and of electrical endosmose, more especially of the latter, water saturated with atmospheric impurities, which in Manchester is a powerful electrolyte, is drawn between the metal bolt and the insulating material, and is forced across from the positive metal of the bolt to the negative metal of the hanger. Electrolysis takes place; the metal of the bolt is corroded; and a rust film is formed beneath the insulation, which is split asunder.

Fig. 2 shows the results of insulation tests carried out from day to day up to the time of writing the Paper on two exactly similar

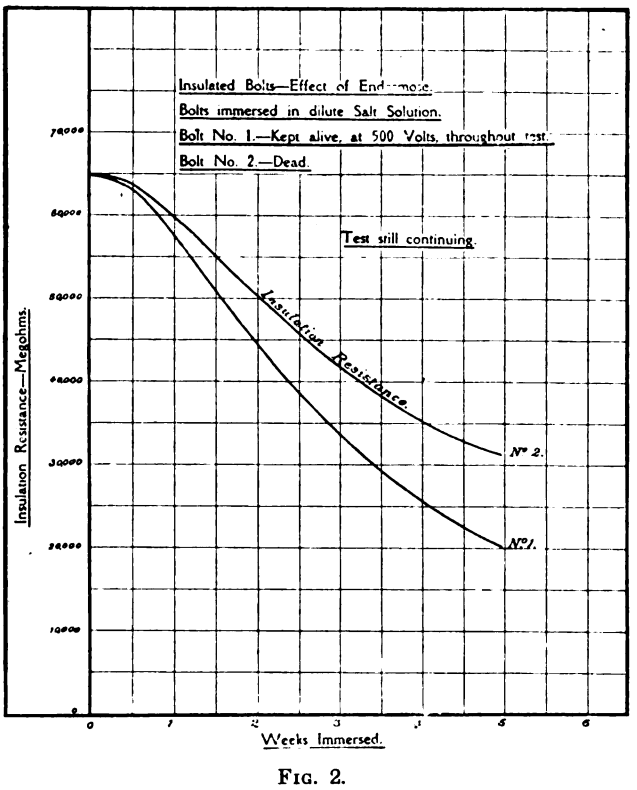

FIG. 2.

bolts fixed in a vertical position in a tank containing a dilute solution of salt, the level of the liquid being kept just above the bottom of the insulation, the part in practice exposed to the weather. Wire gauze was wrapped tightly round the heads of the bolts, and between the water and the gauze of one bolt a potential of 500 volts was maintained night and day throughout the duration of the test, the water being positive with respect to the gauze.

The authors next suggested that considerable benefit might be derived even on level, equally-loaded lines, from having the trolley wires working in parallel, although it is of very little use to have them paralleled at two or three points only by means of "jumpers." They should, the authors said, be paralleled at every span by removing the insulator bolts and building the line as shown in the final section of the Paper, Fig. 7, either with or without the central conductor. It is true that this would cause shut-down of both lines in case of failure of either, but they contended that this is an advantage, as it prevents bunching of the cars at the terminus, and, with an emergency system like that at Manchester, no line fault can keep the service shut down for more than a very few minutes.

Dealing next with the return circuit, they said that owing to the great current-carrying capacity of the rails, there is no financial need to consider electrical losses; in fact, the rails are made far heavier for mechanical reasons than is necessary for electrical purposes. They announced that they would be reading a Paper before the Institution of Electrical Engineers on November 7th, in which they will show that there is no danger of electrolysis under normal conditions, but in case of damp ground between pipes and rails in two or more places some distance apart, damage may be caused.

It has been the practice in Manchester to use a combination of 34″ and 8½″ bonds, mostly 4/0 S.W.G.; two of the former and one of the latter have been used at every joint. The authors express the opinion, however, that in ordinary circumstances there is no excuse whatever for the existence of any bond over 8½″ in length. They support this view by the follow-

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ing figures :—Resistance of 30″ of 100 lb. rail, fish-plated and bonded with two 34″ Chicago and one 8½″ Crown Bonds, all of 4/0 S.W.G. = 0·000021 ohms at 60° F. Resistance of 30″ of 100 lb. rail, fish-plated and bonded with two 8½″ Crown Bonds = 0·00002108 ohms. The difference is hardly appreciable, yet the saving per joint amounts to the value of one 34″ bond, and the difference in cost between a 34″ and a 8½″ bond. Either joint, they add, is as good electrically as the solid rail.

In further reference to the return circuit, the authors said, as a general principle it is uneconomical to run copper conductors in parallel with heavy steel rails, as the rails themselves have a better conductivity than any copper of an economical section. Thus, in the case of junctions, cross-over roads, &c., it is far better to bond the component parts efficiently together by means of short bonds than to run long copper strips haphazard round the special work. Every inch of copper other than the head in a bond is worse than waste, as it causes loss. A factor which is far more important than rail drop is length of section, as the leakage currents are proportional roughly to the cube of this length. Thus return feeders should be installed at short

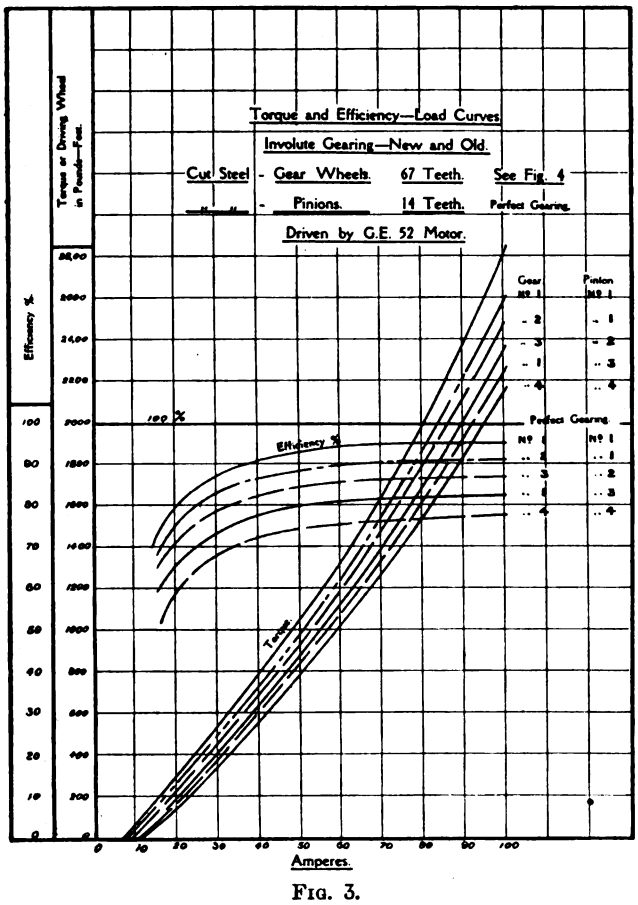

Fig. 3.

intervals, and it is better for each positive feeder to have its negative, as in Manchester. Negative feeders are useless unless they draw the current from the rails in both directions, so that the directions of flow of current in the rail on the two sides of the negative feed point are mutually opposite. If a feeder alone will not cause this reversal, then a negative booster should be employed.

The section of the Paper on car equipment describes as follows some experiments made with a modified controller :—The maximum demand of the car occurs during parallel running, as, the tractive effort remaining about constant, the rate of supply of energy to the car must increase with the speed. In practice this is shown by the doubling of the current in parallel, since the same current per motor is required in order to produce the acceleration, &c. It is important that this maximum demand should be kept low, and this can only be done by diminishing the tractive effort required, *i.e.*, the acceleration, during parallel working, and since a definite average value of the acceleration is required throughout the starting, the acceleration, hence the tractive effort, hence the current, must be increased in the series control, and that without diminishing in the least the time occupied in passing through the series notches, since this time is just as valuable as the acceleration itself in producing speed.

The only way in which the result can be obtained is by diminishing the resistance on the various series notches, and in Manchester a G.E. 52 equipment has been so treated, reducing the resistance on the second series notch, and cutting it out altogether on the third, so that during the whole time allowed for the third and fourth notches the motors are running on the line. Records were taken of the starting current by means of a

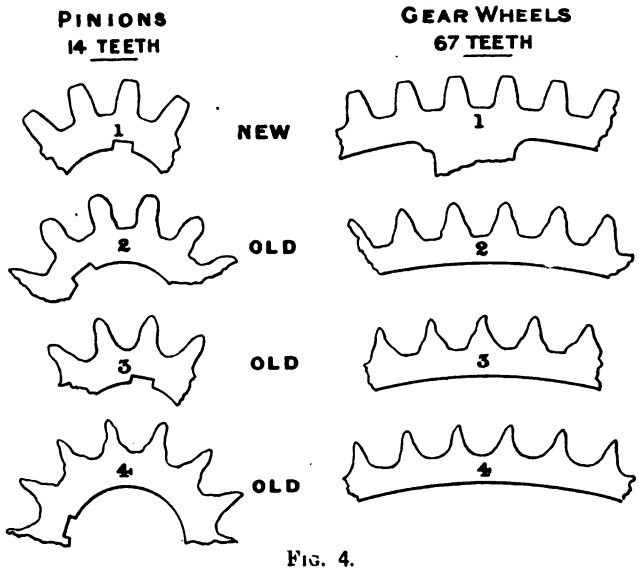

Fig. 4.

specially designed recording ammeter, working at the rate of 12″ per minute, and care was taken never to increase the current beyond the normal full load of the motors. An appreciable increase in series acceleration was obtained, and the maximum demand was reduced by 12 per cent. The increased acceleration was not productive of jerking, or any other uncomfortable sensations to passengers.

Some interesting curves (Fig. 3) were given to show the importance of keeping gearing in good condition; the profiles of the various wheels and pinions are shown in Fig. 4. In addition, the authors say, the driving axles must be kept perfectly straight, as they "found that a bend of from $\frac{1}{16}$″ to $\frac{1}{8}$″ in the centre would cause a loss of efficiency of from 8 to 16 per cent." The tests were carried out on an inverted single truck, with

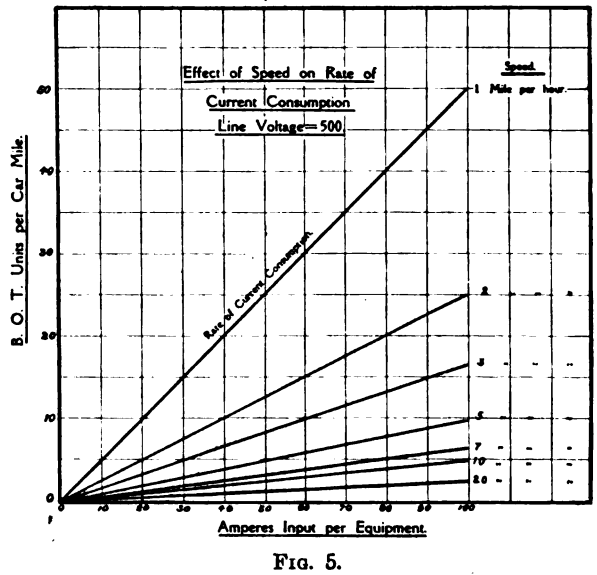

Fig. 5.

the axle boxes and suspension bars fixed on shortened springs in their correct positions, but on the underside of the frame. A specially designed water-cooled band brake was employed, in conjunction with a compound steelyard balance mounted on a tripod, to measure the mechanical output, torque, &c.

It is of advantage, the authors said, to obtain as high an average speed as possible for the system, as thereby not only is the number of cars necessary for a given service diminished, but, although the working current is slightly increased, yet the units per car mile are lower, as the increase in current is not in proportion to the increase in speed, as is shown by Fig. 5.

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The relation is given by the following equation :—

$$U = \frac{C}{2S}$$

Where U = B.O.T. units per car mile.
C = Current taken by car in amperes (average).
S = Speed of car in miles per hour, the line pressure being 500 volts.

The running costs are shown in Fig. 6, both for series and parallel working.

The following figures were given relating to the Manchester tramways :—During the past working year the account for energy supplied to the system amounted roughly to £143,000,

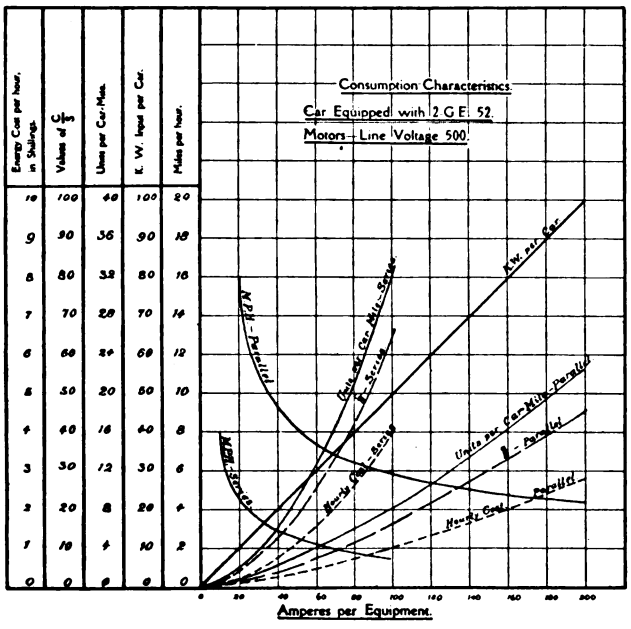

Fig. 6.

so that every one per cent. saved represents over £1,400. By adopting the larger trolley wire Manchester saved several thousands of pounds per annum, in addition to paying the difference in capital costs, &c., and such saving will continue indefinitely. Another large saving is effected by properly maintaining the gearing and axles of the cars. If the gearing is kept in the best possible condition the loss will be £7,000 per annum, but if neglected it can rise to £35,000 per annum. Bent axles may safely be said to account for another £5,000 per annum, and with the slightest neglect this can become £10,000. The efficient maintenance of these parts of the equipment is a costly process, but the care and expenditure are repaid by a saving of many thousands per annum, and the economies effected must, on the whole, make themselves felt even in Manchester's annual expenditure of £500,000 in working costs.

The Paper concluded with the following :—"Suggestions for Profitable Research."—On consideration, it seems strange that a comparatively soft and expensive metal like copper should be employed for trolley wire simply because it possesses good current-carrying properties, and this has led to the adoption of silicium bronze wire, which possesses far better wearing properties than a large copper wire, as it is harder, and, in addition, its hardness extends throughout, as the metal is homogeneous, whereas hard-drawn copper wire consists of soft copper surrounded by a hard envelope. As the conductivity of silicium bronze is only 60 per cent. of that of copper, however, it becomes in the end an extremely costly metal to employ, and the 2/0 S.W.G. silicium bronze trolley wire at present being installed by certain English tramway authorities must be very uneconomical indeed.

In order to combine the mechanical properties of silicium bronze with the electrical properties of copper, the authors suggest the equipment shown in Fig. 7, consisting of two trolley wires of small gauge silicium bronze to take the wear and a central conductor of copper to carry the current. The three would be connected together at every span, the centres of the spans being made of silicium bronze stranded wire in order to carry the current. The present primary insulation would be abolished, together with the costly hangers, a simple gun-metal attachment being required. The tensile strength of silicium bronze is 45 per cent. greater than that of copper, and its resistance is also about 45 per cent. greater for wires of the necessary size, the torsional strength being 20 per cent. greater. Trolley wire fails by cracking about ½" inside the ear, owing to continual vibration equivalent to a bending at the ears, and this would be reduced to a minimum by the adoption of the small gauge silicium bronze, whilst the copper conductor could be stranded, thereby gaining both in flexibility and strength. The first cost would be heavy, but the life of the line would be much greater, and when the time for renewal arrived, only the small silicium bronze wires would require replacing.

Experiments show that the fish-plates provide an important part of the conductivity of the rail points, being on the average better than a 4/0 S.W.G. 34" Chicago bond. As the mass of metal is nearly equivalent to 1 sq. in. of copper, the authors suggest fish-plates with a thin layer of soft copper electrolytically deposited on their edges, tightly screwed to rails having their flanges cleaned and painted with copper sulphate solution. A copper to copper contact would be obtained, and it might be found possible on experiment to dispense with bonding altogether, as with double track efficiently cross-bonded, even the entire failure of a joint would not be noticed.

As both maximum demand and current consumption are proportional to weight of car, this should be kept as low as possible, and any additional expenditure in providing cars of pressed steel with girder sides entirely self-supporting would be repaid by the saving effected.

The most important factor in the current consumption is the driving, and by taking from the driver the control of rate of acceleration whilst leaving him full control of the starting and stopping the car, much could be saved without risk of damage. Thus it might pay to develop a system of control employing one or other of the several alloys at present on the market, possessing the property of automatically lowering their electrical resistance with increasing temperature. Thus, as all the properties are known, it would be possible to design an equipment to start the car at any given rate on the driver putting in the main switch. The only difficulty would be that the temperature of the resistances would not fall quickly enough, but this could easily be overcome.

Motors should be designed for the highest possible torque per ampere, and the starting qualities should be watched just as zealously as the load-efficiency at 500 volts. On systems where maximum demand is of unusual importance, special combinations of the 4-motor equipment are worthy of consideration.

By the insertion of thin sheets of hard steel between the poles and the yokes, a sufficiently high permanent magnetic field to permit of reliable rheostatic braking might be obtained without appreciable loss of efficiency, and the bonding together of the two motor frames makes this independent of the track.

The gear ratio should be as high as is obtainable with single reduction gearing, and the Renolds' silent chain might here be worthy of consideration. The pinions would probably be better made like a truncated cone, with the smaller diameter towards the motor, as pinions worn to this shape give a higher efficiency than when parallel, since with parallel pinions the inner ends of the teeth dig into the metal of the gear wheels, owing to whipping of the armature shaft.

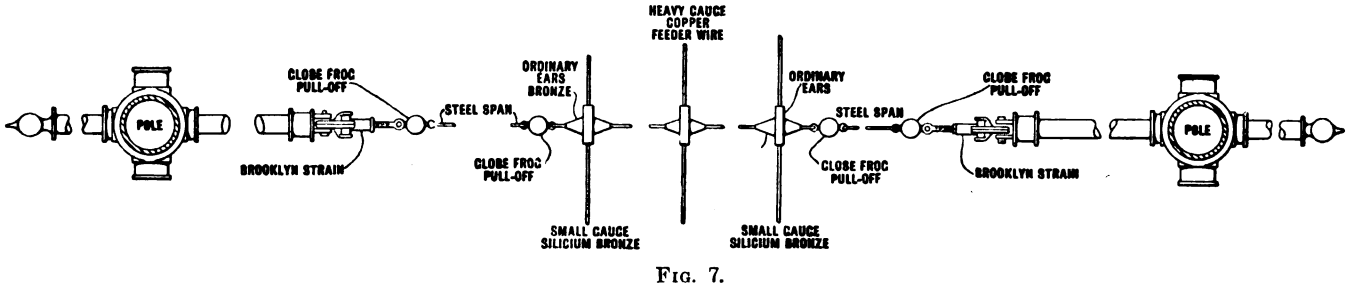

Fig. 7.

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Discussion.

Mr. H. E. Yerbury (Chief Electrical Engineer, Corporation Tramways, Sheffield) said that he preferred varying the section of the feeders, and using trolley wire of uniform size, to varying the thickness of the trolley wire. He inferred from the Paper that at Manchester the section of the feeders had been kept too fine. At Sheffield he had found that galvanised or Sherardised bolts increased the life of fittings. Referring to the authors' remarks to the effect that the rails were made far heavier for mechanical purposes than was necessary for electrical purposes, he called attention to the fact that there was a Board of Trade regulation with regard to the maximum current density in the rails. He was inclined to think that the authors had had no experience with bronze or phono-electric wire, but his experience had lasted several years with bronze wires, and he employed adequate feeders. He found that bronze wire had practically no wear in four years, compared with the 44 per cent. increase in resistance of copper. The only part where bronze wire did wear was at the end of the fittings, where they were attached to the insulators. In Bristol the original bronze wire, put up in 1897, he said is still in use.

Mr. C. J. Spencer (General Manager, Corporation Tramways, Bradford) said that he had experienced considerable trouble with defective field coils, and suggested also that a possible source of loss of energy was deterioration of the insulation between the armature core discs of the motors. He regarded it as essential that the driver must be left control over the rate of acceleration, as it must of necessity depend on the condition of the traffic at the time. But it was advisable to have a check on each man, and therefore at Bradford they used meters on the cars. He did not think that there was much of the whipping of the armature shafts mentioned towards the end of the Paper, and that the chief trouble with armatures was owing to the bearings being allowed to wear away.

Mr. H. Mozley (Corporation Electric Tramways, Burnley) said he had made the experiment of putting in time meters on some cars with 4-motor equipments, and he had found that, since last December, 14 per cent. had been saved in the consumption of energy.

Mr. J. M. McElroy (General Manager, Corporation Tramways, Manchester) said that as they had to pay 1·14d. per unit of current to the Electricity Department, any small economies that could be realised were important. By allowing things to wear, the current consumption would be increased, and the question to be solved was to find out when the increased current consumption was so great as to warrant the cost of renewing the worn plant. The authors' work had thus been of great value to them at Manchester.

Mr. T. R. Smith (Tramways Engineer, Leicester) said that at Leicester they employed 4/0 trolley wire, which had only shown wear at the junctions, &c. They only replaced their wires when it was necessary for safety.

Mr. R. J. Howley (Inspecting Officer, British Electric Traction Co., who was one of the delegates of the Tramways and Light Railways Association to the Conference) did not agree either with the use of an excessively heavy trolley wire, as suggested by the authors, nor the employment of No. 0 wire. He objected to the latter because it was not mechanically good enough. He mentioned incidentally that on the South Staffordshire tramways 1/0 wire had been originally put up, and had lasted some eighteen years. He had a strong suspicion that the wire obtained nowadays was not of the same quality as it used to be. In the current consumption he was convinced that the main factor was the motor. Referring to tests made with wattmeters and time meters, he said that wattmeters were troublesome instruments to have on a car, and on the other hand, time meters, while making the motormen coast more, had frequently the result of making them fail to keep time, as they overdid it. Finally he was of the opinion that the modified design of overhead construction suggested by the authors could not prove more economical than the present methods.

Mr. Spencer rose to explain that he had not made use of either wattmeters or time meters, but of ampere-hour meters.

Mr. W. Wyld (Electrical Engineer and Tramway Manager, Birkenhead) asked what would be the increased weight of the wires on the system suggested by the authors.

Among other questions that were asked were:—How the authors decided when the line was worn out; did they constantly gauge it, or did they wait until there was a fracture? Were the experiments made under running conditions or in the car shed? Also, what was the effect of the size of the trolley wheel on the wear of the wire?

The authors decided to defer their reply to the discussion.

SUPERANNUATION FUNDS.

Among other Papers submitted to the meeting was one by Alderman H. Linsley (Chairman of the Salford Corporation Tramways Committee) on "Treatment of Corporation Employees incapable of Performing Ordinary Duty."

At Salford there is apparently no definite superannuation scheme, but cases of breakdown in health are dealt with by finding the employee lighter work. The Workmen's Compensation Act of course provides sufficiently for cases of accidents. The Old Age Pension system of the Government will not help to solve the difficulty, as motormen, for instance, cannot continue their work until they are 70. In Glasgow they have a Corporation Tramways friendly society, to which each man contributes 1d. weekly, and the committee contribute the same amount as the men. The proceeds from the sale of all unclaimed property found in the cars and the conductors' "overs" are also added to this fund; and nothing is to be drawn from the fund until 1911. No employee is eligible to draw from the fund until he has been in the service and a member of the society for fifteen years, and in any case he has to be physically unfit for any kind of departmental work whatever before he can draw upon the fund. At the end of fifteen years' service an employee has a retiring allowance of 10s. per week, rising to 20s. per week after twenty-five years' service. The Liverpool Corporation Tramways Department have adopted a somewhat similar scheme for providing retiring allowances to their employees. In Belfast a small percentage is deducted from the employee's wage each week, and the Corporation contribute an equal sum. A sick or injured employee is allowed at first a sum equal to half of the average of the weekly wages he receives, and afterwards a payment on a graduated scale. An employee rendered unfit for duty by an accident therefore would receive half wages under the Compensation Act, and the other half from the Corporation Society; and, said Mr. Linsley, he may possibly be obtaining even further relief from other societies of which he may be a member, and thus during incapacity he is for a period receiving more money than when following his employment. The scheme also provides for retiring allowances, both in the case of incapacity through accident or illness, and on a member attaining the age of sixty or sixty-five years, and having been a member of the society for twenty years, he is allowed a retiring allowance equal to one-half of the average of his weekly wage for ten years previous to his retirement.

TICKET CHECK.

A Paper on this subject was read by Mr. L. MacKinnon (Traffic Superintendent, Glasgow Corporation Tramways), who said that the roll ticket had become more or less of an antiquity, and, so far at least as this country is concerned, the bell punch is in general use. He then described in detail the ticket system practised in Glasgow.

THE NEW PRESIDENT AND COUNCIL.

Mr. A. L. C. Fell, Chief Officer of the London County Council Tramways, has been elected President for next year, and Mr. C. J. Spencer, General Manager and Engineer of the Bradford Tramways, Vice-President. The vacancies on the Executive Committee have been filled by the election of Alderman Linsley (Chairman of the Salford Tramways Committee), Mr. Alfred Baker (General Manager of the Birmingham Corporation Tramways), Mr. H. E. Blain (Manager of the West Ham Corporation Tramways), and Mr. Lewis Slattery (General Manager of the Oldham Corporation Tramways). A committee was appointed to deal with the question of rail corrugation, with powers to call in any expert advice that they may deem necessary.

Electric Motors in Mines.—The Presidential address of Mr. G. H. Winstanley, at the first meeting of the session of the Lancashire branch of the National Association of Colliery Managers, is reported in the *Iron and Coal Trades Review* to contain the following remarks:—In many of the larger collieries which have been equipped on modern lines, there appears to be a growing tendency to use steam only for the winding engines, and the power generating plant, and to work all other machinery, both on the surface and underground, by means of electric motors. The only objection which can be urged against such an arrangement is that if the power plant breaks down, or stops for any reason, the whole place is stopped. This objection, however, is more imaginary than real, because in a well-designed plant the power-house will contain several units, that is to say, instead of providing one large engine and generator, equal to the total demand for power, there will be two, three, or more engines and generators, which may either all be worked together, or only one or two worked, according to the demand for power at the moment. This not only obviates the difficulty referred to, but it also tends towards economy, because it is far better to work an engine and generator up to its full load than to work a larger one at half load. In the night-time, therefore, for example, when the demand for power may reasonably be expected to be less than in the day, one, two, or more of the engines may be shut down.

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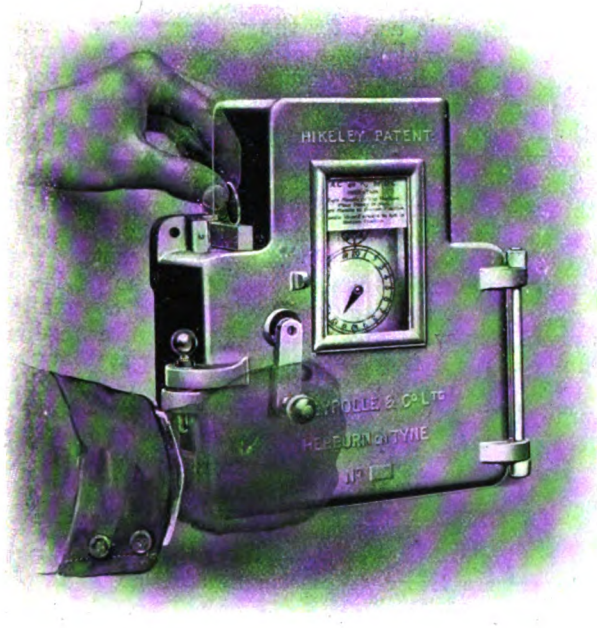
CHARGING FOR ELECTRICITY BY THE HOUR RATE

A METHOD of charging in small installations, where the cost of an ordinary meter is not justified, is coming into use in some places, where the charge is based on the number of hours' use of current, irrespective of the number of lamps that are being fed. This system has met with considerable favour in some parts of Spain, and has lately been developed in England in a tentative manner on the mains of the large supply companies in the Northumberland and Durham areas.

It is therefore of interest to give a few details concerning the Hikeley patent meter, which has been especially designed to meet these requirements for installations up to about eight lamps. Briefly, the meter is supplied for use with alternating or direct currents, and is of the prepayment type. The circuit is closed automatically by putting one or more pennies in the slot, and the switches remain closed for a period depending on the number of coins inserted. The standard design is such that for every penny current can be used for 5½ hours, but the calibration can be altered to suit any other rate.

The general appearance of the meter is shown in the figure. It consists essentially of a clock with an electrically operated detent, beyond which there is no electrical metering gear about it. The clock operates a large toothed disc seen inside the instrument, tending continually to turn in one direction. If this



THE HIKELEY PREPAYMENT TIME METER.

motion goes on uninterruptedly it will, at the end of the travel, operate a trigger which, on being knocked away, allows the switch on the meter to open. The act of putting in a penny and moving a handle in accordance with the directions given, virtually "puts back the hands of the clock," and gives the tenant a further period before the trigger is operated. The motion is effected by first bringing the outside handle, which engages with a drum slotted to receive the penny, to the upward limit of its path. The penny, on being inserted, acts on a connecting piece between this drum and a toothed wheel, controlled by a spring and engaging with the large toothed disc. On bringing down the outside handle the large disc is thus turned through a position equal to one pennyworth, the penny is then dropped into a cash box, and the small toothed wheel is released from the drum. The position of the pointer on the front dial then shows the number of hours' running which the consumer has in hand before further payment becomes necessary. The slot in the drum is made large enough to allow a halfpenny to fall clear, so that if anyone attempts to defraud the electricity supply, the biter becomes bit.

As in slot machines of all descriptions damage is continually done by the insertion of bent pennies, the opening for the admission of coin just allows a straight full-sized penny to pass. The gauge has, however, a slight upward movement, so that, should a bent penny be inserted and stick, it can be lifted slightly and the penny prised from below. The cash box is sealed separately from the cover of the case, so the man who periodically winds up the clock cannot collect the money without breaking the seal. With regard to winding, this in practice is found to be necessary about once a month, as the clock provided runs continuously for a fortnight, and the electrical detent prevents it from working when no current is passing.

The current passes through the winding of the electromagnet, which only allows the clock to run while current passes through it. A current equivalent to one eight-candle power lamp is sufficient for it to operate the detent. The current then passes to one contact of a double switch, with entirely separate arms, through these two switch arms in series to the terminal block of the meter. It is purely in series on one limb of the lighting circuit, no shunt connection being used. The object of the double arm switch is to prevent fraud. One obvious way to close the switch of the meter would be for the action of the handle, either upwards or on its return journey, to bring the brush down into a contact, but this would allow a dishonest person to tie the handle in position without placing a penny in the slot. The way in which this is overcome is to have two separate bridge arms, one closed by the upward sweep of the handle, and the other by its return stroke. Moreover, unless the insertion of a penny has in the meantime caused the disc with the tripping device to be rotated, the trip will immediately operate on the downward stroke of the handle, and no current can be obtained. If there is no money "banked" in the machine in the form of hours to run, the back switch will not operate, but it should be noted that the handle of the meter can, if necessary, be used as a main switch, as the operation of the handle without the use of a penny will not move the pointer either backwards or forwards.

In the illustration it will be noted that the top portion of the window is occupied by a tablet giving instructions as to the working of the meter. The front of the case is hinged and padlocked; if it is swung back there will be seen a set of check dials covered from the consumer's observation by the instruction label, showing the total number of hours that the meter has been working. By comparing the hours run by the money in the cash box the collector can immediately detect theft of money. The electromagnetic detent which holds the balance in such a position that the clock will start again when the detent is withdrawn, can be reached for examination from the back of the meter, which, on being screwed to the meter board, is inaccessible to the consumer. The detent is of peculiar construction, consisting of a thin reed so arranged that, while it yields very easily to the pin on the balance wheel in one direction, it becomes rigid and detains the pin on the return stroke. The detent is withdrawn smoothly on the action of the electromagnet.

It is only necessary to add that the whole design appears to be of very strong and substantial construction, and that the overall dimensions of the device are about 9 ins. by 8½ ins. by 5½ ins. Messrs. A. Reyrolle & Co. have developed Mr. Hikeley's patent, and the first batch of the device made have now been in successful use for about two years.

Imperial College of Science.—Sir William White will distribute the medals, prizes, &c., to the successful students of the Imperial College of Science and Technology in the Lecture Theatre of the Victoria and Albert Museum, South Kensington, on Wednesday, October 7th, at 4 p.m. The Rector (Dr. H. E. Bovey, F.R.S.) will deliver an address.

Railway Electrification.—The Berlin correspondent of the *Financial News* states that it is rumoured that the Allgemeine Elektricitätsgesellschaft, together with the Siemens-Halske Company, has under consideration a project for forming a new company to deal with the electrification of the Prussian railways. In New York, the announcement has been made that the directors of the Illinois Central Railroad Company have decided upon the electrification of their suburban lines at Chicago.

Proposed Tax on Gas and Electricity in Germany.—The exact nature of the proposals for new sources of revenue which are to be put before the German Government has not yet been published, but, according to the *Elektrotechnischer Anzeiger*, very drastic and far-reaching proposals have been made. The above journal publishes an extract from a Berlin paper, in which it is stated that it is proposed to tax not only electric and gas light, but also electrical energy or gas used for power purposes. It is estimated that the total revenue from these sources should be over 60 million marks, which figure, it is stated, could only be reached if the tax were fixed at about 5 per cent. There will, no doubt, be a considerable opposition to such a tax, which would have a very harmful influence on the electrical industry in Germany, and seriously retard progress in the development of the country's water-power resources.

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CATALOGUES AND PAMPHLETS RECEIVED

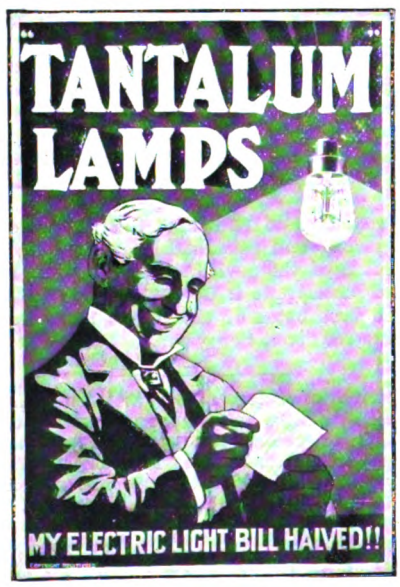
SILENT GEARING.—Pamphlets are to hand from Messrs. W. F. Dixon & Co., describing their improved metal-bushed buffalo raw-hide silent-gears, made at their works at Manchester. These are made in a large number of sizes, up to 4 ft. 6 ins. diameter and 24 ins. face. These pinions are greatly esteemed for the special features of bushing, flanging, and cutting. They are built upon a metal bush made with lugs or keys for driving, and on the outside finished with metal flanges or a plain ring, the function of which is to firmly secure the whole in one piece, and the teeth are machine cut, and the steel or G.M. shrouds are then affixed by steel screws through the entire pinion. No rivets are used. In bevel wheels the teeth are planed accurately to gear with each other.

STORAGE BATTERIES.—A booklet from the Electric Power Storage Co. gives some notes on the history of the development of the storage battery by the firm, followed by a description of the leading features of the E.P.S. forms of stationary cells of the heavy and lighter types, and what are called moting type cells for automobile, launch, and similar work. These latter have an output of 11 watt-hours per lb. Small portable cells and motor car ignition cells are also included, and particulars are given of the latest forms of E.C.C. primary dry cells, which are also manufactured by the company.

ARC LAMPS.—Messrs. Johnson & Phillips have issued a leaflet illustrating their "Magnet-Juno" inclined carbon flame lamp and vertical carbon flame lamps, both of which are of very simple design; a still newer pattern is a single enclosed clutch type lamp of compact form. The same list also includes prices of the firm's well-known ordinary open type arc lamps. They ask us to state that the list will be sent to anyone upon request.

TANTALUM LAMPS

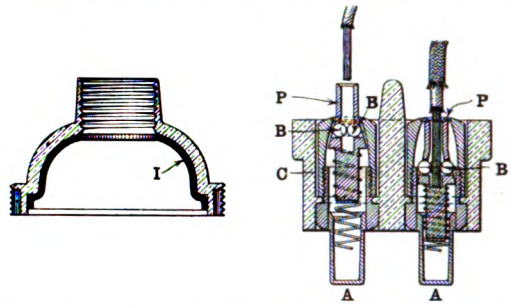
WE understand that Messrs. Siemens Bros. Dynamo Works, Ltd., are making a great feature of advertising their tantalum lamps in a very effective manner, and have placed a large contract for bill-posting on public hoardings in the provinces, and for the display of similar smaller advertisements in the Underground Railway and Tube carriages in London. A large poster, of which the accompanying illustration is a repro-



duction, has been prepared. The expression of satisfaction on the face of the consumer who finds that his electricity bill has been halved is delightful, and the displaying of this should be of considerable value in the campaign of electricity against its natural enemy, gas. A reproduction of this poster in neat show-card form will be supplied on application to Messrs. Siemens Bros. Dynamo Works, Ltd., at 6 Bath Street, City Road, E.C.

A NEW LAMPHOLDER

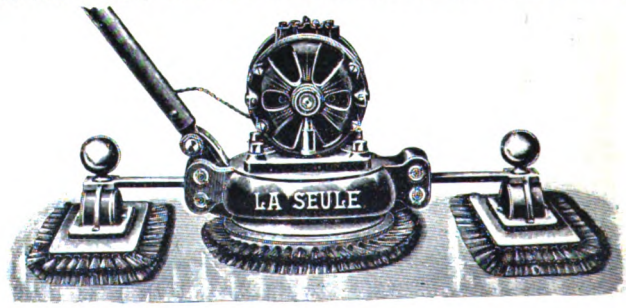
AN exceedingly ingenious new lamp holder is being put on the market by Messrs. Drake & Gorham, Ltd.—one which will save an enormous amount of time and trouble in fitting and is likely to have a great vogue. All men who have anything to do with house-wiring know how much time is wasted in the operation of connecting up the ends of a pendant "flex" into the lamp-holder terminals. The new holder is designed to simplify this by the substitution for the screw terminals of a simple clutch arrangement. The wire is just pushed into the terminal and is held tight. The illustration below shows a section of the porcelain interior C of the holder and also the dome; the outer case of the holder is of the ordinary standard shape and design. In the figure the left-hand terminal is shown as it is before the wire is inserted, and the



right-hand terminal during the act of inserting the wire. The terminal is in the form of a conical plunger, P, with three small recesses in which brass balls, B B, are placed in such a way that they project slightly and touch the bush which holds the plunger in place. The wire is pushed in, forcing down the plunger against the action of a helical spring (which is the same spring as is used for the ordinary pins, A A, for the lamp terminals) and at the same time pushing out the three balls and finding its way to the bottom of the hole below them. This is the position shown at the right-hand side of the illustration. On releasing the wire the spring presses the balls against the side of the bush and makes them grip the wire tightly within the plunger, and pulling the wire merely tightens the grip. The dome of the holder has an internal insulating covering, I, to prevent the terminals from making contact with it. The device is a very clever one and is sure to be popular, especially as its price is very little in excess of that of an ordinary lamp-holder. A frivolous member of our staff suggests that the name given to it, "the Automat," might be improved upon; he proposes "the drum and fife band"—because there is no fiddling about it.

AN ELECTRICAL FLOOR POLISHER

AN ingeniously constructed electrically-driven machine for polishing parquet floors has been devised by a Swiss engineer, M. J. Bruyère. The apparatus, by which a great deal of the arduous labour of polishing a floor can be saved, is shown in the accompanying illustration. It produces a combined rotary and reciprocating motion of the brushes, and is driven by a 1/6 h.p. motor, which takes only 1¼ amp. on a 110-volt circuit, and can be connected to an ordinary lamp-



Electric Floor Polisher.

holder. The reciprocating movement of the outer brushes tends to minimise the reaction of the rotating brush, and therefore lessens the pressure on the handle required to keep the whole machine from rotating. It is found that if care be taken to hold the apparatus so that the reciprocating brushes work in the direction of the grain of the wood as much as possible, a much better polish can be obtained with this apparatus than with either rotary or reciprocating brushes alone. It appears that the revolving brush cleans the floor, while the high degree of polish is due to the action of the reciprocating brushes. The motors are of the commutator type, and can be used for either continuous or alternating current. Inquiries relating to the apparatus should be made to M. Rickert, engineer at Zurich.

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THE FIRE AT THE PARIS TELEPHONE EXCHANGE

THERE has been much talk and there have been many articles in the newspapers with regard to the fire in the chief Paris telephone exchange in the Rue Gutenberg, briefly reported in our last issue, but very few actual facts as to the arrangement of the exchange have hitherto been made known. A few particulars will doubtless therefore be of interest to our readers.

The total number of underground lines coming into the exchange and coming on to the main frame in the basement were 40,000. On the main distribution frame the connections were made by ordinary paraffined cotton wires, and the rising wires to the switchboard were also of paraffined cotton, for the exchange was built long before the present practice of using fire-proof wire came into vogue. There were four separate switchrooms, and all except one were on the magneto system, and all wired with paraffined cotton cable. The ground floor was taken up with offices; on the first floor was the trunk switchroom; on the second and third floors were the old magneto switchboards; and on the fourth floor of the building the new central battery exchange, about which so much has been heard. This latter was in accordance with modern practice, and fire-proof cables, we believe, were employed. In fact, a photograph, which shows the top floor of the exchange after the fire, has the appearance as if the cables on this part were not burnt at all. Naturally, however, the switchroom on the top floor was destroyed, because there must have been a blazing furnace on the floors below with all the paraffined cotton cables burning. The statement made at the time of the disaster that the fire broke out in the basement is correct, and it is practically certain that it commenced at the main distributing frame.

There appears also to be some misconception as to the task of rebuilding the exchange. Contrary to what has been commonly stated, we do not believe that the chief difficulty will be in finding material to replace the burnt switchboards. Although switchboards for 40,000 subscribers seems a large order, yet it must be remembered that the manufacture of central battery boards for Paris to replace the old plant had already been started; and since the telephone departments of other Governments have kindly promised their assistance to the French Government, there will probably be very little difficulty in finding the necessary new material in a comparatively short time, at all events for a temporary equipment. Two years, which has freely been given as the time necessary to restore telephonic communication properly in Paris, is probably much longer than should be necessary. It is reasonable to expect that the chief difficulty will be experienced with regard to the buildings, for it naturally means a very large building to furnish space for a group of exchanges of this character. In addition to this, those who know the methods of administrative organisation in Paris will be aware that the personal factor will be almost equally important. With a good man in charge, strict discipline, and effective organisation, however, the replacement of the exchange could very well be one of those fine pieces of rapid efficient engineering work with which telephone engineers are not unfamiliar, at any rate in this country. We trust that the reports of dissensions among the officials are not true, or have been much exaggerated, and that the work of re-erection of the exchange is already being initiated on a proper basis.

LOCAL NOTES

ABERDEEN: *Tramway Receipts.*—For the week ended September 23rd, the tramways receipts show a decrease of £206 compared with the corresponding period of last year. From June 1st this year the receipts have decreased by £479 compared with last year.

ARGENTINE: *Cordova Tramways.*—The municipality has granted a further extension of time to the electric tramway company to commence construction, on condition that the guarantee deposited is increased by $75,000, which will remain the property of the municipality if the works are not commenced in the proper time.

AUSTRALIA (NEW SOUTH WALES): *Tramways and Railways.*—The Colonial Treasurer, in his Budget statement, states that the capital cost of the railways up to June 30th last was £45,090,000, on which the net returns gave interest at the rate of £4 18s. 10d. per cent. The capital cost of the tramways was £3,681,000, and the net returns gave interest at the rate of £6 2s. per cent. The railway surplus, after paying working expenses and interest, was £581,000, and the tramways surplus £90,000. The railway mileage worked was 3,472 and the tramway mileage 132. The gross returns of both railways and tramways were within a fraction of £6,000,000. Railway construction was proceeding in order to open up more rich farming districts.

BARNSTABLE: *Electricity Charges.*—A resolution is to be moved at the next meeting of the Council that the charge for electricity for public lighting shall not exceed the rate charged to other large consumers for lighting purposes, and that the Electricity Committee be requested to draw up a scale of charges upon this basis.

BATH: *Purchase of Electricity Works.*—It is stated that the negotiations between the Corporation and Mr. Schenk for the purchase of the municipal electricity works are now so far advanced that the Board of Trade only requires to be satisfied on one particular point before their formal assent is granted.

BIRMINGHAM: *Death from Electric Shock.*—An employee of Messrs. W. P. Griffin & Co., electro-platers, Cliveland Street, Birmingham, accidentally stumbled against a dynamo last week, and received a shock from which he died.

BIRMINGHAM: *Telephones at Railway Stations.*—The Midland Railway Co., is erecting public call offices at practically all the local stations on their Birmingham system. It will not be possible, however, to obtain trunk line communication at these suburban call offices.

BOURNEMOUTH: *Tramway Receipts.*—Recently published returns with regard to the tramway undertaking show a considerable decrease in receipts over the corresponding period of last year.

BRIGHTON: *Electric 'Buses.*—The London Electrobus Co. has applied to the Watch Committee for a licence to run a service of electric omnibuses on routes in the town not served by the Corporation tramways. The company propose to start with six 'buses, and to run at the existing fares over the routes now served by the petrol 'buses, but the Committee has deferred consideration of the application for three months.

CARDIFF: *Condition of Tramway Track.*—At the last meeting of the City Council, Mr. Caskell moved that an expert be appointed to make an investigation into the condition of the tramway track, and to report to the Council, recommending the best way of keeping the track in a satisfactory and safe condition. There was considerable opposition to this, as it was contended that the calling in of an expert entailed a very large expenditure which the city could ill afford. It was ultimately decided that a joint report from Mr. Harpur, City Engineer, and Mr. Arthur Ellis, the Tramways Manager, should be prepared.

CHINA: *Electrical Imports into Hankow.*—Recent statistics show that during the year 1907, the importation of electrical fittings into Hankow showed a slight decrease, but the American manufacturers gained a better foothold on certain articles of this trade. An American consular report states that small 12 and 16 inch desk fans, wall sockets, and plugs, switches and minor fittings of American make, are now commonly seen throughout the foreign concessions in Hankow. In main fittings, however, the American manufacturers cannot successfully compete with the German product.

DUNDEE: *Stair Lighting.*—The Electricity Committee recommend the adoption of a new scheme for stair lighting, which has been proposed by Mr. H. Richardson, the City Electrical Engineer. Under this scheme, the Corporation will undertake the lighting of all such property, and the payment of the cost is to be left for arrangement between the landlord and tenants. The lights will be switched on and off at specified hours.

Tramwaymen's Grievances.—The Corporation tramway employees have made application for an increase of 1s. per

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week all round. The claim is based upon the fact that recently increases were granted to other employees of the Corporation, and it is claimed that the extra shilling asked by the tramwaymen is necessary to bring all the Corporation employees into line.

Electric Lighting Charges.—On Monday the Electricity Committee considered a report from the City Electrical Engineer (Mr. H. Richardson) on stair and close lighting, in which he proposed that the department should offer to light a property for a certain sum—in the case of a close and a stair requiring four good lights, for 24s. per annum, payable by the landlord, who would probably come to some arrangement with his tenants. The advantages would be that the department would be responsible for the putting on and off the lights exactly at an hour fixed by the Council, varied to suit the time of the year, and that it would not be possible for an evil-doer to put the lights out. It would put an end to the problem of stair lighting, and equally satisfy the Council, the police authorities, owners and tenants, and would generally tend to a most satisfactory state of affairs at a price which, it must be admitted, erred, if anything, on the side of cheapness. The committee approved the scheme, and agreed to remit the matter to the Lighting Committee.

Gas v. Electric Lighting.—A rather novel situation has arisen in connection with the lighting of one of the outlying districts in Dundee, which tends to show the great competition going on at present between the electricity and gas departments. Some time ago Mr. Richardson, the Electrical Engineer, had erected in this thoroughfare four flame arc lamps, the principal cause being to test the lamps. The new light since erected has given universal satisfaction to the shopkeepers and residents in the district, and had come to be looked on with great favour. Evidently under the impression that the arc-lamp lighting was not sufficiently bright, or, might we say, actuated by jealousy, the gas department a week ago suddenly erected large intensified gas lamps, practically alongside the arc lamps. With this new development the situation has become quite complicated, and has caused a lot of attention, while the local Press have also had several paragraphs lately about the subject. A special meeting of the Lighting Committee is to be held to consider the matter.

EAST HAM: *Lamp Hiring.*—The Electric Lighting and Tramways Committee of the Borough Council have adopted the suggestion that the scheme recently approved for the supply of electric lamps, &c., to consumers on the hire system should be extended, whereby intending consumers can be supplied with a smaller lamp, viz., 200-c.p. lamps at 35s. per quarter per lamp or two 100-c.p. lamps at the same charge.

GLASGOW: *Boxes for Disused Tramway Tickets.*—The Corporation have commenced the system of placing boxes on the cars for passengers to place their disused tramway tickets in. It is calculated that about 25 per cent. of the tickets find their way into the boxes.

Tramway Traffic.—The number of passengers carried on the tramway system last week was 4,470,880, compared with 4,614,061 for the corresponding period of last year, the receipts being £17,947 against £18,814. Since the commencement of the financial year on June 1st, the number of passengers carried has been 66,659,813 against 67,893,719, and the receipts £272,859 against £276,246.

HANDSWORTH: *Engineer's Salary.*—With reference to the increase in the salary of the engineer, recorded in our last issue, a meeting of the Handsworth Ratepayers' Association has passed a resolution protesting against this, whilst the undertaking was making a loss.

HANLEY: *I.M.E.A. Meeting.*—The Chairman of the Electricity Committee and the Electrical Engineer have presented a report upon the annual convention of the Incorporated Municipal Electrical Association at Nottingham this year.

HENDON: *Tramways Construction.*—Messrs. Dick, Kerr & Co., the contractors to the Middlesex County Council for the new tramways in this district, have notified the Council of their intention to commence the tramways in Cricklewood Lane and Finchley Road. When this line is completed, it will connect the Great North Road and Edgware Road systems, and it will be possible to travel from High Barnet to Willesden by electric tramway.

HESTON & ISLEWORTH: *Electric Supply Funds.*—At the last meeting of the Council, the Electricity Committee reported that, owing to the deficiency in the electricity revenue fund (amounting at March 31st to £970) and also to the fact that £1,908 is outstanding in respect of the wiring and fitting of consumers' premises, there is a heavy overdraught at the bank on the revenue account. Also, as the profits estimated to be earned during the present year will be comparatively small, the deficiency will not be greatly reduced, and meantime the undertaking is hampered by the want of working capital. Therefore, the Electricity Committee recommend that the Finance Committee should be requested to consider the question of the finances and to endeavour to take some steps to meet the deficiency. The question has been referred to a committee consisting of the whole Council.

HULL: *Post Office Electricity Supply.*—The Electricity Committee has been asked to supply power to the new post office in Lowgate for 131 eight candle-power lamps, 631 sixteen candle-power, and 16 arcs, and for nine motors of an aggregate power of 22½ horse-power.

Electrical Showrooms.—The Engineer has reported that, owing to the electrical exhibition which is being held, he had experienced great difficulty in getting the necessary material from manufacturers for the Corporation showrooms in Waterworks Street. He expected to have sufficient material towards the end of October ready for the lighting season.

Municipal Telephone System.—During the past 12 months there has been an addition of over 300 telephone instruments upon the Corporation telephone system.

IPSWICH: *Wireless Telegraph Installation.*—The Estate Committee has reported that they have agreed to lease to the Admiralty, as a site for a wireless telegraph station, a piece of land containing about four acres, known as the "Lock Meadow," the lease to be for 75 years from the 29th inst., terminable by the tenants at the end of the twenty-fifth or fiftieth year, on giving six months' notice; the rent to be £50 per annum, payable half-yearly. In addition to the rental the Government will also pay a contribution equal to the rates assessed upon the premises, and will take their supply of electric current, which will be a large one, estimated to amount to about £300 per annum, from the Corporation.

KINGSTON-ON-THAMES: *New Telephone Exchange.*—A new telephone exchange has just been completed at Kingston-on-Thames, and the 1,000 subscribers were transferred from the old to the new exchange without a hitch, last week. The new exchange has a capacity for 2,700 subscribers.

LEICESTER: *Electric Lighting Accounts.*—The accounts of the Electric Lighting Department for the past year show that the profit has diminished from £5,946 to £5,295. After deducting capital charges there is a balance of £1,951 to be carried forward. The total capital expenditure to June 30th was £287,461.

LIVERPOOL: *New Telephone Charges.*—The Council of the Liverpool Chamber of Commerce on Tuesday unanimously decided to re-nominate Mr. C. Lancaster to represent the Chamber on the Telephone Committee of the Associated Chambers of Commerce of the United Kingdom. They expressed their full confidence in him, notwithstanding the fact that he is a shareholder in the Telephone Co.

LONDON: *Chelsea Tramways.*—The Works and General Purposes Committee of the Borough Council have been considering the tramway proposals of the County Council in Chelsea, and have recommended their non-acceptance.

Hampstead: Electric Lighting.—A statement submitted to the Borough Council with regard to the electric lighting undertakings shows that the income for the mid-summer quarter was £7,459 3s. 8d., as compared with £7,293 16s. 5d. for the corresponding quarter of 1907.

Southwark: Capital Expenditure.—The Finance Committee of the Borough Council have decided that application be made to the L.C.C. for sanction to the borrowing of a loan of £8,500 to cover the amount standing against the electricity fund capital account.

PONTYPRIDD: *Tramways and Lighting Receipts.*—The receipts from the tramways for July and August amounted to £3,356, compared with £2,092 for the corresponding period of last year. In a report upon the subsidences which have taken place in the track upon the Rhondda Road route, the Electrical Engineer states that the track is getting twisted badly, and will require to be relaid shortly. Owing to the movement of the ground there was a breakdown of the traction feeder on July 31st. The receipts from the Electric Lighting Department for the same period amounted to £1,158, against £931 for the corresponding period of last year.

WALLASEY: *Tramway Extensions.*—The proposal of the Corporation to extend the electric tramways to Wallasey Village is receiving very strong opposition.

NEW PUBLICATIONS

"The Slide Rule." By Charles N. Pickworth. Eleventh edition. (London: Whittaker & Co.) Price 2s.

"Logarithms for Beginners." By Charles N. Pickworth. Second edition. (London: Whittaker & Co.) Price 1s.

"Hydro-Electric Practice." By H. A. E. C. von Schon. (London: J. B. Lippincott & Co.) Price 25s.

"Outlines of Electrical Engineering." By Harold H. Simmons. Part 1 of 14 fortnightly parts. (London: Cassell & Co., Ltd.) 7d.

Proceedings of the Incorporated Municipal Electrical Association. 1908. (London: Wyman & Sons.) 5s.

The Late Lord Blythswood.—The scientific laboratory of the late Lord Blythswood, at Blythswood House, Renfrew, has been converted into a museum.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BANBRIDGE.—Information has been placed before the Council with regard to an electric lighting scheme, and expert advice is to be obtained.

CASTLEBLAYNEY.—A proposition has been put before the Council for an electric lighting scheme for the district. The matter is now under consideration.

CRAYFORD.—A committee has been appointed to consider the advisability of lighting the parish by electricity.

DUNDEE.—The Secretary for Scotland has sanctioned the borrowing of a further sum of £40,000 in connection with a new station and sub-station.

ELLAND.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £3,000 for the electricity undertaking. Owing to the increased demand for electricity it has become necessary to remove the destructor now attached to the electricity works, and install an additional boiler. The inspector, Mr. R. H. Bicknell, stated that, as the destructor had only been installed five years ago, he was afraid the Local Government Board would not allow the cost of the removal, because it might occur again.

FENTONA.—A proposition for an electric lighting installation in this town is being received favourably, and information as to the probable cost is being obtained from electric lighting firms in Dublin.

GRIMSBY.—The Electric Lighting Committee has reported to the Council that a further £2,000 is required in connection with extensions of mains and services.

Miscellaneous

BECKENHAM.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £1,750 for the purpose of converting the present system of incandescent gas street lighting into electric lighting.

CROYDON.—The Board of Trade has sanctioned the borrowing of £900 by the Corporation for doubling a portion of tramway track in Cherry Orchard Road. Plans and estimates are being prepared for laying a duct in which to run a new cable, recently sanctioned in connection with the tramways. The estimated cost is £1,321.

DUBLIN.—A proposal is before the Corporation for fitting Osram lamps in existing gas lamps in the streets.

INDIA.—The Secretary of State for India invites tenders for a tramway line. Condition of contract from Director-General of Stores, India Office, Whitehall, and tenders by October 13th.

LIMERICK.—Tenders are invited for the supply and erection of two additional panels to the existing switchboard. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by October 2nd.

SOOTHILL NETHER.—On the question of changing street lighting from gas to electricity, a proposition has come from the Yorkshire Electric Power Co., and a deputation from the Council, which has visited some other towns, has reported upon the proposal favourably.

WAR OFFICE.—Manufacturers who wish to be invited to tender for Army requirements are requested to communicate with H. de la Bère, Director of Army Contracts, War Office, London, S.W., stating the particular article they manufacture. The list of goods required from time to time includes lamps, scientific instruments, telegraph poles, traction plant, weldless-steel tubes, wires, cables, and electrical stores.

WARRINGTON.—Tenders are invited for flame arc lamps. Particulars from the Borough Electrical Engineer, fee £1 1s., returnable, and tenders to the chairman of the Electricity and Tramways Committee by October 7th.

WIGAN.—The Wigan Coal & Iron Co., Ltd., are contemplating putting down important and extensive electrical plant at certain of their big collieries in the Wigan, St. Helens, and Leigh districts.

WORSLEY.—The Earl of Ellesmere, now one of the largest private coalowners in England, is about to instal electrical plant at several of his pits in Worsley (Manchester) and adjoining districts.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations, and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Additions, 26 Throgmorton Street. Architect, W. C. Jones, 32 Bedford Row, W.C.

S.E.—Seventeen houses, Algernon Road, Lewisham. Builders, S. J. Jerrard & Sons, 40 Loampit Vale, Lewisham, S.E.

Proposed church, High Street, Lewisham. Architects, Kelly & Dickie, 446 Oxford Street, W.C.

Addition to boys' school, Northbrook Schools, Taunton Road, Lee, Lewisham. Architect, E. H. Ryan-Tenison, 12 Little College Street, Westminster, S.W.

New street, Herne Hill Road to Dane Avenue, Lambeth. Surveyors, R. Ellis & Son, 45 Fenchurch Street, E.C.

PROVINCES.

ABERDEEN.—Additions, Aberdeen City Hospital (£12,500). J. Rust, City Architect, Aberdeen.

BLACKPOOL.—Promenade widening and improvements (£40,000), and public baths (£25,000). John Shanks Brodie, Surveyor, Town Council.

BRIDGEND.—Alterations and additions, Angleton Asylum. Surveyor, Glamorgan County Council.

BRISTOL.—Additions, East Street Baptist Chapel. Architect, H. Williams, 51 Corn Street, Bristol.

Workshops at Avonmouth Dock, Bristol, for J. Shearman & Co., Ltd., engineers and general ship repairers.

CARLISLE.—Cumberland Infirmary extensions.

CHRISTCHURCH.—New infirmary for Christchurch Board of Guardians. Clerk, Board of Guardians.

CRESWELL (BARNSLEY).—Elementary school (£8,000). Surveyor, Derbyshire County Council.

CROMER.—Public mortuary and dust destructor. A. F. Scott, surveyor, Town Council.

DUNDEE.—Extension of baths (£10,000). J. Thomson, borough engineer and architect, City Council.

EALING.—New hall and skating rink (approximate cost £2,000). Architect, Alfred Burr, 85 Gower Street, W.C.

New hospital. Architects, Hall-Jones & Cummings, Parliament Mansions, Victoria Street, S.W.

FULBOURN ASYLUM (CAMBS.).—Mr. Graham Harris is advising the Committee of Visitors, in connection with the electric lighting of this asylum. Further tenders are to be invited from the gas and electric lighting companies.

GLASGOW.—Houses and shops, Glasgow City Corporation. A. B. M'Donald, City engineer and surveyor.

Houses and shops, Egleton Street, for Caledonian Railway Co.

GRIMSBY.—Fifteen houses, Cooper Road. Builder, R. G. Kitching, 75 Convamore Road, Grimsby.

Parish room, Farebrother Street, for St. Augustine's Church Council.

HENDON.—Factory, Colendale Avenue. Builder, A. J. Staines & Co., 154 Gt. Tichfield Street, W.

Eight new roads on Beddington estate. Surveyor, W. Hollis, Church End, Finchley.

Four detached houses, Templars Avenue. Builder, R. V. Hart, Burgess Park, N.W.

ILFRACOMBE.—Public Library. O. M. Plouse, Surveyor, Urban District Council.

JARROW.—New stores for Jarrow and Hebburn Co-operative Society.

Twenty-seven houses, Wansbeck Street South. Architect, C. W. Bell, 17 Norfolk Street, Sunderland

MANCHESTER.—Addition to mission hall, Teignmouth Street and Rider Street.

Zion Church and Institute, Stretford Road and Mulberry Street, Hulme.

Alterations to White Lion Inn and house, 73-75 Sondell Street, Stonehewer Street, and Back Livesey Street.

Addition, Catholic Apostolic Church, Stretford Road, Hulme.

MERTON.—Proposed sub-fire station at Raynes Park. Surveyor, Merton Urban District Council.

NELSON.—Extensions to St. John's Church (£1,200). Architect, E. M. Bruce-Vaughan, Cardiff.

NEWPORT (Mon.).—Eight houses, King's Parade. Architects, Habershon, Fawckner & Co., 41 High Street, Newport.

Thirty-nine houses. Architects, W. Graham, Hitchcox & Co., Bank Chambers, Newport.

Ten houses, Blenheim Road. Builder, W. T. Case, Chepstow Road, Newport.

OLDHAM.—Extension of infirmary and nurses' home, Rochdale Road, for Board of Guardians. Clerk, Board of Guardians.

SALFORD.—Alterations, Welsh Calvinistic School, Broad Street, Pendleton.

Alterations, Wesleyan School, Gravel Lane, Salford.

SALISBURY.—New isolation hospital for Salisbury and District Joint Hospital Committee (£14,265). Architect, J. H. Goodman, Town Hall Chambers, Reading.

SOLIHULL.—Proposed new isolation hospital. Surveyor, Solihull District Council.

SOUTHAMPTON.—Workshop, Church Army Home, Commercial Road. Surveyor, J. F. Crook, 39 Cambridge Road, Avenue Road, Southampton.

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Twenty-four houses. Surveyor, S. C. Greenwood, 11 Portland Street, Southampton.

TIPTON (STAFFS.).—Ten houses and outbuildings, Neptune Street. F. Pitt, Dudley.

UXBRIDGE.—Four houses, Otterfield Road, Yiewsley. Surveyor, A. H. Winterburn, Yiewsley, S.O., Middlesex.

WHITEHAVEN.—School (700 places). E. E. Stiven, engineer and surveyor, Town Council.

WILLESDEN.—Alterations to Coronet Laundry, Alric Avenue, by Badenock & Bruce.

Motor garage and stores, Acton Lane. Architect, G. A. Sexton, 42 High Road, Kilburn, N.W.

Formation of new road off Bolton Road. Architects, Trant, Brown & Humphreys, 332a High Road, Kilburn, N.W.

Boiler house and chimney shaft, Leicester Road. Surveyors, M. W. King & Sons, 6 Holborn Viaduct, E.C.

TENDERS RECEIVED AND ACCEPTED

BARKING.—The tender of S. Anderson & Son, Barking, at £7 8s., for installing electric light in Creekmouth School has been accepted by the Education Committee.

BRIGHTON.—The Electricity Committee has approved of the action of Mr. J. Christie, the Borough Electrical Engineer, in accepting an offer by the North Metropolitan Electrical Power Distribution Co. to purchase the disused maximum demand indicators at 11s. each, the Corporation paying carriage and having the instruments recalibrated.

BURNLEY.—The contract for the supply of electrical sundries during the ensuing half year to the Burnley Guardians, has been placed with Mr. J. Rawlinson, of Burnley.

COVENTRY.—On the recommendation of Mr. J. A. Jeckell, the Electrical Engineer, the tender of the Union Cable Co. has been accepted for the supply of cable to the Corporation, and in explanation of his attitude in recommending a foreign tender in preference to one from a British firm, Mr. Jeckell expresses the opinion that prices quoted by British firms were so suspiciously close as to create a suggestion that there is a "ring" amongst British firms to keep prices at a certain level.

CROYDON.—The Lighting and Electricity Committee complained at the last Council meeting, in regard to the contract of the Weber Concrete and Construction Co., Ltd., relative to the erection of three coal bunkers and one ash cover and receiving hopper, together with constructional steel works at the electricity works, that the work had not been executed with due expedition. The Council agreed to a recommendation that, after seven days' notice, the work be taken wholly out of the contractors' hands, the Corporation to re-contract with some other firm. The contract was to have been completed in June.

The Corporation has accepted the tender of Caspard & Co., Croydon, at £151 9s. 4d., for the lighting of its new swimming bath.

DUNDEE.—The following tenders have been received for the Clepington sub-station:—Mason and brick work, Mr. A. E. Linder, Blackness Road; joiner work, Mr. Thomas C. Stocks, Crescent Lane; slater work, Mr. Charles Brand, Overgate; plumber work, Messrs. J. Robertson & Sons, Princes Street; plaster work, Mr. Michael Lawless, Hean's Lane; steel work, Mr. John Mundy, Glasgow. The total cost of all the tenders is about £1,800.

GRIMSBY.—Tenders have been received for the supply of 6,500 tons of slack from hard steam coal for delivery within twelve months. Mr. W. A. Vignoles, the Electrical Engineer, has carried out a number of tests, and after hearing his report the Committee has decided to carry out a lengthy test, burning about 120 tons of coal from one colliery before deciding upon the placing of the tender. There were two prices which came so close together that the Committee could not choose between them without further tests.

HANLEY.—The tender of Messrs. Ferranti, Ltd., for switchboard extensions at £500, has been accepted.

IPSWICH.—The Electric Supply and Tramways Committee have reported that, with a view to obtaining additional fuel economy at the power station by using slack coal, they had accepted the offer of the Crosthwaite Fire Bar Syndicate, Ltd., to fit their furnaces to the power station boilers, on the understanding that, should the economy at the end of a three months' trial prove satisfactory, the furnaces would be purchased. The economy gained by the use of these furnaces and slack coal has fully justified the makers' claims, and it is anticipated that during the twelve months the total saving will be somewhere in the neighbourhood of £400, as compared with last year's figures. The committee have, therefore, informed the Crosthwaite Syndicate that they will purchase the furnaces at the price agreed upon, viz., £85 per boiler, or a total for the five boilers of £425. In moving the adoption of the report, the Chairman of Committee stated that they had been experimenting for weeks and months with various coals, and with these bars they had been enabled to buy coal at 12s. 6d., whereas last year the coal cost 16s. 9d., and it was estimated that they would save something like £1,200 a year. The report was accepted.

MAIDSTONE.—Eleven tenders have been received for the supply of slack coal, and that of Messrs. Corey & Sons, for Scotch screen-washed peas at 10s. 11d. per ton has been accepted.

NEW POST OFFICE POWER STATION.—The Postmaster-General has just given his decision in regard to the equipment of the new Blackfriars power station, and as a result the steam turbines, surface condensers, &c., are to be supplied by Willans & Robinson, Ltd., and the alternators, water-strainer, &c., by Dick, Kerr & Co. Willans & Robinson, Ltd., are the main contractors for this plant, and the contract price is £24,191.

COMPANIES' MEETINGS AND REPORTS

COMPANIA DE ELECTRICIDAD DEL PLATA.—The report for the year to June 30th last shows a gross profit of $59,715, and a dividend of 8½ per cent. is recommended. The output during the year increased by 23 per cent. New machinery consisting of boilers and a 1,200-kw. dynamo have been contracted for.

DEVONPORT & DISTRICT TRAMWAYS CO.—At the annual general meeting on Friday, the report for the half year to June 30th was adopted. The total capital expenditure on that date was £162,184. The total revenue for the half-year amounted to £11,812, and after deducting all expenses chargeable to revenue, including debenture and other interest, there is a surplus of £579, to which is added £156 brought forward. The total balance of £736 is to be carried forward. The directors report that during the next few years considerable expenditure will have to be incurred in relaying portions of the track, and they have, therefore, transferred for this purpose the sum of £6,749 from the depreciation and reserve fund to the permanent way renewals fund. The report further points out that, owing to the unsatisfactory condition of the company during the past few years, overtures have been made to the Corporation with regard to concessions in the terms under which the company now works, or, alternatively, that the Corporation should purchase. The Corporation, however, have declined to grant any concession, nor have they given a definite answer on the question of purchase.

DICK, KERR & CO.—At the ordinary general meeting on Tuesday, the report and accounts given in our last issue were adopted. Mr. J. Kerr, chairman of the company, presided, and said that it was with regret that the directors had to announce a decrease in the profits compared with previous years. This was entirely owing to the very severe competition met with in every department, and was in no way due to slackness on the part of the directors or restriction in the efforts of their very energetic and capable staff. The position had been further affected by the financial crisis in America, whilst municipal borrowing had also been considerably restricted. The electrical industry, he said, had for some years past been engaged in a very serious struggle, and he was sorry to say that, at the moment, at all events, he did not see much likelihood of competition becoming less keen in this country. They were, therefore, devoting most of their energies to developing Colonial and foreign business, and it was interesting to know that a very large proportion of the machinery now manufactured at Preston was for abroad. They had taken a rather important contract for tramway car equipment for the City of Moscow in face of very keen Continental competition, and their business connections in South America, and Japan particularly, had been increasing rapidly. Owing to the great falling off in the demand for electric tramway equipment, they had turned their attention to developing important power schemes, both hydraulic and steam, a class of business which had been very largely exploited in Switzerland, Norway, America, and Canada. In conclusion, he made a respectful suggestion to their financial friends in the City, and asked their good influence on behalf of English manufacturers on those occasions when they found the capital for enterprises abroad. A little patriotic feeling and support might do much in helping the cause both of the unemployed and in-

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dustrial capital in our own country. Mr. J. B. Concanon having expressed satisfaction at the report in view of the circumstances, the report was adopted as stated above.

HARRISON, AINSLIE & CO.—At the annual general meeting on Friday, it was stated that the arrangements between the company and the electrical company which supplied the electrical pumping plant for the unwatering of the Lindal Mines, will go to arbitration. The chairman said they had been advised that the plant has not yet proved itself equal to what was guaranteed, and differences have consequently arisen. As all the parties concerned are desirous of avoiding litigation, it was confidently hoped that the questions in dispute would be amicably settled before long. The company was not directly a party to the pending disputes, and he believed they were protected against loss. Notwithstanding those disputes and difficulties, the directors continued their efforts to bring the mines into the highest state of efficency and readiness, and, using the new and the former pumping plant, had succeeded in freeing the mines from water and putting them into a condition to meet any demands up to 1,000 or 1,200 tons per day for many years to come. The cost of the electrical plant was agreed at £50,000 in shares. In the accounts it stands at £64,337, the difference being due to additional necessary works not included in the original contract.

OERLIKON CO.—The report for the year ended June 30th shows a gross profit of 2,558,000 francs. The net profit amounted to 447,354 francs, and a dividend of 4 per cent. upon the 8,000,000 francs paid up capital is announced. The sum of 120,000 francs is carried to reserve fund, and the balance of 7,354 francs is carried forward.

SWANSEA IMPROVEMENTS & TRAMWAYS CO.—The directors' report for the half-year ended June 30th, shows that upon the tramway undertaking the gross receipts amounted to £24,267, being an increase of £1,950 upon the corresponding period of last year, and the expenses to £19,690, an increase of £1,115. The expenses include debenture and other interest, and the amount payable to the Swansea Corporation in respect of the tramways and light railways leased from the Corporation. The profit on the half-year's working is £4,576, to which is added the balance of £1,531 brought forward. The directors recommend that this sum be allocated as follows:—To reserve and depreciation, £1,000; to dividend six per cent. preference shares, £295; dividend five per cent. preference shares, £1,004; carried forward to next account, £3,809. The meeting is on the 7th inst.

WILLANS & ROBINSON.—The report for the half-year ended June 30th last states that as regards Rugby, after writing off £6,510 as depreciation, there is a profit of £18,472 as the result of the half-year's work. As regards Queen's Ferry, there is a net loss on the half-year's working (after contributing to debenture interest and to the directors' salaries) of £2,786. The net profit for the half-year is, therefore, £15,685, and the total amount available for distribution or otherwise, including £7,443 brought forward from last half-year, is £23,129. The directors propose to pay a dividend at the rate of 6 per cent. per annum on the preference shares, absorbing £9,999; to apply £1,750 partly in paying interest upon, and partly in redeeming funding certificates, in accordance with the approved scheme; and to pay a dividend at the rate of 10 per cent. per annum upon the ordinary shares, leaving a balance of £8,046 to be carried forward. The profit for the half-year, though inferior to that for the half-year preceding, is approximately the same as for the corresponding period of 1907. Allowing for the fact that the first half of the year is rarely so good as the second half, it will be seen that the company maintains its position, and as the earnings are more than sufficient to pay the usual dividend, and as there is a considerable balance to be carried forward, the directors do not think it necessary to propose any change. But in view of the present exceedingly unfavourable trade outlook, they think it right to point out that, unless there should be a definite revival of business, it will not be safe to assume that the recent satisfactory progress of the company will be sufficiently maintained to assure the continuance of the present dividend upon the ordinary shares. The Queen's Ferry works were offered by auction on September 16th, but were not sold. No exertion will be spared to effect a sale by private treaty, and in any case it is intended to dispose of that portion of the plant which it is not specially desired to retain with the buildings. Work at Queen's Ferry has practically ceased. The meeting is on the 6th inst.

YORKSHIRE ELECTRIC POWER CO.—The half-yearly meeting was held on Tuesday, at Leeds, when the report and accounts given in our issue for September 10th were adopted. Mr. A. Lupton, who presided, referred to the high price of coal, and said that if the Eight Hours Bill were passed there would be small probability of a return to reasonable prices. Although the company was not directly affected by the deplorable strike in the cotton mills, it must necessarily suffer to some extent, when it was considered that the group of textile industries for which the company supplied power was more important than any other single group of customers, and provided 40 per cent. of their total revenue. With regard to the general slackness of trade, he thought this might not in the long run be entirely a disadvantage, as it was at such times that manufacturers were most disposed to consider economies, and the economies arising from use of electric power were undoubted.

NEW COMPANIES

CORDOBA LIGHT, POWER, & TRACTION CO.—This company was registered on September 24th, with a capital of £500,000 in £1 shares, to acquire the benefit of concessions, grants, decrees, rights, and powers granted by any authority in Cordoba or elsewhere in the Argentine Republic, and to carry on the business of electric power station, waterworks, tramway, railway, and omnibus proprietors, carriers, suppliers of electric light, &c. Minimum cash subscription, 50 per cent. of any shares offered to the public, but no public issue of initial capital contemplated. The number of directors is not to be less than three nor more than seven: the first are Sir John I. Courtenay, 263A St. James's Court, Buckingham Gate, S.W. (chairman); G. Kitchin, Warnford Court, E.C.; T. F. Thomson, 62 London Wall, E.C.; and H. A. Trotter, 7 Mincing Lane, E.C. Qualification, 250 shares. Remuneration, £1,500 per annum, divided. An agreement between T. F. Jackson, for this company, of the one part, and various persons and corporations (as vendors) of the other part, provides for the sale to this company of 3,700 shares of common stock of the Corboda Light & Power Co. (incorporated in Maine, U.S.A.), at the rate of £20 (in shares) for each $100 share. The company is also to acquire from T. N. Vail a further 1,840 shares of the common stock, 4,840 shares of the preferred stock, and promissory notes for 126,000 dollars, the purchase consideration for these being 284,940 shares in this company. The shares and promissory notes to be acquired from Mr. Vail are under arrangements made by him, held on account of over 70 persons and corporations. Registered office, 15 Copthall Avenue, E.C.

EGHAM & DISTRICT ELECTRIC LIGHT CO.—This company was registered on September 23rd, with a capital of £25,000 in £5 shares, to acquire the business carried on at Egham as the "Egham Electric Lighting Syndicate," and to take over among the assets thereof the benefit of a certain provisional order. The subscribers are:—F. S. Powell, The Elms, Egham, diamond merchant; F. J. Powell, 17 Poland Street, W., lapidary; G. Gray, Westwood, Egham Hill, builder; T. H. Martin, 3 Pall Mall East, S.W., surveyor; W. H. Gardiner, 155 High Street, Egham, landowner; E. C. L. Baker, Church Street, Staines, builder; J. Goring, jun., Ironbarks, Staines, butcher. Minimum cash subscription, £5. The first directors are F. S. Powell and F. J. Powell. Table "A" mainly applies. Registered by Jordan & Sons, Ltd., 116-117 Chancery Lane, W.C.

FIXARC LAMP CO.—This company was registered in Edinburgh on September 22nd, with a capital of £1,500 in £1 shares, to acquire from Pierre M. Capitaine, electrician, 29 Rue Floreal aux Lilas, Seine, France, and from the Fixarc Lamp Co., 49 Virginia Street, Glasgow, for all their right and interest therein, the exclusive license to exploit, manufacture, and sell in any part of the world a patent for lamps for electric lighting, registered as "Arc Lamp" in Belgium, and to carry on in France and elsewhere the business of dealers in electric lamps, carbons, and accessories, &c. The subscribers are:—W. D. Hendry, 49 Virginia Street, Glasgow, accountant; J. Robertson, 45 Hope Street, Glasgow, machinery agent. The number of directors is not to be less than three nor more than five: the first are W. D. Hendry, J. Robertson, and W. F. Fellows. Registered office, 49 Virginia Street, Glasgow.

I. T. C., LTD.—This company was registered on September 22nd, with a capital of £10,000 in £1 shares, to make, sell, buy, put up, maintain, and work telephones, telegraphs, electrical apparatus, &c. The subscribers are:—I. Mayer, Woburn House, Upper Woburn Place, W.C., merchant; E. C. Cunnew, 120 Howson Road, Brockley, Kent, traveller; A. Stocken, 3-4 Lime Street Square, E.C., gentleman. Private company. The number of directors is not to be less than two nor more than five: the first are H. Mayer (permanent managing director and chairman) and E. Mayer. Remuneration as fixed by the company. Registered office, 64 Leadenhall Street, E.C.

J. L. MANUFACTURING CO.—This company was registered on September 22nd, with a capital of £20,000 in £1 shares, to acquire the manufacturing business carried on by the Johnson-Lundell Electric Traction Co., Ltd., to adopt an agreement with T. L. R. Cooper, and to carry on the business of manufacturers of and dealers in electric motors and dynamos and their accessories, electricians, electrical and mechanical engineers, iron, brass, and metal founders, boiler makers, &c. The subscribers are:—F. Allen, Duppas Hill, Croydon, solicitor; T. L. R. Cooper, 20 St. Leonards Road, Ealing, engineer; H. Rottenburg, Holmhurst, Dowanhill, Glasgow, engineer; L. B. Oldfield, 16 Eastcheap, E.C., solicitor; J. Allen, 16 Eastcheap, E.C., solicitor; A. Berney, 36 Bensham Lane, W. Croydon, accountant; S. Hill, 72 Masons Avenue, Wealdstone, Harrow, clerk. Private company. The number of directors is not to be less than two nor more than five: the first are T. L. R. Cooper and H. Rottenburg. Qualification, £100. Remuneration (except first directors), £50 each per annum. Registered office, Johnson Street, Southall, Middlesex.

TUNGSTEN METAL CO.—This company was registered on September 22nd, with a capital of £40,000 in £1 shares, to acquire from the Cornish Development Co., Ltd., a leasehold factory for the production of tungsten metal (now in course of erection at Widnes), with the benefit of certain contracts for

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the supply of wolfram ore, &c., to adopt an agreement with the Cornish Development Co., Ltd. The subscribers are:—F. A. Dangerfield, Duppas Hill, Croydon, solicitor; J. L. F. Vogel, Hillersdon, East Molesey, engineer; J. Allen, 16 Eastcheap, E.C., solicitor; L. B. Oldfield, 16 Eastcheap, E.C., solicitor; A. Berney, 36 Bensham Lane, W. Croydon, accountant; S. Hill, 72 Masons Avenue, Wealdstone, Harrow, clerk; W. T. Furness, 67 Britannia Road, Fulham, S.W., clerk. Minimum cash subscription, 10 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first. Remuneration, £50 each per annum (£25 extra for the chairman), and a share in the profits. Registered office, 56 Cannon Street, E.C.

COMPANY MORTGAGES

BRUSH ELECTRICAL ENGINEERING CO., LTD.—A trust deed dated September 4th, 1908, to secure £125,000 prior lien debenture stock, has been registered. Property charged—Certain freehold and leasehold property in Loughborough, Leics., and the company's other assets, present and future, including uncalled capital. Trustees—Electric and General Investment Company, Ltd., 1 Great Winchester Street, E.C.

EDMUNDSON'S ELECTRICITY CORPORATION.—Trust deed dated August 15th, 1908, to secure £100,000 debenture stock, has been registered. Property charged—£76,900 first mortgage debentures and £5,800 first mortgage debenture stock in various subsidiary undertakings, and the company's other assets, present and future. Trustees—Electric & General Investment Co., Ltd., 1-2 Great Winchester Street, E.C. Trust deed dated August 13th, 1908, securing an additional ½ per cent. per annum, and in certain events a premium of 5 per cent. in respect of £472,000, the amount now outstanding of an issue of £480,000 first mortgage debenture stock secured by trust deeds dated July 10th, 1899, and December 29th, 1903, and seven indentures dated April 27th, 1900, to January 19th, 1906, have been registered. (The deed of August 13th, 1908, is supplemental to the deeds of 1899 and 1903, and indentures of 1900 to 1906.) Trustees—Sir James Bailey, Eaton Square, S.W.; and Anglo-American Debenture Corporation, Ltd., 20 Birchin-lane, E.C.

HORSFALL DESTRUCTOR CO.—Mortgage to bankers, dated March 24th, 1908, securing not more than £3,000.

ST. JAMES'S & PALL MALL ELECTRIC LIGHT CO.—Four and a half per cent. debenture stock, dated May 29th, 1900, securing £150,000.

SUNBEAM LAMP CO.—Particulars have been registered of £10,000 debentures created by resolution of January 28th, 1904, pursuant to Section 10 (3) of the Companies Act, 1907, the amount of the present issue being £1,200. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., quoted on Tuesday night, was £62 to £62 10s. per ton (same as last week).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The trustee in the bankruptcy of W. A. Roderick, electrical engineer, 12 Penmaen Street, Swansea, has been released.

CAMBORNE MINING EXHIBITION.—The Union Electric Co. has received a letter of thanks from the Royal Cornwall Polytechnic Society for the arrangements which the company made in connection with the lighting of the recent Camborne Mining Exhibition, and for the loan of apparatus.

APPOINTMENTS AND PERSONAL NOTES

Dr. C. C. Garrard has resigned his position of manager of the instrument and transformer department of Messrs. Ferranti, Ltd., in order to take up the position of manager of the switch department of the General Electric Co., Ltd.

Owing to ill-health, Mr. S. B. Cottrell has resigned his position as engineer and general manager of the Liverpool Overhead Railway. Mr. Cottrell, who was at one time on the staff of the Mersey Railway Co., was resident engineer under Sir Douglas Fox and the late Mr. J. H. Greathead, during the construction of the Liverpool Overhead Railway, and upon the opening of the line was selected as engineer and general manager. Mr. Cottrell is at present in Scotland for the benefit of his health, and it is understood to be his intention to commence a consulting practice as soon as the state of his health permits.

Applications are invited for the post of traffic superintendent upon the Metropolitan Railway. Applicants must have experience of the working of heavy local traffic, and a knowledge of goods management. Applications to the secretary of the company by October 17th, endorsed "Traffic Superintendent."

The Leicester Corporation require a shift engineer in the tramway power station, preference being given to one having had previous experience in a large traction station with Corliss condensing engines and Lancashire boilers. Salary 45s. per week, rising to 60s. Applications to the Tramway Engineer.

MISCELLANEOUS CITY NOTES

BERGMANN ELECTRICITY CO.—*The Financial News* states that the Board of Directors will shortly put before the shareholders a proposal for increasing the company's capital from M.14,000,000 to M.21,000,000, by the issue of M.7,000,000 of new shares, which will be offered to present holders at 165.

HOVE ELECTRIC LIGHTING CO.—An interim dividend on the ordinary shares at the rate of 8 per cent. per annum has been declared for the six months ended June 30th.

INTERNATIONAL ELECTRICITY CO.—The *Financial News* states that the absorption of the International Electricity Co. by the Union Bank of Vienna is attracting considerable attention in Vienna. The latter takes over all the assets and liabilities, and will exchange one share of the Electricity Co. for one and a fifth of its own shares, with participation in the dividends beginning from January 1st, 1909. The object of the International Electricity Co. is the working of various electrical systems and patents, and it recently sold its electric light plant to the City of Vienna, the purchase price being 20,000,000k. The Union Bank now proposes to organise a special electro-technical department, under the management of the former directors of the Electricity Co. The capital of the International Electricity Co. is divided into 37,500 shares, and, normally, the Union Bank would have to create 45,000 new shares of its own; but as the bank is already a large holder, an issue of 10,000,000k. worth of new shares will suffice.

KALGOORLIE ELECTRIC POWER & LIGHTING CO.—The directors announce a dividend on the preference shares of 6 per cent. per annum for the six months ending September 30th.

RAILWAY AUDIBLE SIGNAL CO.—Subscriptions have been invited during the week for an issue of 14,793 shares of £1 each of this company, which has been formed to acquire the benefit, except as regards France, of certain inventions relating to signalling on railways. The system is that adopted upon a short length of the Great Western Railway at Fairford, and also between Twyford and Reading, in which condition of the signals is given to the driver upon the locomotive.

TECHNICAL INSTRUCTION.

BOROUGH POLYTECHNIC INSTITUTE,
103, Borough Road, London, S.E.

(Five minutes by Car from Blackfriars, Waterloo, and Westminster Bridges.)

ELECTROTECHNICS DEPARTMENT.

Head of Department:
JOHN HENDERSON, D Sc., F.R.S.E., A.M.I.E.E.

First Year . .	General Principles (for Beginners).
Second Year . .	Technical Applications, including Electric Wiring and Fitting.
Third Year . .	Continuous Current Work: Instruments, Testing Dynamos and Motors.
Fourth Year .	Alternating Current Work, Principles and Theory, Measurements, Alternators, Motors, Transformers, Single and Polyphase Work.
Special Courses .	Electric Wiremen's Work, Construction and Design of Electrical Appliances and Workshop Fittings. Advanced Electricity and Magnetism.

Commencing 28th September, 1908.

For further particulars and detailed Syllabus of each Course, see Prospectus.

C. T. MILLIS, *Principal.*

APPOINTMENT VACANT.

PREMIUM PUPIL. Vacancy for pupil to obtain experience in all branches of Central Station work. Apply ELECTRICITY WORKS, CANTERBURY.

SITUATION WANTED.

DRAUGHTSMAN (25), electrical, mechanical, university, and technical school; four years' experience with good firms. Home or abroad.—D., 24, South Hill Road, Liverpool.

FOR SALE.

ARC LAMP CHARMS. Made in gold, silver, and cheap metal. Splendid advertising novelty. Particulars, JEWELLER (Wholesale), 334, Barking Road, Plaistow.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Sept. 24th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

19,570, **Time-Limit Switch.** C. C. Garrard & Ferranti, Ltd. An improved form of relay for opening or closing the auxiliary trip-coil circuit of a circuit-breaker a definite interval after the overload or other abnormal condition has commenced. In those patterns which operate by winding up a suspended weight, the time interval is varied by altering the length of travel of the weight. According to the present invention, two weights are used; one is secured to the end of the cord, and the other slides loosely on the cord. The height of the latter is adjustable, and determines the time interval. The weights are so proportioned that the lower one is wound up by the normal relay current until it touches the upper weight; under abnormal conditions the upper weight is lifted. Variation in the height of the upper weight provides a simple and effective means of adjusting the time interval. Two claims, two figures.

19,883, **Reverse Current Circuit-Breaker.** British Thomson-Houston Co., R. C. Klinker, E. B. Wedmore, and J. E. Woodbridge. A reverse current circuit-breaker for alternating-current systems, with potential and current windings wound on a common magnetic circuit. These two windings act differentially when the current is in the normal condition, but cumulatively on reversal of the current. In the latter case an armature is moved, and this operates the tripping mechanism of the circuit-breaker. A serious defect of this type of relay is the transformer action which takes place between the two windings. To remedy this defect, the present invention provides means whereby a compensating E.M.F. opposing the induced E.M.F. is applied to the current winding of the relay. This E.M.F. is generated in an auxiliary current winding in series with the main current winding. The auxiliary inducing potential winding may be arranged in parallel or series with the main potential winding. A further advantage is claimed when the two potential coils are arranged in series, in that, on the occurrence of a heavy rush of current, the current coils do not exert any inductive effect on the potential windings, as the effects of the two sets of windings neutralise one another. Three claims, three figures.

20,227, **Impregnated Tungsten Filaments.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). A process for the manufacture of metal filaments consisting of a mixture of tungsten and thorium oxide. Fine tungsten powder and thorium oxide are mixed with an alloy of cadmium, bismuth, and mercury, in the proportion of 35 per cent. of the alloy and 65 per cent. of the refractory material, consisting of tungsten and thorium oxide in various proportions. From only a few per cent. to as much as 50 per cent. by weight of thorium oxide can be used. The alloy used as a binding agent is, of course, vaporised, and the filament sintered together in the usual manner. It is claimed that the hot resistance of a tungsten filament with an addition of 20 per cent. thorium oxide is about 50 per cent. greater than that of the pure tungsten filament. As a filament consisting of 50 per cent. thorium oxide cannot be easily welded to leading-in wires, a paste of fine tungsten powder with a trace of water glass is used for making the connection when such a high percentage of thorium oxide is present. If a higher percentage still of thorium oxide is used, the filament becomes brittle, but has a very high resistance, so that very short filaments without supports can be used. Three claims.

1908 Patent

14,805, **Antiseptic Attachment for Telephone Mouthpieces.** J. Freel. According to this invention, it is proposed to prevent the communication of disease, through the medium of a telephone mouthpiece, by the application of a diaphragm of antiseptically treated fine silk to the mouthpiece. The diaphragm can be secured to the rim of the mouthpiece by an elastic ring. One claim, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

19,870, Kohlen. Burglar and fire alarms.

20,095, Edgcumbe & Everett. Relays for the protection of electric circuits.

20,203, Siemens Bros. Dynamo Works, Ltd. (*Siemens-Schuckert-werke Ges.*). Arrangements for equalising the loads on the phases of polyphase systems.

20,332, Veritys, Ltd., & Gott. Motor controllers.

20,348, Watson & Smith. Multiple trembler induction coil ignition systems.

20,785, Werkner. Electrical transmission of power for propelling vehicles.

20,878, Parsons & Ball. Electrically controlled clocks.

20,986, Bell. Magneto machines.

22,870, British Thomson-Houston Co. (*Allgemeine Elektricitäts-Ges.*). Motor starters.

23,216, Felten & Guilleaume Lahmeyerwerke Akt.-Ges. Means for altering the difference of potential of two points of a circuit between which a practically constant current has to flow.

23,707, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Control of alternating-current motors.

24,635, Legge & Scott. Arc lamps.

24,993, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Controlling mechanism for motor-operated railways signals.

25,684, Pendlebury & Rudd. Means for stopping railway trains independently of drivers.

25,740, Beamish. Electrical signalling installations.

25,834, British Thomson-Houston Co. & Clough. Insulating the windings of dynamos.

25,999, Aarhus Dynamo & Elektromotor-Fabrik & Johansen. Motors.

26,489, De Voe. Devices for threading conduits.

26,661, Langham. Portable electric egg-testing lamp.

26,938, Rider. Signalling systems for railways.

27,412A, Bevis & Angold. Arc lamps.

1908 Patents

16, Phillips. Telephones.

620, Fairweather (*Benjamin Electric Manufacturing Co.*). Lamp cluster holders.

700, Agrell. Type-printing telegraphic apparatus.

811, Glenister & Glenister. Insulating wires and cables.

1,754, Lertourné. Preventing the loss of electric energy by heat when working projectors.

2,357, Lambert. Track brakes for tramcars.

4,145, Greenbaum. Coupling talking machines with circuit making and breaking devices.

4,364, Sveinbjornsson. Generation of electricity on railway trains and boats.

4,461, Michaud & Delasson. Process for manufacturing filaments for illuminating and heating purposes.

4,509, Pidd. Guides for pulleys or trolley heads.

5,297, Bleeck. Primary batteries.

6,764, Soc. Ch. Legrand et Cie. Electrically-controlled locks.

8,421, Wolfram-Lampen Akt.-Ges. Filaments.

8,713, Henrique. Interrupter for ignition systems.

8,994, Krause & Harff. Railway signalling systems.

11,221, Scherl. Single-track vehicles.

11,410, Carroll. Fire alarms.

11,415, Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Production of sodium nitrite.

12,336, Roost. Meter for controlling the duration of telephone conversations.

14,910, Siemens-Schuckertwerke Ges. Protective covers for glow lamps.

16,076, Willey & Worsley. Automatic controlling devices for tramcar trolleys.

16,208, Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*). Current transformers.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1907 Patent

24,027, Timar & Von Dreger. Arc lamps.

1908 Patents

3,504, Wenger. Precipitation of electrolytic copper in the form of sheets by iron.

7,705, Nodon. Process for recovering tin from waste mixtures.

11,599, Rittersberg & Rubert. Process of manufacturing filaments for electric lamps from vegetable oils and resins.

13,527, Firm of Robert Bosch. Ignition apparatus for internal-combustion engines.

15,262, Firm of Robert Bosch. Ignition apparatus for large internal-combustion engines.

17,419, Little. Arc lamp electrodes.

17,530, Land-und Seekabelwerke Akt.-Ges. Cables.

17,934, Palmborg. Automatic telephone exchanges.

18,275, Cooper. Regenerative systems of motor control.

18,330, Cooper. Equalising devices for alternating-current circuits.

18,331, Cooper. Systems of operation for alternating-current motors and generators.

18,935, Felten & Guilleaume Lahmeyerwerke Akt.-Ges. Electric couplings.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5% *	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½%	9¾—10	
Do. 6% Cum. Second Pref.	10	6	6%	10⅛—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	—	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	96—100	
Brompton & Kensington E. S. Co., Ld.	5	10	5% *	7—8	+½
Do. 7% Cum. Pref.	5	7	7%	7—8	+½
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½% *	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3½—4	
Chelsea Electric Supply Co., Ltd.	5	4½	2% *	2⅜—3¼ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4¼	
County of London Elect. Sup. Co. Ld.	10	5	—	7⅜—8⅝	
Do. 6% Cum. Pref.	10	6	6%	10⅝—10⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	—	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	4% *	7⅞—8¾	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E.L. Cos. Db.Rd.	Stock	4	4%	98—102	
London Electric Supply Corporation	3	2½	—	⅞—1⅛	
Do. 6% Pref.	5	6	6%	4⅜—4⅝	
Do. 1% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¼—4½	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. D	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	5¼—5⅜	-⅛
Do. £2 Paid	5	8	2½%	3¼—3⅜	
Do. 5% Pref. (fully paid)	5	5	2½%	5¼—5⅜	
Do. £2 Paid	5	5	2½%	3¼—3⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½% *	5⅝—6¼	
Do. 4% Deb. Red.	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5% *	7—8	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅛—2¾	-⅛
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—¾	
Do. 7% Cum. Pref.	1	7	7%	1⅝—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	—	¼—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	82—85	
Westminster Elec. Sup. Corp., Ltd.	5	10	5% *	7⅛—8⅜	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	94—96	+1
Central London	Stock	3	3% *	68—70	
Do. 4% Preferred	Stock	4	4%	85—87	+1
Do. Deferred	Stock	2	—	50—53	+1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	84—86	
City and South London Cons.	Stock	4¼	1⅞%	32½—33½	+½
Do. 4% Perp. Deb.	Stock	4	4%	100—103	-1
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	2% *	7½—8	+¼
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	½	½%	38½—39½	+1½
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	74—77	+1
Do. 3½% Convertible Pref.	Stock	3½	3½%	74—77	+2
Metropolitan District	Stock	—	—	13—14	+½
Do. 6% Perp. Deb.	Stock	6	6%	118—121	+2
Do. 4% Deb.	Stock	4	4%	75—80	+4
Do. Perp. Extension Pref. (5%)	Stock	—	—	21—25	+1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	48—52	
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	5%	43—47	+1
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	½—¾	
Do. 4½% Deb. Red.	Stock	4½	—	85—90	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	1—1½	-⅛
Do. 6% Cum. Pref.	10	6	6%	3⅝—4⅛	-⅛
Do. 5% Perp. Deb.	Stock	5	5%	96—99	-½
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4⅜	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—100	

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12½—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	—	5½—6¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	75—80	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	¼—½	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—⅜	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	½—¾	
Do. 5% Cum. Pref.	1	5	2½%	⅝—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	92—95	
Provincial Tramways Co. Ltd.	10	4	1½% *	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	78—82	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	3—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½% *	58—61	
Do. 6% Pref. Crd.	Stock	6	6% *	103½—104½	-½
Do. Def. Ord.	Stock	1	—	16⅜—17½	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	89—91	
Direct Spanish Telegraph Co. Ltd.	5	4	—	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13¼—13⅝	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—101½	
Do. do. (Mauritius Sub.)	25	4	—	101½—103½	
Eastern Ext. Australasia & China	10	7	6%	12½—13½	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100½—102½	
Eastern Telegraph Co.	Stock	7	11½% *	135½—138½	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½% *	30—32	+2
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6% *	118—120	
Do. 6% Cum. 1st Pref.	10	6	6%	10¼—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅛	
Do. 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red	Stock	4	4%	102½—104½	
Western Telegraph Co., Ltd.	10	7	6% *	13⅜—14½	
Do. 4% Deb.	Stock	4	4%	101½—103½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅝—1½	
Do. 6% Cum. Pref.	1	6	7%	¾—1⅛	
Babcock & Wilcox, Ord.	1	20	—	3½—4⅛	
Do. 6% Pref.	1	6	—	1⅛—1⅜	
British Insulated & Helsby Cables, Ltd.	5	10	8% *	6¾—6⅞ xd	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅞—1⅛	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	-1
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10⅜	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	—	1⅜—1⅞	-⅛
Do. 6% Cum. Pref.	1	6	6%	1—1¼	-⅛
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	+1
Edison & Swan United "A," £3 paid	5	2/6	—	⅛—⅜	
Do. do. (fully paid)	5	4/2	—	1⅜—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—87	
Electric Construction Co., Ltd.	2	—	—	⅛—⅜	-⅛
Do. 7% Cum. Pref.	2	7	—	1⅝—1⅞	-⅛
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	-1
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7⅛—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	86—90	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5% *	10¼—11¼	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½% *	16—17	+½
Do. 4% Deb. Red.	100	4	4%	97—99 xd	-2
Tel. Const. & Maintenance Co.	12	17½	10% *	32—34	-½
Do. 4% Deb. Bds. Red.	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	—	¾—1¼	
Do. 6% Cum. Pref.	5	6	6%	2¾—3¼	-¼
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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POWER SUPPLY AND ITS EFFECT ON THE INDUSTRIES OF THE NORTH-EAST COAST

ONE of the most interesting of the Papers read at the Middlesbrough meeting of the Iron and Steel Institute was that with the above title, by Mr. C. H. Merz.

In this paper, power supply refers to the provision of electricity for industrial use by companies specially constituted for the purpose. Power supply, though of comparatively recent development, has already had the following effects upon the industries of the north-east coast:—A great saving of coal and reduction of smoke has resulted; there is now, apart from the Power Co., practically speaking, no coal burned on the Tyne for power purposes except in chemical factories. The Tyne shipyards and engineering works may be said to have adopted electricity to the exclusion of all other forms of motive power. The application of electricity to all new uses has been facilitated; the suburban traffic facilities of Newcastle are more ample than those of any other town of similar size at home or abroad; and four new rolling-mills are about to be driven electrically. New industries have been established in the district, purely because of the cheap power supply available. A substantial commencement has been made in the utilisation of the waste heat and gases existing in the area, and in this regard the district occupies a unique position owing to the extent to which its future power requirements can be met by electricity produced as a by-product of two of its largest industries, the making of pig-iron and the making of coke.

The station from which the greater portion of the current is now supplied—Carville—was begun in 1903 by the installation of 14,000 electrical horse-power of steam turbine-driven generators producing three-phase 40-cycle current at a pressure of 6,000 volts. This installation has been increased fourfold during the past four years, so that the generating plant now aggregates 56,000 electric horse-power, and Carville has now a greater output of electricity than any other public supply station in Europe. From Carville the transmission and distribution networks extend westwards to and through the city of Newcastle-upon-Tyne, northwards to Blyth, and eastwards along the river Tyne to North Shields, while in a southerly direction the cables at present reach a point some thirty miles south of Carville, and extensions will shortly be completed linking up the northern cable network to the power system which has now been in operation some eighteen months in the Middlesbrough district.

Unity of policy and uniformity of system on the part of the two other large power companies (the Durham Electrical Power Distribution Co. and the Cleveland & Durham Electric Power Co.), have been secured by working agreements. The development has gradually extended northwards and southwards from the Tyne, and it is now possible to obtain electricity on the same system throughout practically the whole area shown on the map in Fig. 1. The capacity of plant installed represents about one-ninth of the total plant installed in public supply stations of the United Kingdom. But as the power companies are working on a more constant load, *i.e.*, a better "load factor," the electricity actually generated is about one-quarter of that generated in the whole of the public supply stations of the United Kingdom.

Though the extension of the power-supply system has been rapid, its development and the growth of its profit-earning capacity were considerably delayed by the work which had to be done from time to time to secure uniformity of system. Unfortunately with each amalgamation or extension of area considerable alterations had to be effected in the system of the new company concerned, as in some cases the frequencies were different. Five coal-fired stations and three waste-heat stations, aggregating 101,950 h.p., are now in operation on the system, and one further coal-fired station (at Dunston) and two waste-heat stations are under construction, which will bring the total plant capacity up to 136,550 h.p.

A factor invariably of vital importance in the production of cheap current, whether by a public company or by a private manufacturer, is the capital expenditure per useful horse-power of plant. This decreases as the size of plant grows, while the running efficiency at the same time increases. The local conditions governing power supply in this district are:—(1) The low price of coal, enabling manufacturers to produce power themselves at relatively low rates. (2) The fact that the manufacturers' works are mostly of considerable size, *i.e.*, their individual electrical requirements are large. (3) The existence of large quantities of potential energy in the form of waste heat and combustible gas.

The first and second conditions have been met by the power companies, in erecting their main generating stations: (*a*) Taking full advantage of the best coal and water facilities available; (*b*) installing plant of capacity much in excess of that which any individual manufacturer, however large, could adopt; (*c*) by catering for all classes of consumers, thereby securing a diversity of load with a resulting constancy of output, and so utilising the plant installed to the best possible advantage.

On considering the various purposes for which the power supply is utilised, the author remarked that there is at the present moment not a single firm of shipbuilders or engineers on the north bank of the Tyne inside the Power Co.'s area of supply which does not take 95 per cent. of its power from the company. Power is also supplied for working the electrified lines of the North-Eastern Railway. There are now four new electrically-driven rolling-mills being installed in this area—two by Dorman, Long & Co., one by the Bowesfield Steel Co., and one by a new company now being formed. The electricity for these will be purchased from the company. The supply of electricity to coal mines, beginning as it did not more than four years ago,

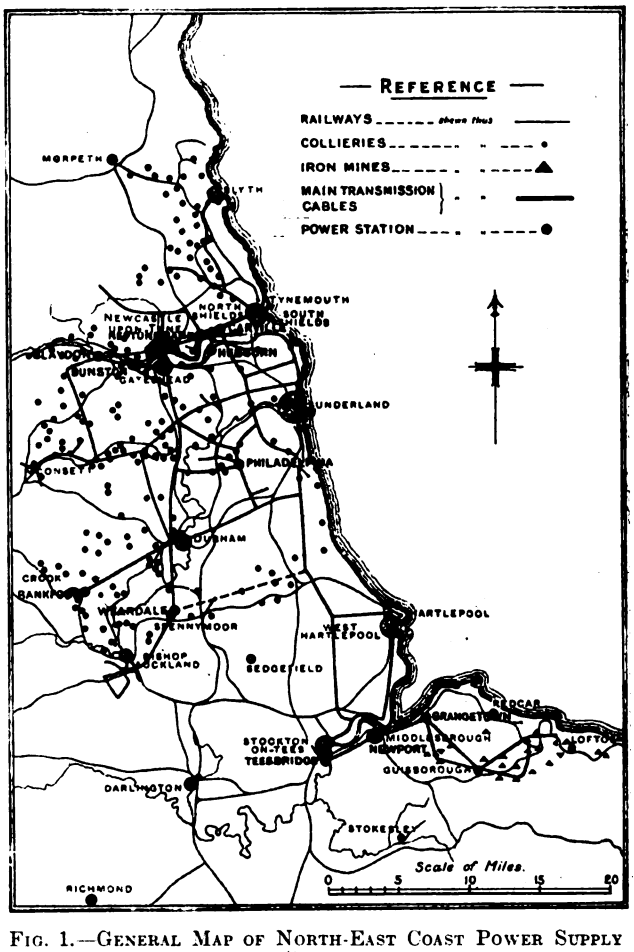

FIG. 1.—GENERAL MAP OF NORTH-EAST COAST POWER SUPPLY SYSTEM.

has not reached the same stage of development as in the case of other industries, though collieries having an ouput of some 8,000,000 tons per annum are taking, or are arranging to take, practically their whole supply from the power companies. This supply will include, among other apparatus, winders of 1,600 h.p. each. It is estimated that the application of electricity to coal mines in this district, when as complete as that to the Tyne shipyards, will render available for outside sale over 1¼ million tons of coal, equivalent to, say, over half a million sterling per annum.

To summarise present results, the three power companies are now responsible for the supply of current to 80 miles (single track) of electrified railway, four tramway systems, the lighting in towns having populations aggregating over 700,000, motive power to the extent of 85,000 h.p., and electro-chemical works of over 12,000 h.p. The last-named are new industries attracted to the Tyne solely by cheap power supply, and there is every indication that their number will in future be largely increased.

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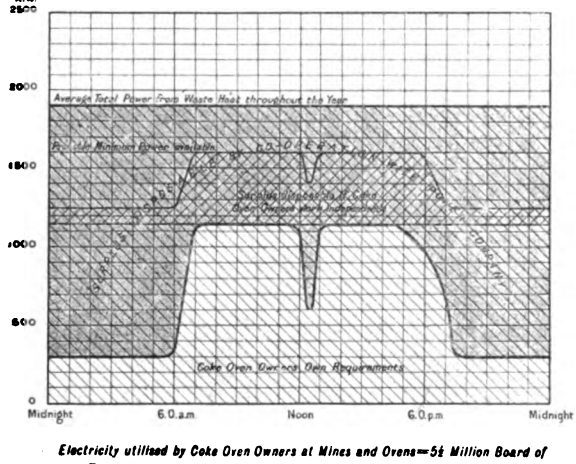
Mr. Merz then went on to speak of the important question of the efficient utilisation of waste heat. He estimated that in the counties of Northumberland and Durham and the North Riding of Yorkshire, from the working of coke ovens there ought to be available waste gas and waste heat capable of developing over 150,000 h.p. continuously, if used under boilers, or probably a quarter of a million horse-power, if the gas were used in gas-engines. With regard to blast furnaces, he said that if gas-engines were used exclusively for power purposes, then, after the requirements of the stoves and the blowing-engines had been met, there would still be available from the Cleveland furnaces alone a supply of surplus gas equivalent to 61,000 h.p. continuously.

In all cases investigated by the author it has been found that a greater profit will accrue to the coke-oven owner by co-operating with a power company than by proceeding on independent lines. There are three reasons for this :—(1) When a private owner erects a generating plant independently he must install some reserve or spare plant, with a consequent heavier outlay of capital than is necessary to a power company, which, possessing a coal-fired station, need install no spare plant in any of their waste-heat stations, but can, instead, meet any variation of load by the coal-fired station, which also acts as a stand-by against any breakdown. (2) This necessity of putting down spare plant results in smaller, and therefore more expensive and less efficient plant. To take a case—supposing 2,000 h.p. is available, if the station is to be used in conjunction with the power company's system—one 2,000 h.p. unit would be entirely satisfactory, the power system acting as stand-by. If it is to be used in a separate generating station, one would probably install three 1,000 h.p. units—two working and one spare. The gain in the former case in capital cost, running cost, and efficiency is obvious. As a matter of fact, the capital cost in the second case would be nearly double what it would be in the first. (3) The power company, having a market for current many times greater than the output of any individual waste-heat station, can run such a station continuously at maximum output, so utilising completely all the current that can be produced; whereas it is impossible to conceive the power requirements of an individual coke-oven and colliery owner coinciding even approximately over 24 hours with the amount of gas or waste heat available.

ESTIMATED DAILY OUTPUT AND LOAD CURVE OF WASTE HEAT STATION AT CROOK.



Electricity utilised by Coke Oven Owners at Mines and Ovens=5¼ Million Board of Trade Units per annum.

Maximum Surplus available for Outside Sale, if Coke Oven Owners work independently = 2¼ Million Board of Trade Units per Annum.

Surplus disposable by Co-operating with Power Company = 10 Million Board of Trade Units per Annum.

FIG. 2.

Fig. 2, which refers to Messrs. Pease & Partners' installation at Crook, shows the advantage of co-operation very strikingly. It will be seen that the area of the rectangle enclosed between the top line and the base (shown "hatched") represents the total amount of power available, that "hatched" (but not shaded) the requirements of the colliery owner, and that "cross-hatched" the amount disposable had the colliery owner put in his own plant independently, and been able to find a purchaser; it also assumes that the outside purchaser had approximately the same load-curve as the colliery owner himself, which is a reasonable assumption, unless the power be transmitted long distances, as the only users of power in the vicinity of coke-ovens are other colliery owners. The area shaded grey represents the surplus power actually used under the co-operative arrangement.

It is more difficult to get out so typical a curve in the case of blast-furnaces, as the conditions vary so widely. Of course, if a company produces pig-iron only, and does not convert the iron into steel, co-operation with a power company is at present, practically speaking, the only outlet which it has for its surplus power. If, however, a blast-furnace works has a steel mill attached, it may be argued that the correct thing to do is to follow the plan adopted by many large works in Germany, namely, to install gas-engine blowers and gas-driven dynamos at the blast-furnaces, the latter plant producing the necessary power for driving the steel mills.

Capital charges are invariably the controlling factor in the total cost of electricity, and the question raised above, namely, whether it is commercially sound for a blast-furnace owner to co-operate with a power company or not can only be decided in each individual case. It is clear that if it be decided to make the works self-contained, then the supply capacity must always be in excess of the possible demand, otherwise a risk is run of a portion of the works having to be stopped, and as the demand varies from time to time there must be a variable amount of gas utilised involving wastage when supply exceeds demand, or the burning of coal at certain periods when demand exceeds supply. Given an equitable arrangement, it is clear that the same general arguments in favour of co-operation which hold in the case of coke-ovens are applicable to blast-furnaces with steel-works attached.

The power companies in the Newcastle district having their transmission cables interlacing the entire industrial area, and being in a position, with their large load already developed, to utilise any amount of electricity whenever and wherever produced, are arranging for waste-heat stations at different points, turning all the electricity so produced into a common network from which the colliery company, the coke-oven owner, or the blast-furnace owner can purchase any amount he may require, all spare plant and all plant to deal with exceptional peak loads being kept at the main central coal-fired station. To summarise briefly the work which has already been done in the utilisation of surplus power, the first co-operative arrangement made by any of the power companies was brought about by the initiative of the owners of the Priestman Collieries, and resulted in the erection of the power station at Blaydon in 1905. At the present moment the three power companies have at work or in hand five waste-heat stations, three in connection with coke-ovens and two in connection with blast-furnaces. Additional stations are under consideration.

It will be remembered that as regards the Cleveland blast-furnaces the calculations quoted dealt with the surplus available on the basis of the gas being utilised in gas-engines, but the adoption of gas-engines to the exclusion of all other types of prime-mover still lies some distance in the future, and in the majority of cases in Cleveland it is found that steam blowing-engines are used, and that after the requirements of the stoves have been met the gas is practically all expended in raising steam to supply these blowing-engines.

To free any substantial quantity of gas for outside power users would involve therefore the substitution of gas engines for the existing steam-blowers. Considerations of capital expenditure usually forbid this course, and had it not been for the development of the exhaust steam turbine the Cleveland furnaces could not be regarded by a power company as an immediately available source of energy. In this connection, as capital outlay controls so completely the cost of electricity, and as exhaust steam turbines are so dependent on a high degree of vacuum for efficiency (at 26 inches they consume 50 per cent. more steam than at 29), it is perhaps not always easy to justify the policy of installing small exhaust steam turbines inland in conjunction with an intermittent supply of steam such as that from a colliery winding-engine, as this involves a cooling-tower and a regenerator with a consequent poor vacuum and high capital outlay.

Olympia Motor-Car Show.—The annual exhibition of motor-cars at Olympia, promoted by the Society of Motor Manufacturers and Traders, has been fixed for November 13th to 21st. The show will be confined to racing, touring, and pleasure cars and accessories, and a separate exhibition for commercial vehicles and motor boats will be held next spring.

Obituary.—The death occurred last Thursday, at the advanced age of 85, of Sir Samuel Canning, who was well known as one of the pioneers of submarine telegraphy, to which sphere of action he devoted his energies from 1850 onwards. He acted as chief assistant to Sir Charles Bright in the laying of the 1858 Atlantic cable, and had superintended the laying of the Gulf of St. Lawrence cable in the preceding year, and was also connected with various other cable enterprises, including those to Gibraltar, Malta, and Alexandria.

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ELECTROLYTIC PRODUCTION OF IRON SHEETS AND TUBES

A PAPER was read by Mr. S. Cowper-Coles at the Middlesbrough meeting of the Iron and Steel Institute, describing an electrolytic process for making tubes, cylindrical vessels, sheets, and wire in one or two operations from crude or scrap iron, or direct from the ore, without the processes of smelting, rolling, or drawing, at a cost that has hitherto been thought impossible.

The author referred to the early work in this branch of electrometallurgy, including that of Bockbushmann in 1846, Feuquieres, Smee, and Klein, and explained some of the difficulties met with in his own experiments in the year 1898 on the production of electrolytic iron plates. These were chiefly the occurrence of gas lines, pits, and exfoliated deposits, but the results obtained were a great advance on what had hitherto been effected, although they were not far enough advanced to be turned to practical account. It was not until the present year that sheets and tubes were obtained of a quality equal to steel, and with a surface that required no after-treatment, such as rolling or drawing.

An electrolytic iron production process, to be of commercial value, must fulfil the following conditions, namely, the voltage between the terminals of the depositing cell must be low, the current density per square foot of cathode surface must be high, and the iron or steel deposited must be in such a form that it can be used for industrial purposes without smelting.

The process briefly consists in placing crude iron (which may contain those elements which are at present so detrimental to the production of high-class iron or steel), or finely divided iron ore, in suitable containing vessels in which an acid solution is circulated, using an insoluble anode material; or, further, the process may combine the use of soluble and insoluble anodes. The crude iron or iron ore being in each case connected to the positive pole of the supply, the iron goes into solution, and is deposited on cylinders or plates which may be either rotated or stationary, depending upon the class of finished product required. It is conceivable that in some cases iron might be recovered without mining, acid liquor being circulated over the ore deposits.

When it is desired to produce a highly finished sheet, a metal sheet of the desired surface is wrapped round the cathode, and held in position by means of grooves and wedges. In this way sheets of large dimensions can be made, by employing a mandrel, say, 8 ft. in diameter, a sheet 24 ft. by 5 or 7 ft. can be produced. When it is desired to produce tubes, iron mandrels somewhat smaller than the internal diameter of the finished tube are coated with lead by electro deposition, or by having lead drawn over them. When the desired thickness of iron has been deposited the mandrel is heated to a temperature sufficient to melt out the lead, and thus admit of its easy withdrawal.

The electrolyte employed consists of a 20 per cent. solution of sulpho-cresylic acid saturated with iron. In some cases it is advantageous to add small quantities of carbon di-sulphide, the temperature of the solution being about 70° C., the current density about 100 amperes per square foot. The solution is kept charged with iron oxide, which is kept in suspension in the electrolyte by means of stirrers, by moving one or both of the electrodes, or by circulating by means of a pump. Excellent results have also been obtained by depositing the iron in a closed cell with a vacuum of a few inches, and also with a chloride solution and porous cells, bleaching powder being produced as a by-product; or the chlorine utilised to form fresh iron chloride.

Amongst other applications the process can be applied to the production of bi-metallic tubing and plates; that is to say, to tubes or sheets coated on the one side with copper or other metals or alloys. The process can also be applied to the direct production of large sheets or strips representing the cutting surface of a file, and cut up into portions of the desired shapes, and secured to suitable backing, to form separate files. The prints are produced by making a continuous impression or a number of impressions from a suitable die, revolving roller, or reciprocating tool in a lead alloy. The matrix thus prepared is mounted on a revolving drum, and steel deposited by the process which has already been described.

Electrolytic steel, with considerable variation in the percentage of carbon, can also be produced. Houllevigue observed that when iron is deposited from iron containing uncombined carbon, the product at the cathode was free from carbon; but when deposited from iron containing combined carbon, the cathode product also contained carbon. The author's observations confirm this statement, and at a future date he hopes to publish figures showing the results that can be obtained. The amount of silicon in the iron can also be considerably varied. An important feature of the electrolytic process will no doubt be the introduction of some new ferrous alloys, which cannot be made by fusion. Alloys of iron and nickel have already been produced electrolytically.

The structure of electrolytic iron varies considerably, and in some cases it is found to be amorphous, whilst in other instances it possesses a structure somewhat similar to that of wrought iron. The properties of electrolytic iron appear to depend largely on the amount of hydrogen present, and therefore on the annealing, which reduces or eliminates the occluded hydrogen. The more hydrogen it contains the greater is its hardness.

Samples tested have given a hysteresis loss of under 0·3 of a watt per pound. The hardest varieties will scratch glass.

There are two distinct varieties of electrolytic iron, with varying percentages of hydrogen; the softer kind of iron is silver-grey in colour, whilst the other variety is very hard and brittle, breaking as readily as glass, and containing a higher percentage of hydrogen. The hardness varies between these two extremes. A surface can be obtained on the latter of a silvery whiteness, and with a mirror finish, without polishing, as will be observed by the specimens exhibited. Either quality can be produced at will by increasing or decreasing the electromotive force at the terminals of the cell.

Iron highly charged with hydrogen is very inert, and not readily attacked by acids. The softer quality is also comparatively inert.

Mr. Cowper Coles considers that the electrolytic production of iron and steel has now emerged from the laboratory or academic stage to a practical conception, enabling iron and steel to be produced in a highly finished form from iron ore or scrap iron, in a condition which realises the highest market value, by a process which reduces labour to a minimum, and under conditions which can be compared to the working of a central electric-light station for cleanliness and health.

The advantages of the system are summarised in the Paper as follows:—

Finished products, such as tubes, sheets, and wire, can be produced at less cost than by the processes of smelting, refining, and rolling. A product is obtained which does not corrode so readily as steel, at less cost. The process can be worked economically when no coal is available. Iron ore that is useless for ordinary smelting operations can be advantageously utilised by the electrical process. The process is a power process, and utilises but little labour. Small units can be worked economically. The process is more cleanly and healthy than the operations of smelting. Little or no scrap is formed.

From figures given in an appendix it appears that the estimated cost of plant for producing 5,000 tons of electrolytic iron in the form of tubes, sheets, and wire per annum, would be £108,295, and the cost per ton of production £5 5s. 3d.

THE POSTMASTER-GENERAL'S ANNUAL REPORT

THE fifty-fourth report of the Postmaster-General, giving an account of the business of the Post Office during the year ended March 31st, 1908, was published on Friday. We give below an abstract of the sections relating to telegraphs, telephones, and wireless telegraphy:—

Telegraphs.

During the year 85,969,000 telegrams passed over the Post Office wires, as compared with 89,493,000 in 1906–7, a decrease of 3·9 per cent. The estimated value of the railway and canal free telegrams is £56,550, against £59,600 in 1906–7; that of the Government free telegrams £20,150, against £22,700 in 1906–7. The decrease in the number of telegrams is, to some extent, apparent only owing to the basis of computation having been somewhat altered, with the view, primarily, of giving a more accurate presentment of the amount of work actually done by the Post Office in connection with telegrams. The decrease in the number of ordinary telegrams is most marked in the case of London local traffic, and is attributed to the increasing popularity of the telephone.

The loss to the State on Press messages, which pass at the special rates prescribed by the Telegraph Act of 1868, is estimated at about £225,000 a year.

Steady progress has been made with the underground tele-

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graph line between Edinburgh and Glasgow. The line to the West of England will, it is hoped, reach Penzance in the financial year 1908–9, with a spur to Plymouth, as well as to Weston-super-Mare. The construction of this line will greatly diminish the risk of interruption in the important cable routes which start from the West and South-West of England. Underground lines from Birmingham (southwards) and from Bristol (northwards) are being put in hand, with a view to a line hereafter between those two cities; and progress is also being made with the underground line which is to connect Newcastle-on-Tyne with Leeds, and so with the main underground system. The section from Newcastle to Durham has been completed.

The International Telegraph Conference which has just concluded its labours at Lisbon, although not falling within the year 1907–8, may perhaps be referred to. The British delegates were Sir H. Babington Smith, K.C.B., C.S.I., Mr. A. M. J. Ogilvie, Mr. R. J. Mackay, and Mr. F. W. Horne. No very important changes were made by the Conference; but various smaller measures have been agreed to which will help to facilitate international telegraphy, and will be to the advantage of the public. In the International Telegraph Regulations, the Conference incorporated regulations which deal with the acceptance, wire-transmission, and delivery of wireless telegrams to and from ships, and with the accounting arrangements in respect of such telegrams, so that the wireless telegraph installations on ships and shore stations are now for purposes of public communication joined to the general telegraph and cable system in most countries of the world. One of the subjects discussed at the Conference was that of Code Telegraphy, and the Lisbon Conference, while maintaining the privilege of using artificial words, has adopted measures designed to check the tendency shown in some codes to depart altogether from a reasonable standard of pronounceability.

Wireless Telegraphy.

During the year 39 licences (covering 58 installations) have been granted under the Wireless Telegraphy Acts. Of these, 37 were for experimental purposes and two for private business purposes. Since the end of the financial year the Postmaster-General has licensed installations at Liverpool for general public communication with ships, and installations at Heysham Harbour and Parkeston Quay for public communication with the packets of the Midland and Great Eastern Railway Co. respectively. Under the Order in Council of February 29th, 1908, licences have become necessary for radio-telegraphic installations on board British ships on the high seas. Licences are in preparation, and will shortly be issued to a considerable number of ships. The formal ratification of the Radio-Telegraphic Convention of 1906 has now been deposited; and the Government has also adhered to the Convention on behalf of the whole of the British Empire, except Newfoundland, which has decided not to adhere for the present, and the Orange River Colony, which, as an inland country, sees no necessity for adhesion. The Convention has been ratified by the great majority of the other signatory Powers, and came into operation on July 1st, 1908. The Marconi Co. has accepted the position, and decided to co-operate with the Government in giving effect to the Convention and the regulations annexed to it. The Post Office has continued during the year to collect and deliver the Marconi Co.'s telegrams to and from ships at sea under the arrangements settled in 1904. The total number of outward telegrams dealt with during the year was 1,725, as compared with 1,140 in 1906–7, and of inward telegrams 20,067, as compared with 15,853. Under the new arrangements, consequent on the coming into operation of the Convention, telegrams can now be forwarded (with the charges prepaid) from foreign countries for transmission to ships through the Marconi and other stations open for public traffic in this country, while telegrams can similarly be forwarded from this country for transmission through any foreign or colonial station so open. In connection with the Convention, a new Post Office station (which will have a range of about 250 miles) is being erected at Bolt Head, Devonshire, and will shortly be opened for public communication with ships. The Post Office stations for communication between Tobermory and Loch Boisdale (Marconi system), and between Hunstanton and Skegness (De Forest system), have continued to work satisfactorily during the year.

Telephones.

The number of telephone trunk wire centres open on March 31st, 1908, was 551, as compared with 533 on the corresponding date in 1907. During the year 342 new trunk circuits were provided, bringing the total number in use up to 2,385, containing about 80,000 miles of double wire. The capital expenditure on the purchase and development of the trunk wire system up to March 31st last amounted to £3,946,658, including an expenditure during the past year of £570,406. The total number of conversations which took place over the inland trunk wires during the year 1907–8 was 21,993,113, showing an increase of about 11 per cent. upon the number for the previous year. The gross revenue derived from the inland trunk service was £535,104, as against £480,658 in 1906–7, an increase of 11·3 per cent. The average value of each conversation was slightly more than in 1906–7, namely, 5·84d., instead of 5·82d. The receipts for the Continental Telephone Service for the year 1907–8 were £21,187, as against £20,166 for the previous year. The reduction of fees above 6d. for trunk calls made between 7 p.m. and 7 a.m., which took effect on October 1st, 1906, has resulted in a large increase in the number of calls. Not only has the loss of revenue been made good, but there has been an actual increase of about 12 per cent. In addition to 101 exchanges, 93 public call offices connected with the Post Office trunk line system were opened at places where the number of prospective subscribers was not sufficient to warrant the opening of an exchange. The total number of subscribers to the Post Office provincial telephone exchanges on March 31st, 1908 (excluding those at Glasgow and Brighton) was 11,579, as compared with 10,010 on March 31st, 1907; and the number of exchange telephones rented increased during the year from 13,232* to 15,785. This increase in the number of subscribers is the result of the normal development of the provincial telephone system of the Post Office. There has been a slight decrease in the number of the subscribers to the system taken over in 1906 from the Corporations of Glasgow and Brighton. On March 31st, 1908, the number of exchange telephones on the Glasgow system was 12,151, and the number on the Brighton system was 1,768. Steps are being taken to put the systems on a better footing.

On the question of telephone charges, it is pointed out that the present tariff is to some extent experimental; and further experience under the new conditions which will arise after 1911 will show whether its requires modification. Much interest has been shown during the year in the method adopted by the Post Office in recording calls made by subscribers. A committee of the London Chamber of Commerce, which made a thorough investigation of the system in use at the larger exchanges of the department, have satisfied themselves that the measures taken to secure the accuracy of the accounts rendered to subscribers are efficacious, and that the percentage of error, which is very small, is in favour of subscribers and not of the Post Office. There are now only two municipal telephone systems in the United Kingdom, viz., Hull and Portsmouth, and the number of telephones connected is 2,445, and 2,545 respectively. The sum received as rental in respect of private wires was £185,269, as compared with £183,008 for the preceding year. The number of telephones connected with the Post Office telephone system in the metropolitan area increased during the past year from 41,236 to 48,032, and additional subscribers are being connected at the rate of about 160 a week. The City Exchange, situated in the same premises as the Central Exchange, was opened during the year, and new exchanges have been established at Southall and Hornsey. It has also been found necessary to enlarge the London trunk exchange in order to provide accommodation for the additional circuits which, owing to the rapid development of the trunk system, will shortly be brought into use. There were 534 Post Office call offices open in the London area on March 31st last, and the number of calls made from call offices increased by nearly 55 per cent. during the past year. The length of the underground pipes which had been laid in the metropolitan area for telephone purposes up to March 31st last was 2,227 miles, 197 miles of which were laid during the year. Cables containing 383,070 miles of wire have been laid, including 95,862 miles rented by the National Telephone Co., and 43,548 miles provided for telegraphs, private wires, &c. The lines of the present subscribers and the junction lines connecting exchanges amount to 136,979 miles, and 102,357 miles of wire remain available for the future development of the telephone system. About 65,280 miles of telephone wire were laid by the Post Office in the metropolitan area during last year. The Postmaster-General has been considering whether a form of accounts could not be devised which would show more clearly the financial results of the telegraph and telephone services. He accordingly appointed a committee, on which the Treasury was represented, to report on the matter. The question is a very complicated one, and the committee has not yet finished its work; but, in accordance with their preliminary recommendation, the Estimates for 1908–9 have been presented to the House of Commons in such a way as to show separately the expenditure involved in the telegraph and telephone services. The amount of royalty received during the year from the National Telephone Co. was £269,789, and from other licensees £2,677. Having regard to the transfer of the National Telephone Co.'s system to the State at the end of 1911, arrangements are being made so far as practicable to prevent unnecessary duplication of plant during the period which still remains for the dual development of the telephone system in this country. The mileage of wire provided on rental terms by the Post Office for the company and by the company for the Post Office is constantly increasing. The company's Central Exchange at Cardiff is accommodated on Post Office premises, suitable rental being paid by the company for the facilities that are being afforded; and similar arrangements will be made in other cases.

Negotiations are also being carried on as to the development of the telephone service in those areas where competition has led to the duplication of wires and plant in general. The Post Office has to deal at present with 946,165 miles of wire distributed as follows:—Public telegraph wires, 274,183 miles; telephone wires, 482,394 miles; leased and other wires maintained by the Post Office, 189,588 miles. The new buildings for the central power station at Blackfriars are nearly completed, and the foundations for the engines, &c., are being laid.

* The figures for 1906-7 have been adjusted.

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THE TRACKLESS TROLLEY SYSTEM

Report of the Manchester Committee

THE deputation appointed last July by the Manchester Corporation Tramways Committee to inspect the trackless trolley system in operation in certain towns in Germany has now presented its report. The deputation consisted of the chairman, deputy-chairman, the chairman of the Permanent Way Sub-Committee, and the general manager, Mr. J. M. McElroy, to whose courtesy we are indebted for a copy of the report.

The introductory portion deals with the general question of transit facilities for suburban districts, and considers the two following questions :—(*a*) How far is it desirable and advantageous to extend the tramway system into the suburban and thinly-populated outside districts, having due regard to the financial stability of the undertaking? and (*b*) when a reasonable limit of extension has been reached and some means of transit is desired beyond that limit, what is the best system to adopt? It is pointed out how the cost of operating tramways may be divided into running expenses, which remain approximately constant no matter how the total car mileage increases, and standing expenses, which *decrease* as the number of car miles per mile of track *increases*.

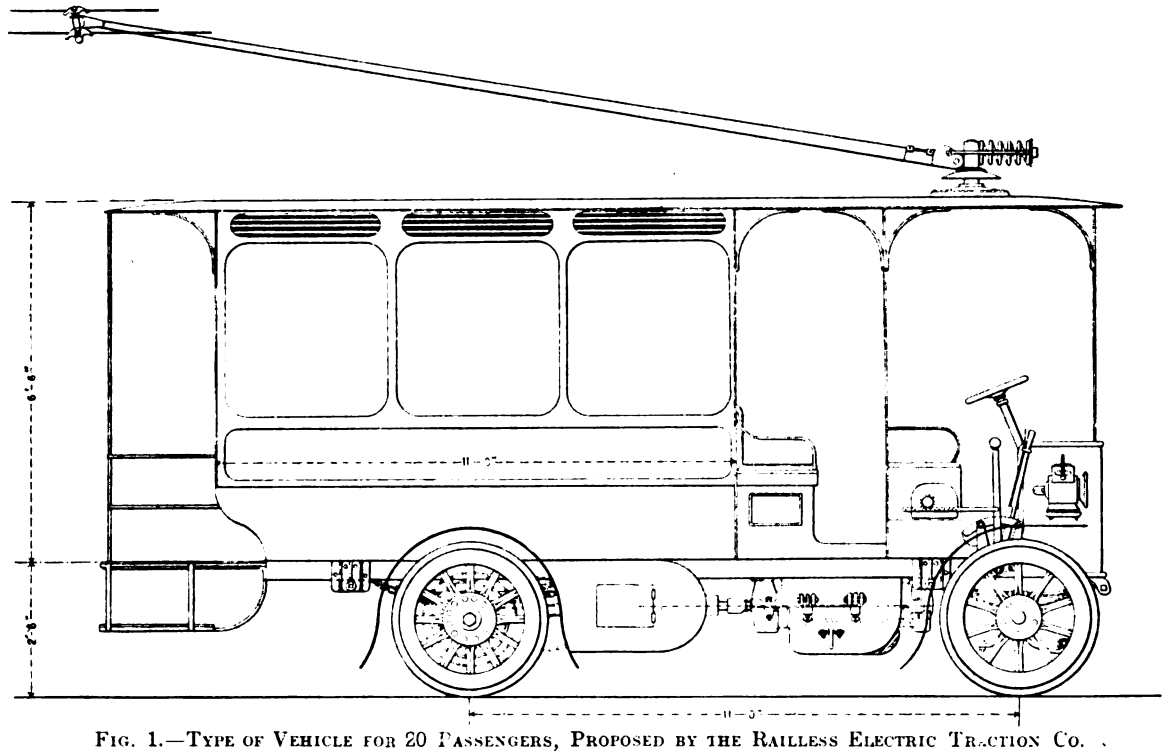

FIG. 1.—TYPE OF VEHICLE FOR 20 PASSENGERS, PROPOSED BY THE RAILLESS ELECTRIC TRACTION CO.

In illustration of this, a table is worked out to show how such expenses increase per car mile as the number of car miles per mile of track increases. Taking extreme cases, it is seen that, taking a figure of £380 per mile of single track, with a half-minute service the standing expenses are 0·138 pence per car mile only, whereas with a half-hour service they reach the sum of 8·26 pence per car mile. Taking the receipts at 11d. per car mile and the running expenses at 8·5d., *i.e.*, the surplus receipts at 2½d. per car mile, it would appear from the table that a nine-minutes' service is the economic limit. When dealing with the question of extension of a tramway system, however, the earnings and expenses of the extension must not be viewed as if such extension were a separate undertaking to be operated apart from the general tramway system. It must be remembered that, generally speaking, extensions tend to increase the value of the existing lines right from the centre of the city, and, therefore, the economic limit may be placed at a less frequent service than nine minutes. It may be safe to say that the economic limit would probably be reached on routes which would provide suitable revenue for a commencing service of, say, ten to fifteen minutes—provided that the length of the extension is not too great compared with the length of the existing line measured from the centre of the city.

The report then considers briefly the advantages of tramways for city traffic over mechanically propelled vehicles running independent of rails and independent of a central power station, as regards running expenses, ability to handle extra traffic at rush hours, and the overload capacity of the power station. In connection with this last point, it is pointed out that the work which a tramcar has to do varies considerably at different times of the day and at different periods of the year. In winter, when the track is in a bad condition, the tractive effort required reaches its highest point, but this may only occur for a few weeks. It is better and more economical to generate energy to provide for these "peak" loads in large quantities in a central power station than to provide each separate vehicle with an equipment for generating or for storing its own energy, which may only be called upon for its maximum output a few times a year, but which will have to be carried about by the cars all the year round. The motors in tramcars are capable of dealing with these exceptional loads whenever they occur, and, whilst the cheapness of generation in central stations is somewhat neutralised by having to transmit the energy through feeders to the trolley lines, yet on the whole the advantages of such stations for the working of large tramway systems are altogether too great for us to think of generation in small quantities in automobiles.

The only field for the motor 'bus is (*a*) in towns or cities where tramways are not permitted, or (*b*) in suburban districts where the traffic is not sufficiently great to warrant the laying down of tramway rails, and in the latter districts it will have a competitor in the trackless trolley. For providing means of transit beyond the economic tramway limit the trackless trolley system claims consideration. Briefly it may be said to employ vehicles operated by electric motors obtaining their energy from overhead trolley lines, which are in duplicate—positive and negative. The vehicles are, of course, subject to the usual disadvantage of all vehicles which run on the ordinary roadway instead of on rails, namely, that the tractive effort is greater, the difference between the two varying, of course, according to the condition of the road surface.

The report then describes the three trackless trolley systems inspected by the deputation in Germany. A number of particulars of the working of these lines have already been given in our columns in connection with the Dundee report upon the same subject (see ELECTRICAL ENGINEERING, July 30th, page 184). That connecting the townships of the Monheim and Langenfeld near Cologne, was opened for traffic in 1904, and is 2½ miles in length. The overhead equipment is of the bracket-arm type, and there are two trolley wires. The passenger car is a single-deck vehicle equipped with a 25-h.p. motor, with a front-axle drive by ordinary gear wheels. The car is able to carry 30 passengers, and its total weight is 4 tons 15 cwts. The front-axle weight is 3 tons 4 cwts., and the back-axle weight 1 ton 11 cwts. The two rigid trolley booms are 18 ft. long, and are so constructed as to be able to swing round in all directions, to allow the cars to move about 10 ft. from

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the centre of the trolley line in a lateral direction. They are fitted with special contact shoes, about 5 in. long.

A more recently constructed line is that connecting the townships of Neuenahr, Ahrweiler, and Walporzheim. This was opened for traffic in 1906, and is a little over three miles in length.

The rolling stock is an improvement on that seen at Monheim, being much lighter in construction. The cars are single-deckers, and weigh 3 tons 2 cwt., as against 4 tons 15 cwt. in the earlier constructed line. The seating capacity is 20, but a number of passengers are allowed to stand. The cars are driven from the front axle by a 20-h.p. motor, and the front wheels are rubber tyred, the back ones steel tyred. Two-thirds of the weight is carried on the front wheels, and one-third on the back. There are two trolley booms on each car. These are fitted with sliding shoes for making the connection with the trolley lines, and they appear to give no trouble whatever in actual working. Lightly-constructed trailer cars, weighing 32 cwt., and fitted with rubber tyres, are run during the busy hours. The trailers are provided with seats for 19 passengers.

In the town of Mülhausen the most up-to-date system of the trackless trolley has been equipped. The overhead equipment consists of four trolley lines—two positives and two negatives. This does away with the necessity, when cars are passing, of one of them pulling off their trolleys, or providing special passing places. The cars are very similar to those at Ahrweiler, with the exception that they are somewhat lighter in construction (weighing only 54 cwts.) and have only one trolley boom. This is fitted with a special double pole connection for taking current from the trolley line.

The result of their inspection convinced the deputation that in the towns they visited the authorities had succeeded in getting what they set out to obtain, namely, a means of transit at the lowest possible operating costs—costs which the small revenue from the sparsely populated districts just about cover. The report continues :—It was interesting to see the improvements effected between the earlier and the later constructed lines, and the following is a brief summary of the system as developed to date :—A lightly-constructed overhead equipment with bracket-arms and four trolley lines fed with electrical energy carried by overhead cables. Specially designed overhead fittings for ensuring the safe working of the positive and negative lines.

Small single-deck cars equipped with single motors, with a front-axle drive. Controllers of the barrel type, with five power notches and four rheostatic brake notches. To minimise maintenance expenses, rubber tyres fitted on the front wheels only. Single trolley booms, with a double shoe attachment for taking current from the trolley lines. Trailer cars used during the busy hours.

The deputation consider that the system as seen by them in Germany will require some modification if it is to satisfactorily fulfil our English conditions. The type of 'bus would have to be materially altered. The front-axle drive which the Germans have adopted renders the steering gear somewhat ineffective. 'Buses driven from the back axle, with all four wheels rubber-tyred, would be necessary for our requirements.

The Railless Electric Traction Co., of London, have been giving consideration to the problem of providing a design of trolley car suitable for English conditions, and they are proposing a single-deck 20-passenger car, equipped with a single motor of the ordinary tramway type, driving the back axle through differential gear, counter shaft, and Renolds' silent chain. The report considers, however, that this size of car is too small to be commercially useful unless trailer cars are used. The general arrangement of the car proposed is shown in Fig. 1.

In reviewing the financial aspect of the question and making comparisons with petrol omnibuses, it is remarked that trackless trolleys would be cheaper to operate than internal combustion motors, mainly under two heads—general maintenance and depreciation. As regards reliability, the report says :—We must say that we have more faith in cars equipped with tramcar motors satisfactorily fulfilling this requirement than we have with internal combustion or steam engines as developed up to the present time; and a visit to London—where numbers of 'buses which have broken down on their journeys may be seen—tends to confirm this view. Other advantages of cars equipped with electric motors—as may be judged by travelling in an "electrobus" in London—are that there is less vibration, less noise, and no smell.

"Trackless trolley cars" act as pioneers for tramway extension—as a means of developing traffic before going to the expense of laying down rails. When the time arrives for the construction of tramways, the overhead equipment can, with slight modification, be adapted for tramcars, and the trackless trolley cars can be transferred to other routes.

The report concludes :—We have consulted the Board of Trade on the subject of the powers necessary for equipping and running the trackless trolley, and they advised that a suitable clause should be inserted in the Bill which we understand will be promoted by the Corporation in the next session of Parliament, and we recommend that this course be adopted. This will cause some delay, but, in one sense, that is an advantage : it will give us more opportunity of fully considering the type of car and car equipments best suited to our requirements, and it will give time to the Railless Traction Company, who are introducing the system into this country, to further develop their plans for the modification of the German system so as to bring it more into harmony with English conditions.

PETROL-ELECTRIC CARS ON THE HUNGARIAN RAILWAYS

For some time experiments have been in progress on the Arad-Csanad Railways in Hungary on the use of different forms of traction for independent coaches and short, light trains, which have resulted in the partial replacement for the lighter traffic of steam traction by cars driven by petrol engines with electric transmission. The experiments were commenced some six years ago with cars provided with equipments of 40 h.p., but, as will be seen below, some larger cars are now also employed, and the system has since been extended to such an extent that more than 1,800,000 train miles have been covered in this way, and the result of the improved conditions has more than doubled the receipts during the last five years.

Some particulars of this car and of the results of working are given in *Le Genie Civil*. The equipment of each motor coach comprises a petrol engine coupled directly to a continuous-current generator, which supplies current to ordinary series-wound traction motors geared to the driving axles and provided with apparatus for series parallel control. Batteries are not employed. The generating sets are contained in the driver's cab at one end of the vehicle, and the radiators for the engine-cooling water are placed on the roof. In the smaller cars a single driver has control of the equipment, but in the faster cars for longer distances a separate mechanician is carried. An illustration is given in the article referred to of a mixed train consisting of a Westinghouse 40 h.p. petrol electric car weighing 13 tons, drawing a 6·3-ton passenger trailer and an 8-ton goods van. This latter is constructed for a 6-ton load, so that with the full complement of 90 passengers and two attendants the train has a total weight of 40·8 tons. Passenger trains consisting of one motor coach and two trailers, seating in all 198 passengers and of a total weight of 35·26 tons, are also run. These vehicles are all four-wheeled, and the wheel base of the motor coaches is about 26 ft. The speed of this train is from 22 to 25 miles per hour. The 40-h.p. engines have four cylinders, 120 mm. diam. by 140 mm. stroke, with Simms-Bosch low-tension magneto ignition, and when towing one trailer at 22 m.p.h. consumes about 0·2 gallon of petrol per mile.

The larger cars already referred to are equipped with 80-h.p. engines, with six cylinders, each 135×155 mm., running at a normal speed of 900 r.p.m., with high-tension magneto ignition and driving 50-kw. generators. These cars weigh 16·3 tons, and in the standard three-car passenger train they draw two 6·3-ton trailers, giving a total weight, including 134 passengers, of 38·3 tons. They are capable of running under these conditions at from 34 to 38 miles per hour.

In a summary of the results of working it is stated that the average working expenses per ton kilometer from 1900 to 1906, for petrol electric traction, were from 1·4 to 1·533 heller (one heller is a hundredth part of the Austro-Hungarian krone, and is thus approximately equal to one-tenth of a penny), as against 0·74 to 0·894 heller for ordinary steam goods traffic and 1·094 to 1·129 heller for ordinary steam passenger traffic. As, however, the average receipts per ton mile for petrol electric traction were 3·007 heller, as against 1·580 for goods and 0·935 for passengers with steam working, the increased working cost has been amply justified. It is interesting to note that the dead weight of train per passenger with the system under consideration is 0·255 tons, as compared with 1·09 tons in the case of the ordinary steam trains formerly employed on the same lines.

There are at the present time 37 of these motor coaches in use on the Arad-Csanad Railways, including some of 30 h.p. capable of running about 20 miles per hour. Including experimental cars, 41 have been constructed and 13 more, of 40 h.p., are on order. The capital expenditure incidental to the adoption of the system has been 2,026,000 krone (about £84,500), and the result of its introduction has been to convert a loss of 180,000 krone of previous years on the passenger working to a profit of 24,000 krone in 1905 and 300,000 krone in 1907.

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Supplement to "Electrical Engineering" of Oct. 1, 1908.

THE MANCHESTER ELECTRICAL EXHIBITION OF 1908

PART I.

Published by

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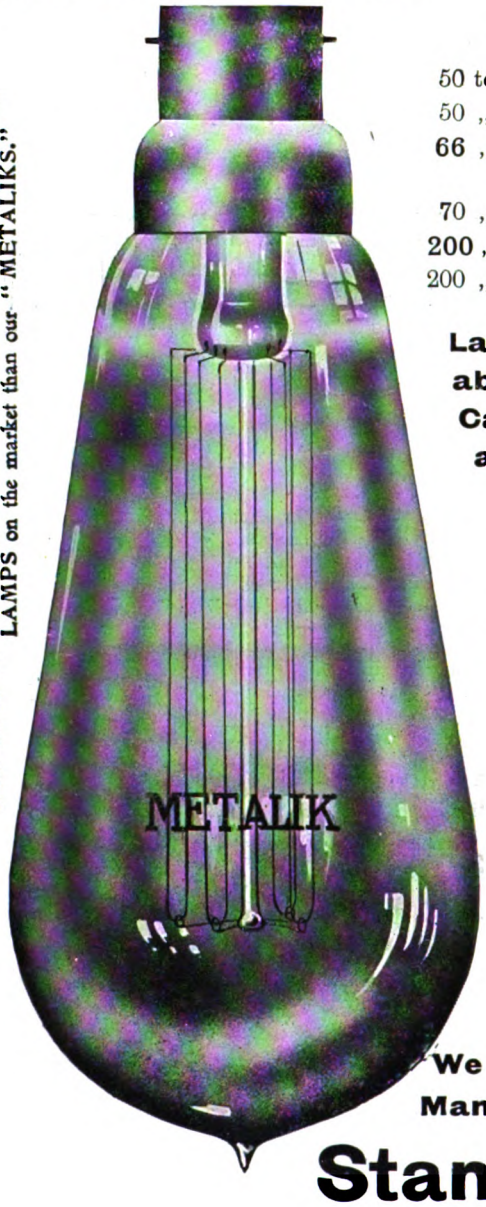

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THE

MANCHESTER ELECTRICAL EXHIBITION

OF

1908

OF all the trades and industries, electrical engineering is probably the one which can derive the greatest benefit from a properly organised exhibition, promoted by a representative committee of men, and recognised by the leading societies and institutions devoted to the interests of which it is the exponent. Any exhibition that is not merely a pleasure ground has for its object the improvement of some particular industry, either by bringing its products before the general public in an attractive manner, or by affording an opportunity for the various trading members of the industry and the allied industries to meet and inspect one another's wares, thus assisting the free buying and selling upon which business prosperity must necessarily depend.

An electrical exhibition, however, is beneficial in both these directions. The applications of electricity appeal directly to the public in a hundred ways. Progress is being made in electric lighting; and every householder and every business man is interested in ascertaining the very latest modifications in the science of illumination, the improvements that are constantly being made to promote economy and convenience, and the newest ideas in artistic designs of fittings. Electric heating and cooking appeals to the general public also, even if to a limited extent, as do likewise the advances that are being made in telephony and telegraphy. At the same time the supply station engineer and the wiring contractors desire to keep themselves informed of the various details of the new current-consuming devices, and the former must know of all the improvements that are being made in the design of generating machinery, its auxiliary plant, and distribution devices. The manufacturer of these things has to keep himself acquainted with the developments in machine tools and other labour-saving machines, and with the various mechanical parts that he uses but does not make himself. The mechanical engineer, again, and the manager of practically every manufacturing concern now take a keen interest in electric driving. All this is facilitated by an exhibition which brings together specimens of manufactures, machinery, and plant that are ordinarily distributed all over the country, and, what is equally important, an occasion which brings together and into more or less intimate contact the people who make, sell, and use them.

Apart also from its purely utilitarian aspects, an exhibition of this character has an educational value which must not be underrated. It has been said by a great man in one of those happy epigrammatic expressions that combine humour, terseness, and accuracy that a truly educated man knows something of everything and everything of something. The man of education is, in fact, a student all his life, and to him an industrial exhibition is a welcome means of extending his knowledge to those things of which he has still to learn "something."

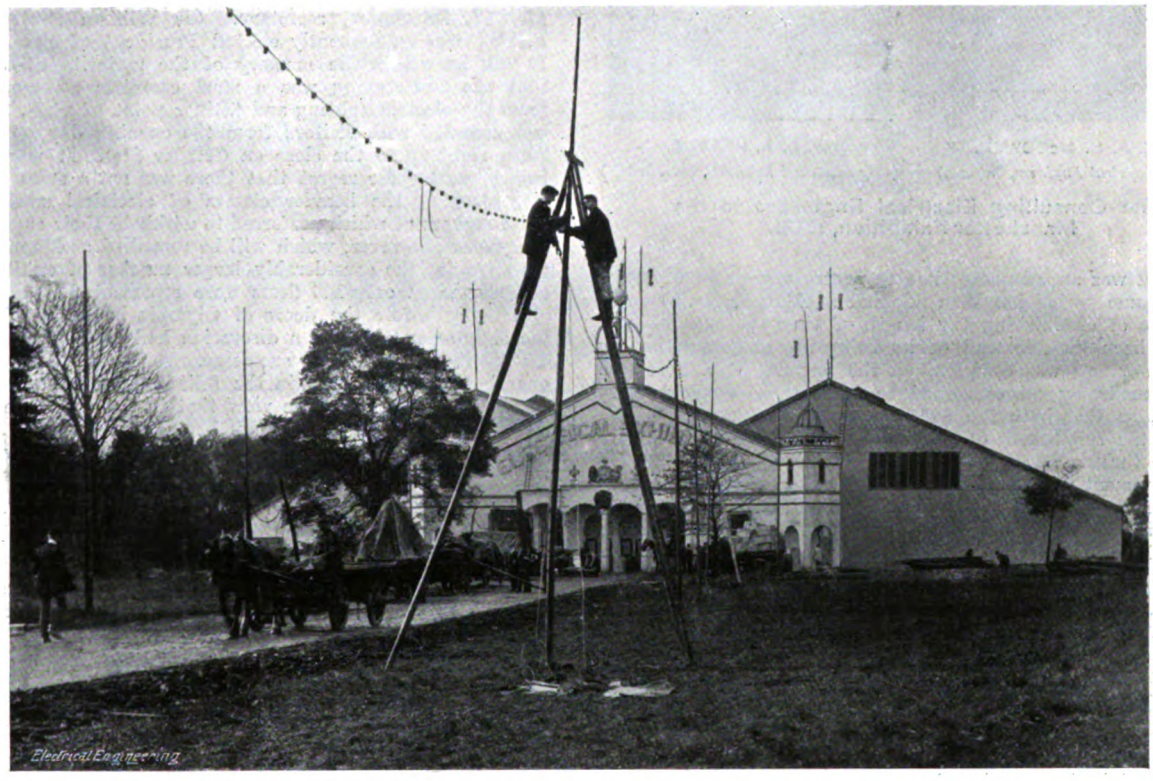

Fig. 1.—Erecting String of Lamps for Illuminating the Approach to the Exhibition.

It is, however, for the more selfish considerations that the electrical engineer is at present regarding the Manchester Exhibition. The electrical industry has suffered from a long period of depression, and it has probably been injured more than any other by the falling off in the general commercial activity of the country during the past few years. At the present moment a decided revival has taken place so far as electric lighting is concerned, fostered by the recent improvements in the incandescent lamp. It may confidently be anticipated that the present exhibition will assist in extending this revival to the other branches of electrical engineering.

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SOME HISTORICAL NOTES

Leaving out of account the innumerable small local exhibitions which have been held in different parts of the country during the past few years—enterprises which have not always been regarded as a blessing by electrical manufacturers—the Manchester Exhibition of 1908 will be the fourth national electrical exhibition held in Great Britain during the 25 years' existence of the electrical industry here. The previous ones were held at the Crystal Palace in 1882 and 1892, and at Olympia in 1905. One sensible improvement has been made in the length of time such exhibitions are now allowed to run. The two Crystal Palace exhibitions were open for six months, whereas it was found that

Mr. V. A. H. McCOWEN.
(*Borough Electrical Engineer, Salford.*)

Mr. S. L. PEARCE.
(*City Electrical Engineer, Manchester.*)

The Consulting Electrical Engineers to the Manchester Exhibition, 1908.

one month was an adequate time to secure success at Olympia, and the same period has been adopted at Manchester. One of the results of diminishing the length of time the exhibition is open has been that, instead of its being the exception that an exhibitor's stand was complete on the opening day, a serious effort is made by all concerned to have their displays fully equipped, so that both the exhibitors and the public are able to derive the full benefit of the exhibition from the moment the doors are thrown open. In another direction, however, where an improvement might have been expected, one cannot but feel a sense of disappointment. When the remarkable growth of the industry is taken into account, it is a fact of more than ordinary interest that at the Crystal Palace Exhibition of 1882, inspired by the Paris Exhibition of the previous year, and mainly devoted as it was to electric lighting and telegraph work, the exhibitors numbered very few short of those at Manchester. They included a score of makers of magneto- and dynamo-electric machines; batteries and telephones were exhibited in similar quantities; and the remaining exhibits, making a total in the neighbourhood of 300, comprised, in approximately equal proportions, electric lamps and cables with a few of a miscellaneous character.

The Honorary Council of Advice at the first Crystal Palace Electrical Exhibition included Prof. Ayrton, Dr. John Hopkinson, Sir (then Mr.) William Crookes, Dr. Fleeming Jenkin, and Dr. C. W. Siemens, with Major Flood Page as general manager, and the exhibition, which was of more scientific than engineering interest, was honoured with visits by Royalty. The main feature of the Exhibition really was electric lighting. Weston and Brush arc lamps were shown, in addition to Edison and Swan incandescent lamps, to say nothing of the Jablockhoff candle, which was at the time in the height of its spluttering and dazzling ascendency. And it was in this year that the gas industry first gave evidence of its now notorious capacity for emulating both the methods and the practices of the electrical engineer. Stirred by the undoubted impression made upon the public mind by the advantages of electricity which were demonstrated at the Crystal Palace, a gas exhibition on similar lines was organised there in the following autumn.

Unlike the exhibition of 1882, which was a private speculation, that of ten years later was run on broader lines; the Crystal Palace Co. organised the exhibition, upon the suggestion of the London Chamber of Commerce, and gave the necessary space to exhibitors free of charge. A point of similarity, however, was that whereas in 1882 many foreign exhibits were transferred to London from the Paris Exhibition, which had been recently closed, in 1892 exhibits were transferred from the Frankfort Exhibition. Great strides had been made in electric lighting and in electrical machinery during the previous ten years, and consequently the exhibits were of a much more engineering character than in 1882, although the number of exhibitors was considerably less—about 200. The Advisory Committee in this year included many who took office in 1882, with the addition of Mr. S. Z. de Ferranti, Mr. J. E. H. Gordon, Mr. Gisbert Kapp, Mr. W. H. Preece, Major Cardew, Mr. Alex. Siemens, and others, who were assisted by a sub-committee appointed by the London Chamber of Commerce.

A long interval was allowed to elapse before the idea of another exhibition of a similar character was mooted. The suggestion eventually came early in 1905 from the National Electrical Manufacturers' Association in deference to the feelings of their members, who were at the time coming to the conclusion that the expense of sending machinery and apparatus to the many small local exhibitions, which had become quite a fashion, was not justified by the moderate results obtained. Electrical contractors and supply authorities gave their support to the proposal, which at once took definite form to the exclusion of a proposal, from other quarters, to hold a similar exhibition at the Crystal Palace. The Executive Committee, which included representatives of electrical manufacturers, municipalities, and supply companies, was presided over by Mr. E. Cunliffe Owen, C.M.G., of the Metropolitan Electric Supply Co., Mr. C. S. Northcote (Verity's, Ltd.) being elected deputy chairman, and Mr. W. Davenport, secretary. Sir William Preece, K.C.B., F.R.S., was subsequently elected President of the Exhibition. It will be within the memory of the majority of our readers that the undertaking was a most complete success, especially from the electric lighting and fittings point of view, and that it was crowded with visitors from the opening day on September 25th, right up to the close on October 21st. It was, nevertheless, a matter for regret that there was not a more representative show of the heavier classes of electrical machinery, the chief makers of which preferred to withhold their support. This is a defect, however, which will be remedied at Manchester, and accounts for the considerably larger number of exhibitors than in 1905, when only 140 firms were represented.

Actually before the doors of Olympia had been closed upon the Exhibition of 1905, a discussion had taken place as to the desirability of holding a successor. It was even suggested that one should be organised in the following year, but the Council of the Association held the view that it would not be politic to entertain the idea of holding another exhibition for at least three years. The matter was not discussed again seriously until the annual meeting of the National Electrical Manufacturers' Association, in April, 1907, when there was considerable difference of opinion about a suggestion emanating from the Manchester district, that an exhibition should be held there in the autumn of 1908. The general impression at this meeting was that whether the members of the National Electrical Manufacturers' Association acquiesced or not, the electrical engineering interests in Lan-

Mr. W. DAVENPORT.
(*Secretary of the Manchester Exhibition, 1908.*

Mr. C. S. NORTHCOTE.
(*General Manager of the Manchester Exhibition, 1908.*)

cashire intended to hold an exhibition, the case of which was particularly urged by Mr. Longbottom, of Electromotors, Ltd. By August last year, matters had advanced sufficiently for the announcement to be made that the Manchester and Salford Corporations had decided to hold an exhibition in their district, with their direct patronage and substantial support, in the autumn of 1908, and arrangements were then made for calling a meeting of corporation officials and supply companies' representatives in the North of England. Mr. S. L. Pearce and Mr. V. A. H. McCowen, chief electrical engineers to the Manchester and Salford Corporations, consented to act as Consulting Engineers to the scheme, and Mr. C. S. Northcote and Mr. Walter Davenport were appointed General Manager and Organising Secre-

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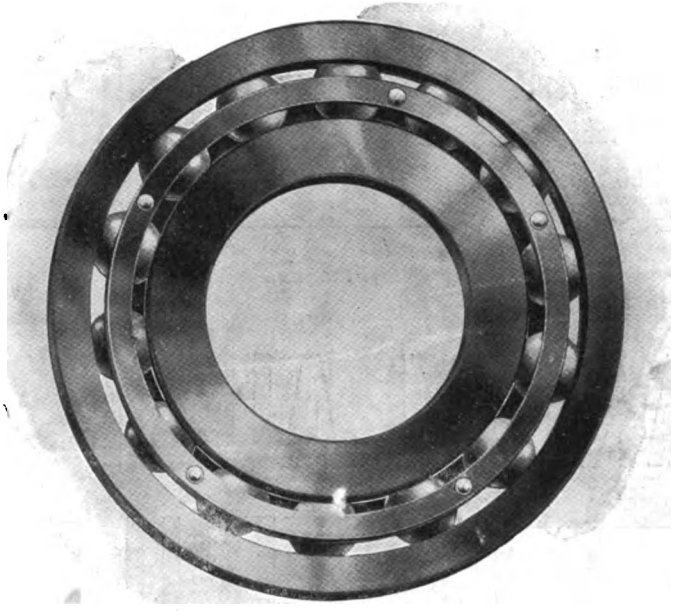

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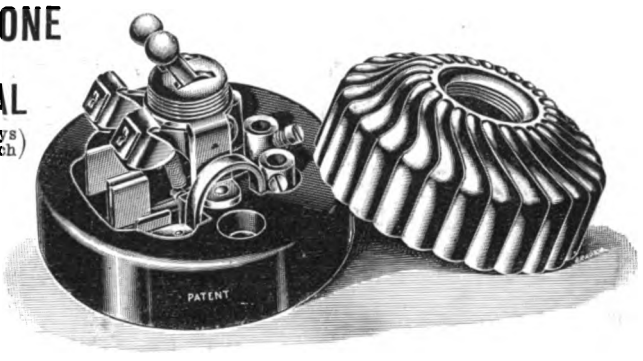

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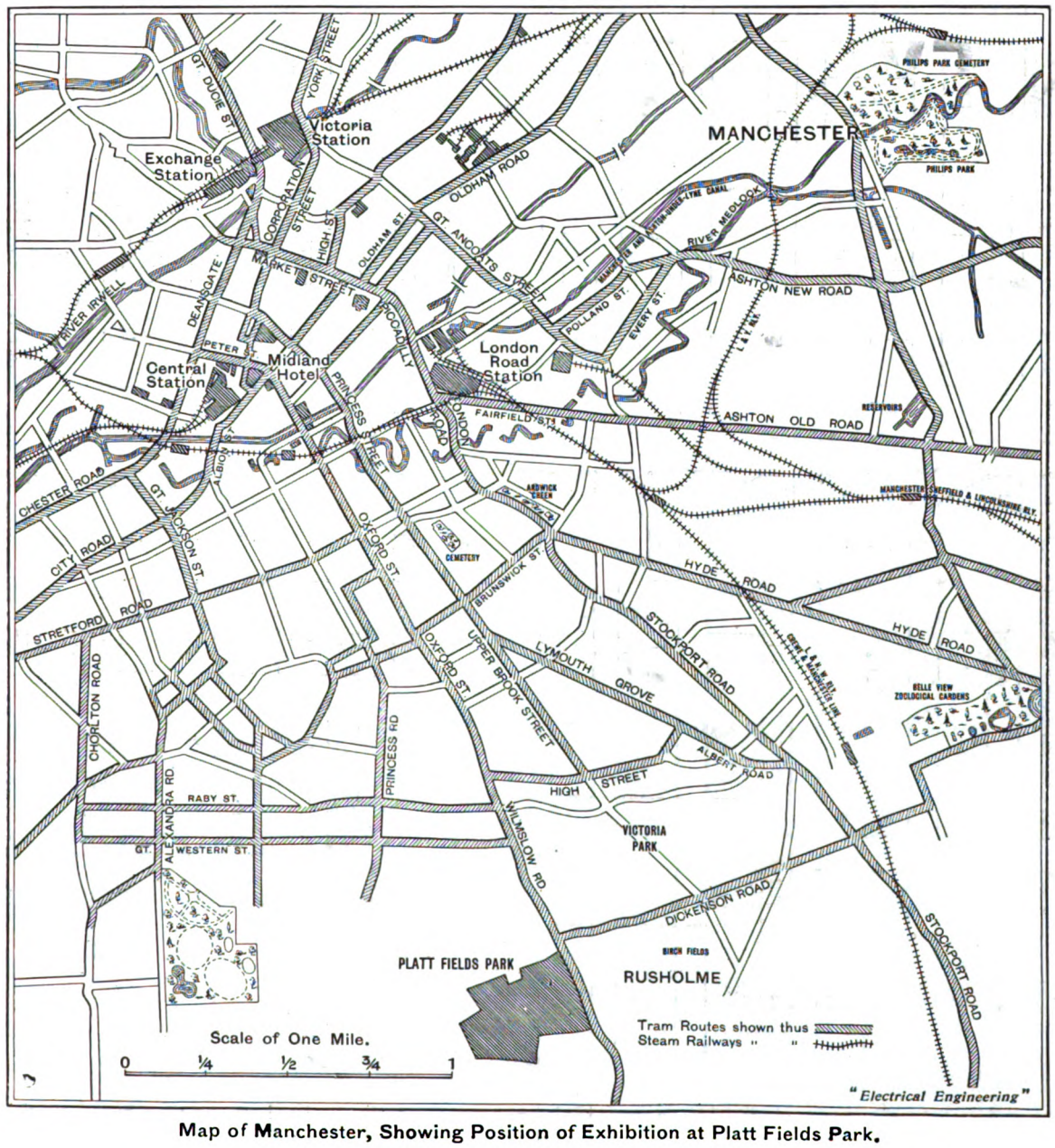
tary respectively. The support of corporations and others was invited, and generously given in the form of donations, in exchange for which tickets of admission to the exhibition, printed specially for each authority, were supplied to the various contributors for free circulation in their respective areas. We believe that in Manchester alone some 50,000 tickets have been issued to picked consumers and potential consumers. It was also found necessary, in order to find additional working capital, to form a limited company to take over the necessary financial risk and guarantees. The profits arising from the exhibition, after the guarantors have been allotted their proper share, will be partly returned to exhibitors, and sums will also be allocated to the charities connected with the electrical industry, and, in consequence of the exhibition being held in the Manchester district, to a charitable institution nominated by the Manchester and Salford Corporations, and situated within their respective districts. A somewhat similar allocation of profits was made after the Olympia Exhibition. A preliminary canvass as to the probable support by the municipalities of the United Kingdom produced, as we have said, very satisfactory results, but a notable exception was the Glasgow Corporation. The plan and lists on the next three pages speak sufficiently for the canvass for exhibitors.

SITE AND BUILDINGS

The Manchester Corporation kindly consented to allow the use of a portion of Platt Fields Park, in the important residential district of Fallowfield, without charge, a site which, as will be seen from the map below, lies about 2½ miles along the Palatine Road tramway route. The building, erected by Messrs. Davenport Sons & Co., of Manchester, measures roughly 550 ft. long by 190 ft. wide. A feature of this is that there is practically no natural lighting, so that the interior will be lighted by arc lamps all day long.

The plan which we publish on page 4 shows at a glance the disposition of the various stands, &c., and in view of the fact that the buildings consist almost entirely of wood, it may be well to mention that elaborate fire precautions have been made.

A Corporation fire engine is stationed inside the building, firemen are on duty day and night, and water mains and standpipes have been erected at all the exit doors on one side of the building, with hose which will reach any distance. The river has also been dammed to preclude the possibility of the water supply giving out, whilst in addition there are to be a number of automatic fire alarm systems exhibited in working order. There should be no risk of fire from the electrical installations, either in the body of the hall or on the exhibitors' stands, as everything has been most carefully inspected by Mr. Pearce and his staff on behalf of the Manchester Corporation, who are supplying current, but smoking is allowed.



Map of Manchester, Showing Position of Exhibition at Platt Fields Park.

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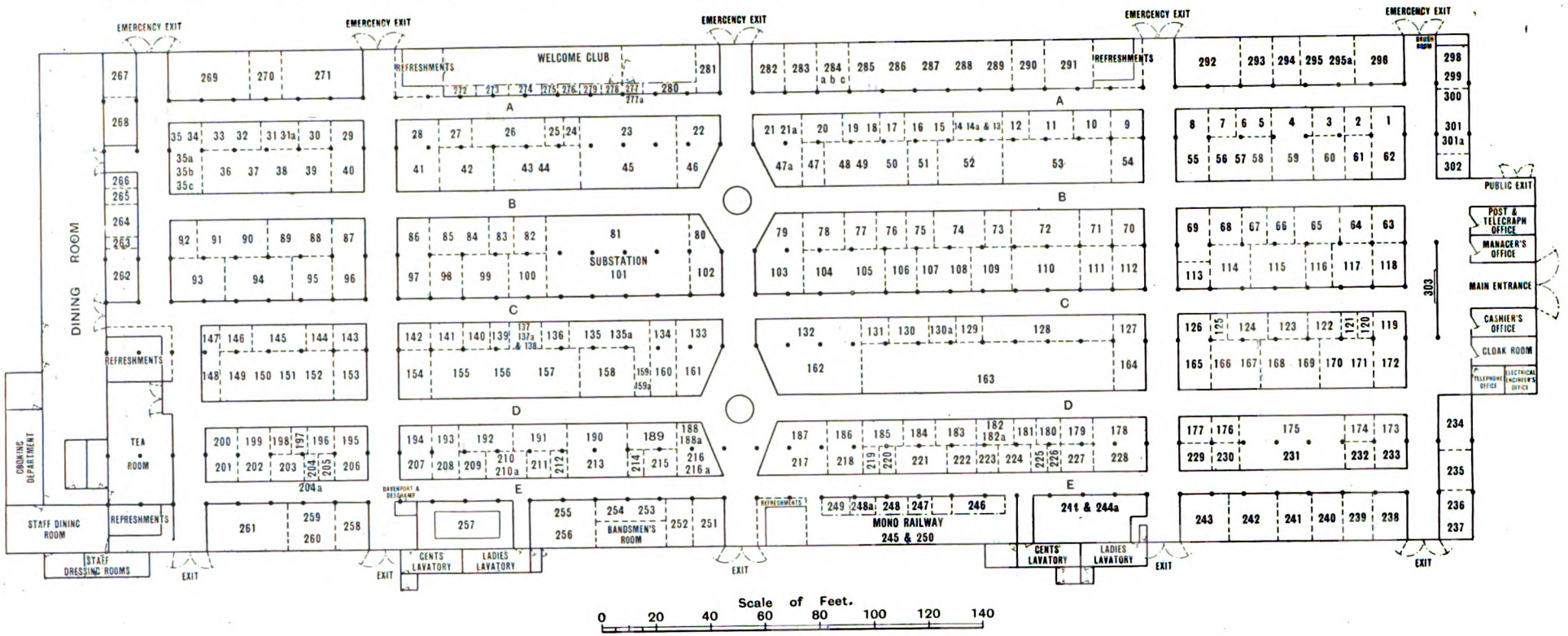
PLAN OF EXHIBITION SHOWING POSITION OF STANDS



ALPHABETICAL LIST OF EXHIBITORS

	STAND NO.
Abbey Electric Co.	204
Adams Manufacturing Co., Ltd.	130
Aërators, Ltd.	125
Aëro Automatic Fire Alarm Co.	19
Allen, Clement	303
Aron Electricity Meter, Ltd.	131
Ashton, H.	263
Asquith, W., Ltd.	168 & 169
Auto-Controller & Switch Co.	214
Automatic Machine Co.	255 & 256
Babcock & Wilcox, Ltd.	230
Bailey, W. H., & Co., Ltd.	215
Bate, D. C.	284
Bateman Machine Tool Co.	90 & 91
Bates, W. J., & Co.	290
Batty, W., & Sons, Ltd.	294
Beanland, Perkins & Co.	234
Bell Rock Belting Co.	270
Berry, Skinner & Co.	188*a* & 216*a*
Birch, G., & Co., Ltd.	15
Birch, J., Ltd.	284*b*
Blackwell, R. W., & Co., Ltd.	60
Boddy, G. M., & Co.	198
Bonnella, D. H., & Son, Ltd.	248
Bradford & Co.	285 & 286
Brady, G., & Co.	181
Brayshaw, Ltd.	259 & 260
British Thomson-Houston Co., Ltd.	48, 49 & 50
Bray, Markham & Reiss, Ltd.	20
British Insulated & Helsby Cables, Ltd.	28 & 41
British Westinghouse Electric & Manufacturing Co., Ltd.	79 & 103
Broadbent, T. W., Ltd.	31
Browett, Lindley & Co., Ltd.	21*a* & 47*a*
Brown, A. G., & Co.	14
Brown, Boveri & Co., Ltd.	4 & 59
Brown, F. V., & Co.	34 & 35
Bruce, Peebles & Co., Ltd.	101
Brunner, Mond & Co., Ltd.	129
Bullers, Ltd.	29 & 40
Bullough's Adjustable Rail Joint Support Co., Ltd.	137
Burton, Griffiths, C. W., & Co.	27
Calmon Asbestos & Rubber Works, Ltd.	182
Carbone, Le	120
Chamberlain & Hookham, Ltd.	195 & 206
Check Fire Door Co.	182*a*
Chorlton & Knowles	67
Churchill, Chas., & Co., Ltd.	292
Climax Fire Extinguisher Co.	273
Clipper Belt Hook Co.	300*a* & 301*a*
Collier, J., & Co.	262
Combination Metallic Packing Co., Ltd.	25
Concordia Electric Wire Co., Ltd.	209
Congdon & Muir	174
Consolidated Pneumatic Tool Co., Ltd.	225
Crossley Bros., Ltd.	269
Crypto Electrical Co.	302
Cunliffe & Croom, Ltd.	296
Cutler, Wardle & Co., Ltd.	265
Daniels, T. H., & J., Ltd.	34*c* & 35*c*
Dey Time Registers	122
Diesel Engine Co., Ltd.	261
Direct Gas Fuel Co.	204*a*
Dowsing Radiant Heat Co.	73
D.P. Battery Co., Ltd.	142
Drake & Gorham, Ltd.	127 & 164
Dryden & Co.	14*a*
Dugdill, John, & Co.	268
Electrical Engineering	189
Electrical Review	194 & 207
Electrician	66
Electrical Engineer	61
Electrical Times	75
Electrical Magazine	180
Electrical Field	121
Electric Journal	24
Engineer	68
Electrical Contractors' Association	149
Electric Rifle and Target Co., Ltd.	291
Ebenestos Manufacturing Co.	197
Eckstein, Heap & Co.	84
Edison & Swan United Electric Light Co., Ltd.	22 & 46
Electrelle, Ltd.	116
Electric & Ordnance Accessories Co., Ltd.	1 & 62
Electrical Power Storage Co., Ltd.	128
Electrical Press, Ltd.	148
Electric Rifle Co.	—
Electromotors, Ltd.	133 & 161
Elkington & Co., Ltd.	163
Elliott Bros.	85
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Evans, E. M., & Sons	238
Eversheds & Vignoles, Ltd.	226
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Faulkner, John	264
Ferranti, Ltd.	80 & 102
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Galloways, Ltd.	72
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Gilbert Arc Lamp Co., Ltd.	135*a* & 159*a*
Glenfield & Kennedy	5 & 6
Goodalls	163
Green, E., & Sons, Ltd.	111
Grevener, J. & H.	210
Griffin, J. J., & Sons, Ltd.	272
Hacking & Co.	64
Halcrow, J. (Nuremberg Engine Co.)	221
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Heenan & Froude, Ltd.	153
Herbert, Alf., Ltd.	87 & 96
Hodgkinson, Jas. (Salford), Ltd.	242
Hoffmann Manufacturing Co., Ltd.	126 & 165
Hopkinson, J., & Co., Ltd.	93
Howard Asphalt Troughing Co., Ltd.	229
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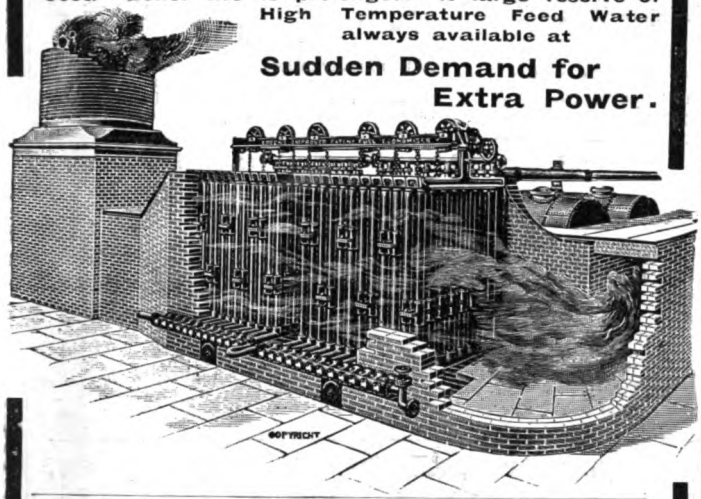

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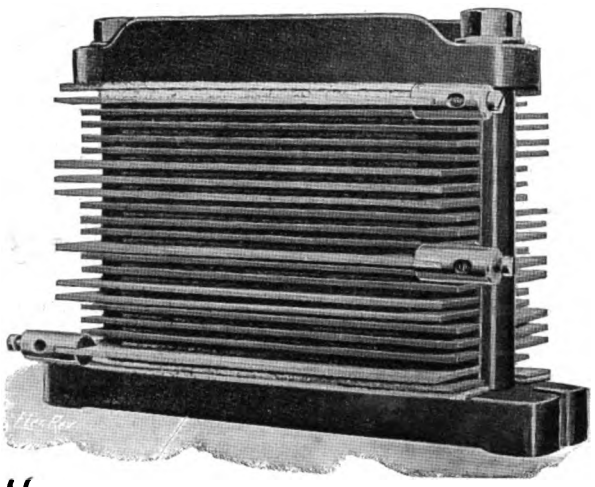

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"High Velocity" Feed Water Heaters.
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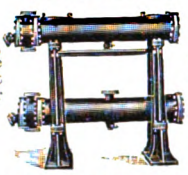

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No rivets.
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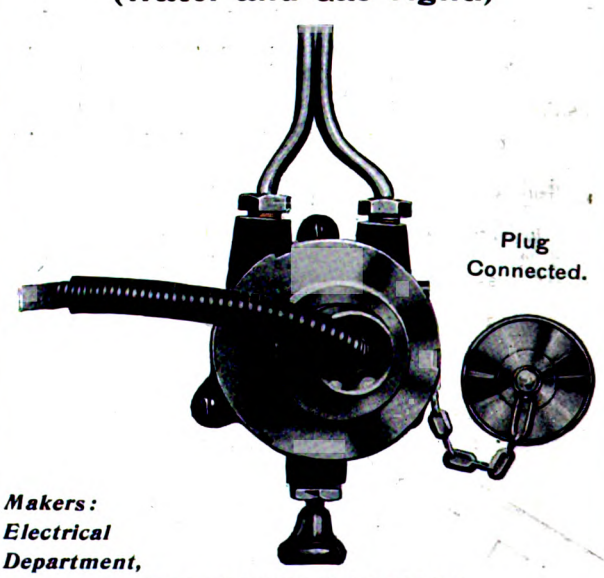

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Consulting Electrical Engineers.

S. L. Pearce, A.M.I.C.E., M.I.E.E., M.I.M.E.
V. A. H. McCowen, M.I.E.E., M.I.M.E.

Honorary Consulting Electrical Engineer.

S. G. Castle Russell, M.I.E.E.

Consulting Architect.

Albert Jennison, Deansgate Arcade, Manchester.

General Manager.

C. S. Northcote, M.I.E.E.

Secretary.

W. Davenport.

MEETINGS OF SOCIETIES AND MISCELLANEOUS ARRANGEMENTS.

A new feature of the Exhibition will be the holding of meetings of various engineering societies in the Exhibition. Among those who have decided to do so are the Incorporated Municipal Electrical Association (October 16th and 17th), the Electrical Contractors' Association, and the Rugby Engineering Society. There will also be official visits made to the Exhibition by several municipal electricity committees.

An official visit will be paid by the I.M.E.A. on Friday, the 16th inst., and a Council meeting will be held on the following morning. The quarterly business meeting of the Electrical Contractors' Association will be held on the 16th inst., and on Saturday, the 17th inst., there will be a "propagandist" meeting, when all firms outside the Association will be asked to attend. This will be an open meeting, at which the aims and objects of the Association will be explained. The meeting will be at 11 a.m., and any electrical contractor not a member of the Association will be supplied with a ticket admitting to the Exhibition on application to the Hon. Sec. of the Manchester Branch, 10 and 16 Warren, Stockport, or to the Hon. Sec. of the Association, Haymarket Lane, Percy Street, Newcastle-on-Tyne.

A glance at the plan will at once show the position of the post office and telephone office inside the building, where full facilities are available. For the convenience of those visiting the Exhibition by motor-car, a garage has been erected, and full accommodation is afforded in the dining room, tea room, lounge and Welcome Club. Arrangements have also been made for the maintenance of a special taxi-cab rank immediately outside the Exhibition, which together with the very fine service of cars which the Corporation tramway department have available, should amply meet the needs of the visitors.

It had been intended to arrange for a series of more or less popular lectures, as was done at Olympia three years ago, but we understand that this idea has now been abandoned. Nor will there be any competitions in the way of electric cooking and heating, although there will be a number of such exhibits distributed throughout the building. We are also able to state that the management has abandoned the idea of installing a wireless telegraph outfit for maintaining communication with some town in the Manchester district. The possibility of this, as an attraction, had been announced, and it is evidence of the keenness of the Government department concerned that they should have communicated with the management a few days ago inquiring as to whether this idea was to be carried into effect.

THE "ELECTRICAL HOME."

An "Electrical Home," designed, built, decorated and furnished by Messrs. Goodall, Lamb and Heighway, of King Street, Manchester, occupies a central position in the Exhibition building. This house has been constructed bungalow style in one storey, of rough cast, painted white, with red tiled roof and overhanging door canopy surmounted with the heraldic device of former owners of Platt Hall. In a panel on one of the gables an inscription has been placed in French denoting that this is the little house with the good servants. Entry is gained by an ingenious "Sesame" door, which opens automatically when the visitor steps upon the mat and closes quietly when he steps off. An electric fire is fitted in the carved mantelpiece, and there is a central ceiling lantern with wall brackets. To the visitor's left will be found a spacious dining-room, oak panelled, in the Tudor manner, with arched beams. Adjoining the dining-room is the kitchen, in which every possible operation will be carried out by the aid of electricity. In the drawing-room a crystal chandelier and wall fittings have been installed, the design of the room being in the style of the later English Renaissance. Messrs. Drake & Gorham are responsible for the electrical lighting installation and the artistic fittings, and have on their stand a 25-volt oil engine plant which supplies the current. The General Electric Co., Ltd., have fitted the cooking apparatus, and will, we believe, give demonstrations in the kitchen, and Messrs. Elkington & Co., of London, supplied the silver.

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THE EXHIBITORS' STANDS

Among the various exhibits that will attract particular interest is the miniature lamp factory, at which several skilled operators sent over specially from the Robertson Electric Lamp Works will be busy showing some of the processes in lamp manufacture. Electro Motors, Ltd., have some textile machinery in motion. Siemens Bros.' Dynamo Works show an electrical substitute for the "gassing" process in cotton manufacture. The British Thomson-Houston Co. exhibit a 1,000 kw. Curtis turbine and Messrs. Musgrave a 600 kw. Zoelly turbine with a glass cover on the wheel chamber so that the actual construction can be seen. The British Insulated and Helsby Cables have a wire-drawing machine working and also a section of 20,000-volt overhead transmission line. Messrs. Mawdsley's, Messrs. Drake & Gorham, and one or two other firms have put in complete 25-volt lighting plants for private house lighting with metal filament lamps. A new system of speed regulation for electrically-driven ring frames in cotton mills, shown by Messrs. Brown, Boveri & Co., will doubtless attract attention, as will also the new prepayment meter devices exhibited by Messrs. Reyrolle. The Post Office will have on view a historical collection of apparatus. Last, but not least, the great feature of the Exhibition will be metallic filament lamps.

These notes and the list below refer only to a very small proportion of the numerous exhibits of interest, detailed description of which will appear in our successive supplements.

To avoid any invidious distinctions, we have arranged the firms below in alphabetical order and not in order of magnitude.

The Aron Electricity Meter, Ltd.—Induction motor meters of various types. Clock meters. A complete system of clocks. Time switches. Hour counters for registering the total hours a lamp or lamps have been burning. Taximeters.

G. M. Boddy & Co.—Specimens of high- and low-voltage "Metalik" lamps, &c.

British Insulated & Helsby Cables, Ltd.—In addition to the exhibits mentioned above: Electric welders. Bates & Peard annealing furnace. House services, fuse boxes, and various switches, fuses, feeder pillar fittings, &c. The "Phantophone," an apparatus designed for simultaneous telephony and telegraphy, is exhibited for the first time altogether with a large collection of other telegraph apparatus.

British Westinghouse Electric & Manufacturing Co., Ltd.—Among this company's numerous exhibits is an automatic transformer cut-out. This consists of two auto-transformers, one to take the full load current, and one for light load. In the day-time the larger transformer is cut-out. Edgewise instruments with a V-shape scale so that readings can be taken from a distance at either end of the switchboard.

F. V. Brown & Co.—This firm is agent for Sanders Rehders & Co. (CO_2 recorders), Ross Hotchkiss & Co, (automatic "circulator," preservative compositions, &c.), and for the Daniels gas engine plant.

Crossley Bros., Ltd.—Suction gas plant. Horizontal gas engine driving a dynamo for emergency supply to the Exhibition. Arc light circuits.

D.P. Battery Co., Ltd.—Collection of storage cells, together with a specimen of plates, including the new "sponge" negative.

Drake & Gorham, Ltd.—A complete 25-volt lighting plant driven by an oil engine, and utilised for lighting the model home adjoining the stand. In the reception rooms of the home a selection of the firm's high-class fittings is shown. Jandus flame arc lamps. Motors and pumps. Switchgear. Metal filament lamps. Switches. Magnetic clutches.

Edison & Swan United Electric Light Co., Ltd.—Electric signs. Flame arc lamps. Fans. Switchgear. Measuring instruments. Lamps.

Electromotors, Ltd.—Motors with various gears. Steam and petrol sets. Textile machinery in actual operation.

The Electric & Ordnance Accessories Co., Ltd.—Dynamos and motors. Starters. Controllers. Miniature enclosed arc lamps. Flame arc lamps. Telephones. Heaters. Switchboards. The "Auto-meter," a combined speed indicator and speed recorder for use on motor-cars. Centrifugal fans.

Electrical Power Storage Co., Ltd.—Storage cells of various types. A large portion of the back of the stand is almost covered with 25-volt metal filament lamps, which are lighted from a battery of 14 cells.

The General Electric Co., Ltd.—This firm have a very large stand in the centre of the hall, and the searchlight erected on the top of it is particularly noticeable. Needless to say, Osram lamps and the fittings for them are an important feature of this exhibit.

Ferranti, Ltd.—A complete low-tension power switchboard built for their own works power station at Hollinwood.

Galloways, Ltd.—Galloway flue. Front end plate. Two superheaters. Boiler fittings.

E. Green & Son, Ltd.—Two models of Green's economisers and show case of sample tubes and specimen castings.

Hart Accumulator Co., Ltd.—A very large and representative collection of storage cells, including a battery of 30 11-plate cells, with capacity of 300 ampere hours, at the 12-hour rate. Practically every type of cell is represented from ignition batteries to large central station cells, and specimens of plates, separators, and accessories are shown.

Alfred Herbert, Ltd.—Machine tools.

The Hoffmann Manufacturing Co., Ltd.—Steel balls and ball bearings, and motors both vertical and horizontal fitted with these.

International Electric Co.—Orieco metal filament lamps. Meters. Telephone apparatus, &c.

Key Engineering Co., Ltd.—This firm have the Manchester agency of John I. Thornycroft & Co., Ltd. (motor vehicles), Cowans, Ltd. (switchgear), Ehrhardt & Sehmer (high-power gas engines. High-speed pumps.), Harris Patent Feed-Water Filter Co. (feed-water purifiers), Le "Carbone" (arc lamps), Otis Elevator Co. (elevators), Reavell & Co. (air compressors), Bat Electrical Co. (A.C. meters), Appleby's, Ltd. (lifting machinery).

Lancashire Dynamo & Motor Co., Ltd.—Motors and dynamos of various sorts, including a semi-enclosed backgeared motor. Flywheel equalising set for equalising peaks in a central station. Motor-driven winch and fan. Enclosed pipe ventilated variable-speed interpolar motor. In addition to these, motors made by the company are in use on twelve other stands.

Mawdsley's, Ltd.—"Zone" dynamos and motors, with their special winding. 200 : 25 volt motor generator for metal filament lamps, arranged in such a way as to show the increase in light given by this set and the metal filament lamps as compared with the 200-volt lamps supplied direct.

J. Musgrave & Sons, Ltd.—600-kw. Zoelly turbine driving a Siemens set, being a duplicate of the set described in our last issue, in connection with our description of the Falcon Mill, and destined for use at this mill. An electrically-driven barring gear, manufactured for use in conjunction with a 4,000 I.H.P. slow-speed vertical cross-compound engine for the Bankside station of the City of London Electric Light Co., Ltd. Cruse superheater.

Nalder Bros. & Thompson, Ltd.—Moving coil and moving iron instruments, including some quite new patterns. A large-sized illuminated dial instrument. Leakage indicators. A new tele-thermometer for use in cold-storage warehouses or cold-storage ships. Circuit-breakers. Jigger switch (the company's name for their limit indicator).

New Gutta Percha Co., Ltd.—Wires and cables insulated with Gutta Gentzsch and Pernax, as used by several railway companies, &c.

Oliver Arc Lamp, Ltd.—The Oriflamme arc lamp.

Pollock & MacNab, Ltd.—Machine tools.

Reyrolle & Co., Ltd.—An ironclad switchgear similar to that recently described in our columns, and also motor starters. The Merz-Price feeder protection system is shown under test, and some new prepayment devices, including the Highfield device used by the Metropolitan Electric Supply Co., Ltd., and the Hikeley prepayment hour meter, used by the Newcastle-upon-Tyne Electric Supply Co., and described in our current issue.

G. Richards & Co., Ltd.—Machine tools.

T. Robinson & Sons, Ltd.—Wood working machinery.

Siemens Bros. Dynamo Works, Ltd.—Loom motor fitted with spring belt tightening arrangements. Various motors. Specimens of switchgear. Meters. Arc lamps. Measuring instruments. Very many tantalum lamps.

Union Electric Co., Ltd. Motor-driven pumps and compressors. A compact paraffin motor and dynamo for private house installations. Numerous types of motors and arc lamps, measuring instruments, and switchgear.

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ELECTRICAL ENGINEERING

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☛ **Manchester Exhibition Supplements.** With this issue, No. 2 of a series of five supplements describing the Manchester Electrical Exhibition is given *Gratis*. All readers should see that this supplement is included in their copy of to-day's "ELECTRICAL ENGINEERING."

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PUBLISHERS' ANNOUNCEMENT

THE price of "Electrical Engineering" has been reduced to 1d.

The first number of "Electrical Engineering" was published on January 3rd, 1907, and the paper immediately took the leading position among the electrical newspapers. A thoroughly sound and practical technical paper, written and edited by men with long experience on the practical side of the electrical engineering industry, and illustrated with useful drawings to scale and well-printed photographs, was welcomed, and in spite of the comparatively high price of 6d., which it was necessary to charge for it, the paper scored an immediate success. The proprietors were, however, repeatedly urged to reduce the price in order to bring the paper within the reach of a wider circle of readers, and they decided from October 1st last to place "Electrical Engineering" on sale throughout the United Kingdom at the popular price of 1d. weekly (post free 1½d.). The leading features of the Paper remain unaltered. No change has been made in the Editorial Staff, the same high-class printing and illustrations are maintained, and the proprietors rely absolutely on the enormous increase of circulation which is assured, to recompense them for the sacrifice they are making in decreasing the price.

SUMMARY

THE Electrical Exhibition was opened to the public at Manchester on Saturday last, and inspected by the Press on that day. A formal "opening" ceremony took place on Monday, at which the Lord Mayor of Manchester expressed the opinion that electrical exhibitions should be held yearly in every large town. Some of the exhibits are described in the supplement published with this issue.

MR. J. B. HAMILTON, General Manager of the Leeds Corporation Tramways, has been retained by the Bournemouth Corporation to advise with regard to the administration and working of their tramway undertaking. (Page 514.)

THE electric generating station of the Letchworth Garden City is of particular interest on account of its small size and low cost. We give in this issue not only a description of the plant, but also some particulars of the capital cost of the undertaking and the working re-

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sults. The station supplies six works with power, and a pumping plant is supplied separately by means of an overhead line. There is only a very small lighting load. The largest of the works is the book-binding and printing establishment of Messrs. W. H. Smith & Sons. We describe in full the method of automatic control adopted for some of the large printing machines. In the book-binding department a special form of ball-bearing is used, as it was absolutely necessary to ensure that no oil or grease should drop on the costly book covers. The total horse-power connected to the mains amounts to only 117 h.p. (Page 515.)

A short article describes an American installation in which a battery is used to equalise the load on an alternating-current system by means of a booster automatically controlled through a series transformer and auxiliary rotary converter. (Page 518.)

Illustrations are given of some of the very handsome fittings which have been installed in the new Holborn Borough Council Offices to be opened during the coming week. (Page 519.)

An electrically-propelled ferry-boat has been put into service recently on the Rhine. It is a twin-screw vessel, and is designed to carry 645 passengers. The electrical equipment comprises two 50 h.p. interpole series motors and a battery of 160 cells, with a total capacity of 335 ampere-hours on a one-hour discharge rating. The motors are controlled by levers in the navigating cabin where the instruments are placed. Two small motors are provided for operating the landing gangways, and an electrically-driven pump is also installed. Plug contacts for charging are provided at the landing-stage on one side of the river. (Page 520.)

Two of the fifty-seven accumulator railway cars ordered for the Prussian State Railways have been delivered, and are in service near Berlin. The design of the cars is quite different from that of the original cars in use at Mainz. Instead of placing the cells under the seats of the passengers' compartments they are now arranged in special shallow compartments in front of the driver's cabin. Each unit consists of two four-wheel cars, each car being equipped with one 80 h.p. motor and a battery of 84 cells. A run of over 60 miles can be made on one charge. (Page 518.)

The discussion on the Paper read by Mr. Merz on Power Supply at the Middlesbrough meeting of the Iron and Steel Institute turned largely on the utilisation of waste heat for power purposes, either in co-operation with a power company or for local needs. (Page 533.)

At 2.45 p.m. last Saturday the Lots Road generating station of the Underground Railways Co. of London had to be shut down for about two hours. The station supplies current to the District Railway, three tube railways, and (through a ten-mile trunk main) sections of the London United Tramways. The initial cause of the trouble was the burning out of a current transformer on a machine circuit. The transformer exploded, and this short-circuited the main oil-switch. The current surge, due to the earthing of one phase, overtaxed the static dischargers on the feeders, so that the 'bus-bars were earthed, and it was necessary to shut down the station. It took considerable time to clear up the earth connections on the 186 static discharge panels, and to make sure that it was safe to put 10,000 volts on the 'bus-bars again. (Page 524.)

The Elective Auditor at Cardiff, in his annual report, records with satisfaction that depreciation and renewal funds have now been created in connection with the electric light undertaking.—A committee appointed by the Erith District Council to consider the administrative expenditure of the various departments, recommends that the management of the electric lighting and tramways undertakings should be vested in one officer, instead of two, as at present.—Intercommunication with the municipal and company telephone systems in Hull is now complete.—Complaint is being made in Liverpool at the high charges for electricity.—An effort is still being made to secure compensation for the Mutual Telephone Syndicate in connection with its efforts to promote a telephone service in Manchester.—The Kensington Borough Council refuses to give its consent to the London County Council for the construction of tramways.—Particulars are given of some tests upon the water-purifying plant at the Summer Lane generating station of the Birmingham Corporation. (Pages 525–526.)

The London County Council require twelve water-tube boilers with mechanical stokers; the Salford Corporation require vertical steam and feed pumps; the Great Western Railway Company advertise for electrical stores, and tenders are invited for an electrical installation at the Twickenham Isolation Hospital. (Pages 526–528.)

The report of the Cleveland & Durham Electric Power Co. states that the connections to the company's system now amount to 20,105 h.p., against 9,172 h.p. last year. The net revenue for the year, after writing down preliminary expenses by £10,000, amounts to £5,142, in addition to £3,230 brought forward.—Some exception was taken at the meeting of Messrs. Willans & Robinson on Tuesday to the payment of the dividend upon the ordinary shares, but a resolution to this effect was lost.—There is a profit of £10,191 upon the business of Messrs. Scott & Mountain for the year to June 30th. (Page 530.)

In a specification published by the Patent Office on Thursday last K. Edgcumbe and C. I. Everett describe an improved pattern of motor-operated time-limit circuit-breaker, in which the timing-scale is independent of the current for which the switch is set. Among the other specifications published is one by the British Thomson-Houston Co. and F. H. Clough for a method of preventing chemical action in the armature slots of high-tension machines due to the high electric stress in the air space surrounding the conductors. A field system, consisting of poles with alternately series and shunt windings, is described in a specification by the Aarhus Dynamo & Elektromotor-fabrik. It is stated that this system of field winding is particularly suitable for crane and hoist motors. A specification by H. Bevis and A. E. Angold relates to an improved device for cutting out the shunt coils of arc-lamps when the carbons are burnt out, and another by J. E. and G. W. Glenister describes a proposed method of insulating electric wires with braided paper strip. A process for the manufacture of filaments of the rare earths for incandescing in the atmosphere is described in a specification by G. Michaud and E. Delasson. The filaments consist of an inner conducting core of carbon or tantalum and an outer radiating envelope of alumina and thoria. (Page 531.)

An International Conference on Electrical Units and Standards will be commenced on Monday at the rooms of the Royal Society, Burlington House, London. The main object of the conference is to obtain international agreement on the three electrical units, the ohm, the ampere, and the volt, so that the realisation of these units in all countries of the world shall be as near as possible identical. (Page 533.)

A recent article in an American contemporary by Messrs. H. C. Parker and W. O. Clark gives an interesting account of some of the experimental work in the development of the "Helion" lamp. The specific resistance of the Helion filament, which is formed of a preparation containing silicon on a carbon core, is stated to be several hundred times that of tungsten, and it is even possible to maintain the incandescence for long periods in the open air. (Page 534.)

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The instantaneous success of the Electrical Exhibition in Manchester must be a matter for congratulation to every electrical manufacturer, whether he be an exhibitor or not. A large attendance of visitors who are taking an active and intelligent interest in the exhibits is encouraging the exhibitors to continue the adequate personal representation at their stands with which they have started, and there is no doubt that the business intercourse, both with the outside public and beween the firms within the Exhibition, will give a stimulus to the activity in the industry which has already shown signs of a revival during the past few weeks. There is another cause for satisfaction after a view of the exhibits. In spite of the fact that the keenness of competition has been a large factor in creating the depression from which the electrical industry has suffered during the past two years, and that cheap manufactures from abroad have joined in this competition, and in spite of the cut prices that have prevailed, necessitating the utmost economics in production, yet the general quality of the material exhibited, both as to workmanlike finish and solidity, shows all the characteristics which have long been the property of British-made goods. During the past few years many engineers have found it necessary to devote more of their energies to the selling department than to the designing office, but it is evident that this exigency of commerce has not caused any serious departure from the best principles of British engineering, and that our works remain well equipped in the technical departments. That the commercial side has now engineering knowledge and ability, as well as the technical side, is a clear gain, and so long as the selling department is not overstaffed or too lavish in its methods, the present system is a distinct improvement over the old one, in which there was a sharp barrier between the engineers and the men of commerce, the men on the one side of it lacking commercial experience entirely, while those on the other were lamentably ignorant of engineering methods and of the actual properties of the manufactures they had to sell.

Enthusiasm on the success of the exhibition must not tempt us to adopt the suggestion made by the Lord Mayor of Manchester and clamour for a yearly electrical exhibition in every town of importance. To do so would be to remove one of the chief causes of the success of the present exhibition, which is that sufficient time has elapsed since the last general exhibition of the same character to make it an "event" in the electrical industry. A yearly exhibition in every large town would mean that the same exhibits were carried about from place to place, and it would take the character of a travelling showroom. There is no doubt that the manufacturer must have a means of bringing his new patterns and new inventions before the buying public at frequent intervals, but a score of exhibitions yearly for this purpose in as many different towns would be a costly and inefficient way of carrying this out. It is for this purpose, however, that the technical Press of the country exists. We ourselves, and we believe our contemporaries also, are always ready to publish descriptions of any new electrical machinery, plant, or apparatus that may be introduced, and, speaking for ourselves, we know that our readers are as interested in learning of improvements in small detail as in our articles of more general character. This is a feature of our journal that we have always developed, and our editorial drawing office exists largely for assisting us in giving full effect to it. It may be argued that this does not give repeated publicity to the new article or pattern as would a series of exhibitions, but for this facilities are offered in the advertisement pages of our own and other technical papers at a far smaller expense and more effectively. The period of two or three years between exhibitions is, in our opinion, the right one, and one general exhibition for the whole electrical industry and for the whole country at this interval of time is best calculated to attain the desired object.

The mishap at the generating station of the Underground Electric Railways Co. of London, last Saturday, was a serious occurrence on account of the delays caused to thousands of passengers occasioned by the entire stoppage for about two hours of the whole of the important group of tube and other railways supplied from that power station. In considering the well-thought-out arrangements all over the system for the duplication of feeders, the provision for isolation of sub-stations, and so on, it has often been remarked that nothing but a complete breakdown at the Lots Road power-house could cause a serious interruption, and owing to the elaborate precautions which were taken in its design, even to the extent of dividing the whole power-house into duplicate and mutually independent halves, this has been regarded hitherto as a practical impossibility. That the peculiar circumstances, which led to a burn-out on a current transformer causing such a prolonged shut down of the station, are not likely to occur frequently is obvious from the official statement, which we publish in another column; but it is nevertheless a fact that no station, however complete its sectionalisation, is absolutely secure from temporary breakdown. One is naturally led to the question of how far it is advisable in matters of power supply to put all one's eggs in one basket, and the more so in view of the colossal single stations which have been featured in some of the proposed power schemes for London. It should be pointed out that in such a scheme as that of the Newcastle-upon-Tyne Electric Supply Co. there are several interconnected stations which could maintain, at any rate, a portion of the load in event of a complete shut down at Carville. One is tempted to ask whether some such interconnection for emergency purposes could not be arranged in London between the stations, say, of the Underground Electric Railway Companies of London at Chelsea, the Metropolitan Railway at Neasden, the London United Tramways at Chiswick, the Great Western Railway at Park Royal, and the London County Council Tramways at Greenwich, when the time comes for appointment of the London Traffic Board and the much-desired co-ordination of London traffic facilities. It may not be generally known that arrangements of this nature already exist in the case of some of the large London electric supply companies. The technical difficulties would be no greater than were got over by Mr. Merz in linking up the power companies of Northumberland and Durham.

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While the small house transformer for enabling 25-volt metal filament lamps to be employed on 200-volt A.C. distributing networks is generally regarded as a more or less temporary expedient, it is clear that the 25-volt private lighting plant has come to stay. At the Electrical Exhibition in Manchester there are many examples of compact 25-volt country-house plants, in which a small generator is driven at high speed by a petrol or oil engine, making a very compact set, and the reduction in the number of cells of the battery increases the economy in first cost, and at the same time lessens considerably the floor space occupied and the labour involved in maintenance and supervision. The advent of the 25-volt systems, however, will necessitate some modification in house-wiring practice that must not be overlooked. Economies in insulating and protecting the conductors can, doubtless, be effected, but there are other directions in which departures from 200-volt practice must be made which may add somewhat to the cost of the wiring work. This cannot be too strongly urged at the present juncture, for the details of house-wiring are now left largely in the hands of the wiremen themselves, who simply work to conventional rules as to the number of lamps that may be connected on a cable of particular size and the number of lamps that can be allowed on a circuit from the distributing-board. Thus on 200 volts, ten 16-c.p. carbon filament lamps are the rule for a 3-ampere circuit from the distributing-board. At 25 volts, ten 16-c.p. metal filament lamps will require about 8 amperes, while if the same number of watts be taken for the circuit—viz., 600—the allowable current is no less than 24 amperes. It is probable that so large a current will only be taken in rare instances from a single way of a distributing-board, but even putting the limit at from 10 to 15 lamps per circuit, it is seen that considerably larger currents are used than at present. The percentage drop in volts over a bad contact is twenty-one times as great on a 25-volt 8-ampere circuit than over a 200-volt 3-ampere circuit, and the heat evolved is seven times as great. As also larger wires must be used for the heavier currents, difficulties will sometimes be introduced in "looping in," and the whole question of lamp-holders and fuse terminals must be examined. These are only some of the points that will arise on 25-volt installations, and the matter is certainly one which has now become of some importance.

We have to thank a large number of our readers for their congratulations and good wishes in connection with our new policy of reducing the price of Electrical Engineering from 6d. to 1d. So many letters have been received that it has been impossible to reply to each one individually. We assure our readers once more that no change has been made either in our editorial staff or management, and that the quality of the contents of the paper will be fully maintained.

Telegraph Traffic.—The cables between Paramaribo and Cayenne and between the Dardanelles and Constantinople, as well as between Arecife and Las Palmas having been repaired, the list of cables still broken is greatly reduced.—Owing to the hurricane in the Bahamas, the Nassau–Florida cable was interrupted on the 1st inst., but was repaired on the following day. Communication with Point-à-Pitre, Guadeloupe, was interrupted for a day. The landlines between Constantinople and Salonica and Smyrna are now in proper working order and clear. The cable of the Direct United States Cable Company is again in working order.

ARRANGEMENTS FOR THE WEEK

SATURDAY, OCTOBER 10th.

Birmingham & District Electric Club.

7.30 p.m. Smoking Concert at the Colonnade Hotel, New Street, Birmingham.

WEDNESDAY, OCTOBER 14th.

University College, London.

5 p.m. Lecture by Prof. J. A. Fleming, F.R.S., on "The Scientific Principles of Radiotelegraphy."

Association of Engineers-in-Charge.

8 p.m. Presidential Address by Mr. James Swinburne, F.R.S., on "Smoke," Mr. W. H. Patchell in the chair.

FRIDAY, OCTOBER 16th.

International Congress on Electrical Units and Standards.

Banquet by the Lord Mayor at the Mansion House to the delegates.

Incorporated Municipal Electrical Association.

Official visit to the Manchester Electrical Exhibition.

Electrical Contractors' Association.

Quarterly Business Meeting at the Manchester Electrical Exhibition.

SATURDAY, OCTOBER 17th.

Incorporated Municipal Electrical Association.

Council Meeting at the Manchester Electrical Exhibition.

Electrical Contractors' Association.

"Propagandist" Meeting at the Manchester Electrical Exhibition.

BOURNEMOUTH CORPORATION TRAMWAYS

Mr. J. B. HAMILTON, General Manager of the Leeds Corporation Tramways, has been called in by the Bournemouth Corporation to advise upon the administration and working of their tramways undertaking. This action on the part of the Corporation recalls the recent report of Major Pringle upon the Bournemouth tramways undertaking, in which he severely criticised the organisation of that department. He complained that there had not been a regular manager at Bournemouth, and that no one officer is responsible to the Corporation for the administration of the whole undertaking. He strongly advised the Corporation to make a change in the organisation by selecting, in open competition, a properly qualified general manager, and giving him control over the whole department. In reply to this it will be remembered that reports were furnished by the Borough Electrical Engineer and the Engineer and Traffic Manager, setting forth the duties of the various officials and claiming that the present system was efficient. It is stated that the present action of the Corporation is a direct result of Major Pringle's report.

Electro Harmonic Society.—The programme of the Friday concerts of the Electro Harmonic Society during the coming season is as follows:—Smoking concert, Friday, October 23rd; ladies' night, November 27th; smoking concert, December 18th; smoking concert, January 8th; ladies' night, February 2nd; smoking concert, March 26th. All the concerts will be held in the King's Hall, Holborn Restaurant, and commence at 8 p.m.

International Electrotechnical Commission.—The members of the International Electrotechnical Commission, which, it will be remembered, had its origin at the St. Louis Exhibition in 1905, and is a permanent international commission, will hold a meeting in Paris on October 14th, and a meeting also will be held in London on October 19th, in the evening of which the delegates will be invited to dinner as the guests of the "Dynamicables" at the Franco-British Exhibition. The meeting on the 19th inst. is mainly for the election of a new president, in succession to the late M. Mascart, and Prof. Elihu Thomson is to be nominated. It should be pointed out that these meetings are quite distinct from the International Conference on Electrical Units and Standards, which commences on Monday, at the invitation of the British Government, although the delegates in some cases are identical. The invitation to the "Dynamicables" dinner on the 19th inst., however, is extended to the delegates to both functions. An error in the date of the "Dynamicables" dinner appears on p. 533 of this issue, where it is given as October 14th. This date was originally fixed, but in consequence of the Paris meeting of the Electrotechnical Commission being on that day we are advised, as we go to press, of the change to the 19th inst.

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ELECTRIC POWER AT LETCHWORTH GARDEN CITY

THE Letchworth Estate, which is the property of the First Garden City, Ltd., is situated between Hitchin and Cambridge on the Great Northern Railway, about 34 miles out of London. The total area of the estate is 3,818 acres, and the town proper, which covers about 1,000 acres, has a population of over 5,500. Ten factories have already started working, and others are in course of erection. The town itself consists of about 900 houses and 40 or more shops. At present the whole of the lighting of the town is by gas, which is supplied from the company's gasworks at 3s. per 1,000 cub. ft. for lighting and 2s. per 1,000 for power. There was, however, a considerable demand for electric power from some of the factories, and it was decided nearly two years ago to build a small power station. A gas-driven plant was settled on, and the tenders for the installation were called for in December, 1906, to a specification drawn up by the consulting engineers, Messrs. O'Gorman and Cozens-Hardy. With the exception of the buildings, the whole contract was placed with Messrs. Johnson & Phillips (Limited), Charlton, Kent, who sublet the gas engines and suction plants to the Campbell Gas Engine Co., and the battery of accumulators to the D.P. Battery Co.

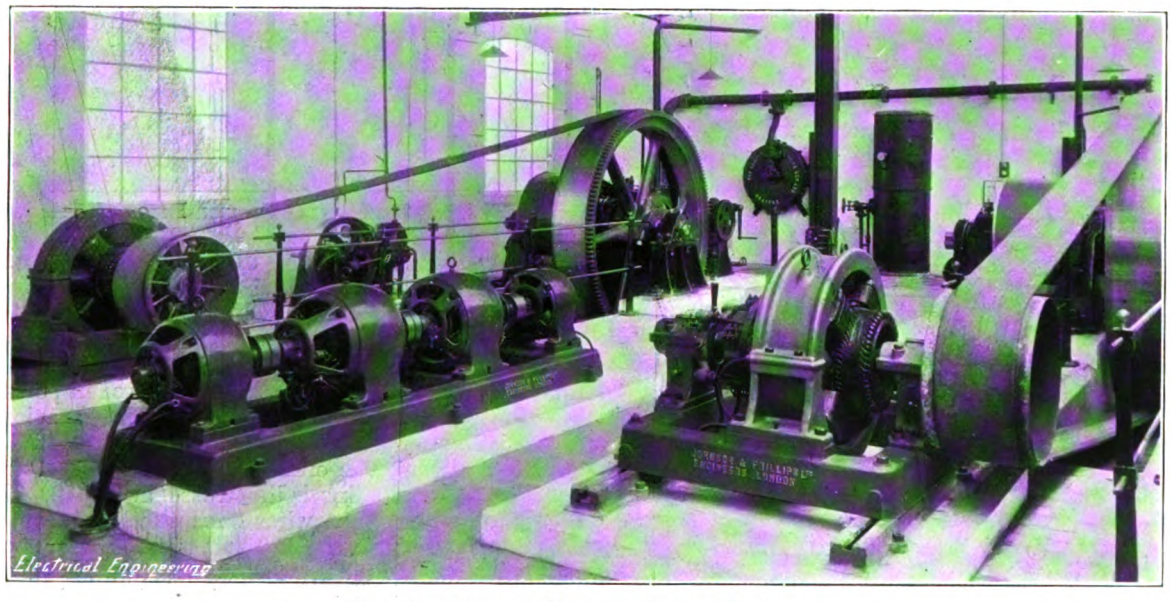

Fig. 1.—Interior View of Power Station.

The power station, an interior view of which is given in Fig. 1, contains two horizontal gas engines, each rated at 100 b.h.p., and two belt-driven continuous-current interpole generators, rated at 65 kw. at 500/550 volts, and running at 600 r.p.m. The booster balancer set consists of four machines coupled together on one bedplate. The balancing set, mounted in the middle, is capable of dealing with an out-of-balance current of 80 amps. when the boosters are not excited. The machines are cross compound wound, so that the E.M.F. on the overloaded side is automatically increased by one volt for every 10 amps. out-of-balance. The battery-charging boosters give 50 amps. at any voltage from 2–90. The three-wire switchboard consists of panels to control the two dynamos, balancers, boosters, battery, two feeders, and the usual B.O.T. earth panel. The battery is of the D.P. type, and consists of 260 cells, capable of giving a discharge of 30 amperes for 10 hours, with a final voltage of 1·85 per cell. The cells are in glass boxes, mounted on insulators and trays in the ordinary way. A milking booster, coupled to a ½ b.h.p. motor, is used in connection with this battery. The feeders and distributing cables are triple concentric paper-insulated and lead-covered, laid in wooden troughing on earthenware bridge pieces and covered by tiles. There is at present laid 320 yards of 0·125, 0·062, 0·125 sq. in. cable and 250 yards of 0·075, 0·0375, 0·075 sq. in. cable. Supply is given to the factories at either 500 volts or 250 volts for power, and 250 volts for lighting. Service boxes of the usual type were supplied, and in each factory a cut-out, switch, supply meter and maximum demand indicator were fixed. The engines are supplied with gas from two suction-gas plants, designed for working with anthracite fuel. There is also an alternative arrangement whereby the engines may be worked with town gas, and the pipework has been arranged so that the engines can be supplied with producer gas from either of the two suction plants. A geared barring arrangement is provided, so that one man is easily capable of turning the engine into a starting position; the engines are then started by means of compressed air contained in a mild steel receiver. A small gas-engine and single-acting compressor are provided to obtain the necessary store of air under a pressure of about 150 to 180 lb. per square inch. The air receiver is of large capacity, and has a sufficient store of air to start the engine several times in succession. The gas plants are of special design, so as to enable continuous runs to be made. They are provided with a water-motor fan for assistance in starting up; owing to the large amount of dust present, a water-motor fan is often better in such circumstances than an electrically-driven fan. Each gas plant is provided with two coke scrubbers of large capacity.

By the courtesy of the consulting engineers we are able to give the figures for the capital costs of the installation. These are as follows:—Buildings alone, £1,500; plant, £3,500; and mains, including an overhead line half a mile long, £500. This totals up to £5,000, or about £36 per kw., excluding mains, and £5,500, or about £40 per kw., including mains. At present the total connected horse-power amounts to only 117 h.p., but this figure will soon be increased. There are about 600 lamps connected, equivalent to 900 8 c.p. carbon lamps. The maximum load on the station amounts to about 65 kw. There is no night load, and the engines are not running Saturday after-

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noons or Sundays, unless it is required to charge the batteries. At present it is only necessary to give the batteries a full charge once a week. The load is almost entirely power, and generally fluctuates between 30 and 60 kw.

The following results of working for the month of August are of interest:—The coal consumption per unit generated works out at a little under 2 lb.; the gas taken from the town mains for running the compressor amounted to 1,400 cubic feet; the number of units unaccounted for were 16 per cent. of the number generated; and the total number of units generated was 7,520. The works costs are as follows:—

Salaries and wages	0·511d. per unit
Coal (at 38s. per ton delivered)	0·387d. ,,
Water	0·060d. ,,
Oil, stores, and gas for compressor	0·056d. ,,
Total works cost, excluding capital charges	1·014d. ,,

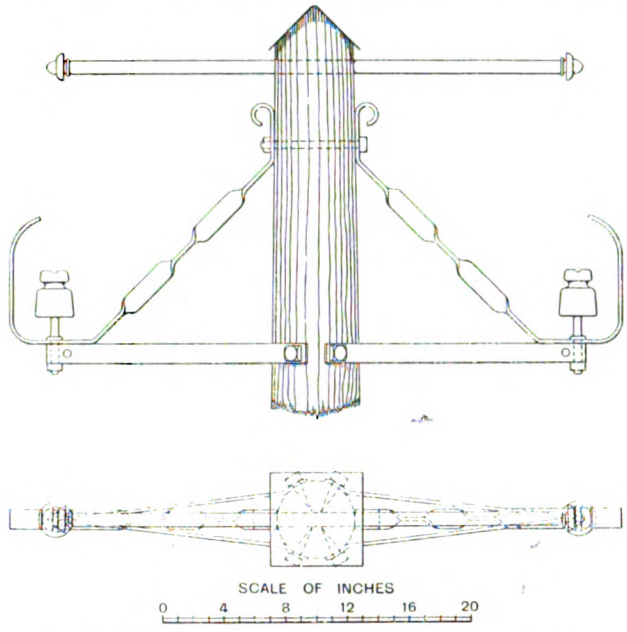

Fig. 2.—500-volt Overhead Pole Line Construction.

Considering the very small output of the station these results are very satisfactory. The maximum demand system of charging has been adopted; the rates for lighting are 8d. and 1½d., and for power 3d. and 1d., the higher figure being for the first 100 hours per quarter for all four quarters of the year. The average price obtained works out at 4d. per unit for lighting and 1·7d. per unit for power.

The overhead line mentioned above runs from the station across the fields to a pumping station half a mile away. Instead of crossing the road, the first 50

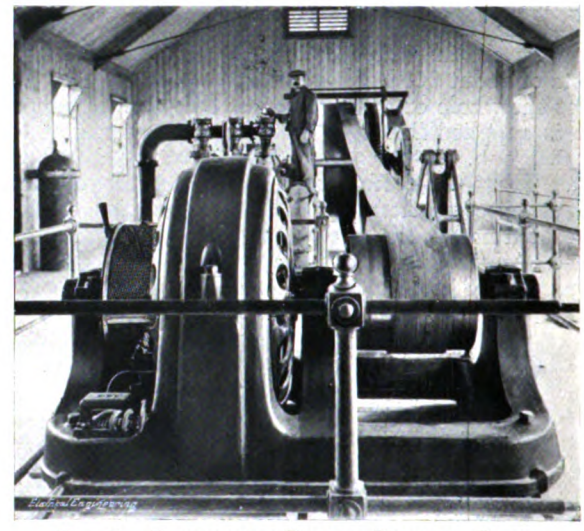

Fig. 3.—Electrically-Driven Pumping Plant.

yards of this line is v.i.r. cable drawn into cast-iron pipe. The first 170 yards of the overhead line consists of two wires of 19/14 stranded copper and the remaining 330 yards is 7/12 stranded copper. The wires are supported on porcelain insulators fixed to galvanised iron brackets, which, in turn, are fixed to wooden poles sunk into the chalk sub-soil. At the angles a special form of bracket and a heavier and stronger pattern of insulator is used. The ordinary form of bracket for the poles in a straight line is illustrated in Fig. 2. Where telegraph or telephone wires cross the line a protecting cradle is fixed above the 500-volt wires; the support for this is shown in Fig. 2. The contractors for this overhead line were Messrs. Christy Bros. & Co., of

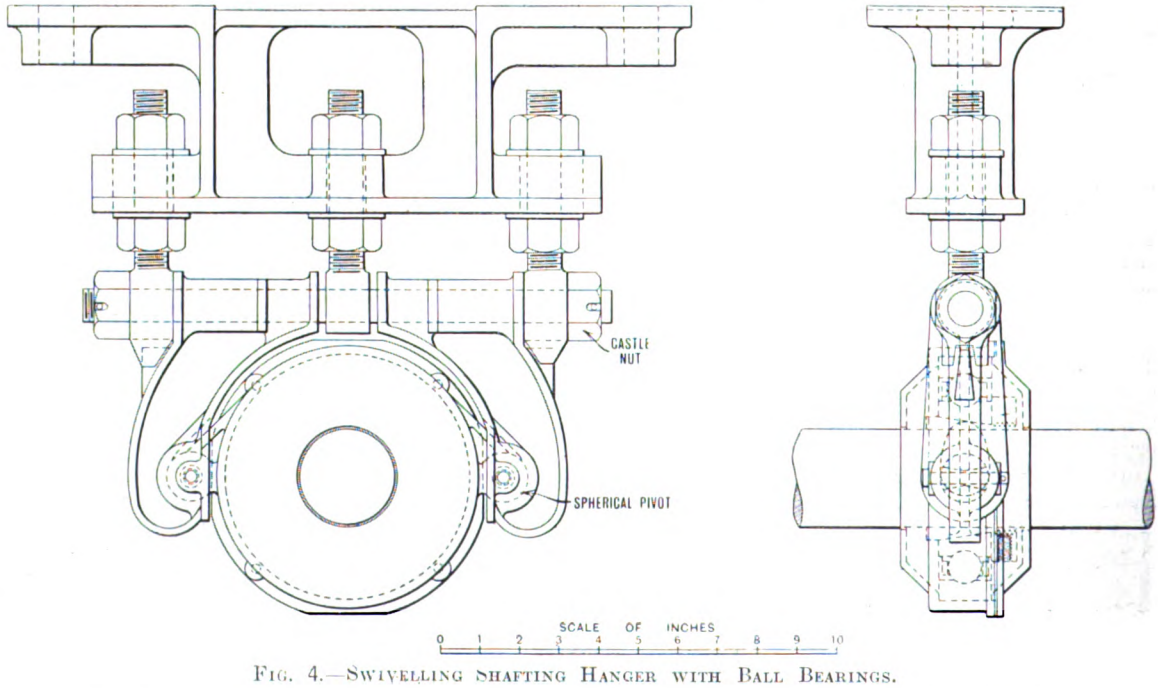

Fig. 4.—Swivelling Shafting Hanger with Ball Bearings.

Chelmsford. The drop along the whole line with a load of 45 amps. is 40 volts; most of this drop is in the smaller cable however; the first portion of the

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line is designed for a much heavier load, there being a suitable site for one or more factories at the end of the first portion. At the pumping station at the end of the line there are two wells sunk into the chalk to a depth of 210 ft. The water is drawn up by means of an Ashley ram pump in each case which delivers into a tank; from the tank the water is pumped up into the

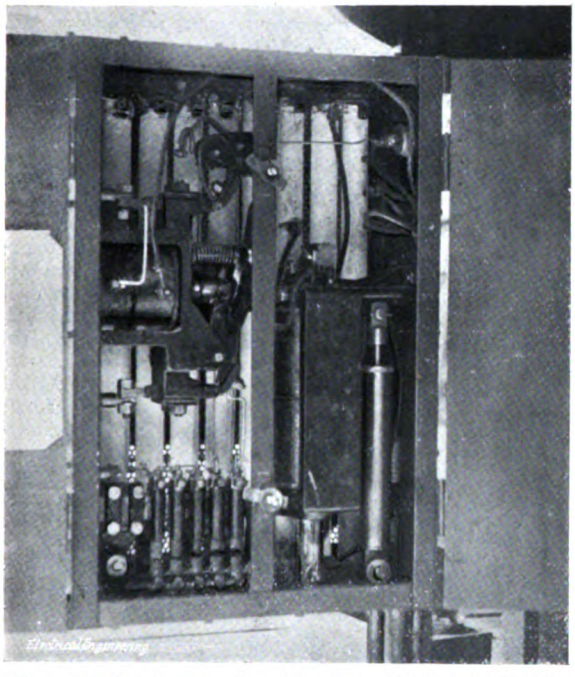

Fig. 5.—Automatic Starter for Printing Press.

main reservoir, on a hill some distance away, by means of a Glenfield and Kennedy three-throw pump which is coupled to the ram pump. In one case the complete set is belt driven by a 30 h.p. E.C.C. motor. The other set is at present driven by a gas engine. The electrically-driven set is illustrated in Fig. 3. Each set is capable of dealing with 11,150 gallons of water per hour.

The Letchworth power station has at present only seven customers; these include two printing works, the pumping station, a saw-mill, and a tapestry works. The largest consumers are the bookbinding and printing works of Messrs. W. H. Smith & Sons. In our issue of September 17th last we described the lighting and power arrangements at the London premises of this well-known firm. At the Letchworth works all the bookbinding and a large amount of printing is done. The works at Letchworth consist of two buildings, the one devoted almost entirely to bookbinding and the other, known as the Arden Press, to printing. In the former building there are in all six motors, aggregating 20 h.p. All the machines are belt driven, and it is worthy of notice that in many cases the machine or shafting pulley is arranged vertically above the motor pulley. Chrome leather belts are used, and this arrangement has caused no trouble whatsoever. "Brookhirst" starters with worm and wheel gear for ensuring slow starting are provided. A large number of small machines are driven through shafting by a single motor, and this shafting has, of course, several bearings, supported by brackets from the roof. As a number of expensively bound books are always in the works, it is essential that no oil or grease should drop from these bearings. To satisfy this condition the form of ball-bearing, illustrated in Fig. 4, was adopted. Only a minute amount of grease is required with such a bearing, and besides obtaining smooth and economical running the absence of falling drops of oil or grease is ensured. These hangers were supplied by Messrs. Mair, Sykes & Ferguson, of Kettering, and are constructed so as to allow for both angular and axial movements of the shafting. One bearing on each shaft has a device attached to it for the purpose of holding the shaft on end and yet still allow freedom to swivel. When swivelling takes place the levers shown in the figure move differentially; they move together when allowing for end motion. The ball bearings are of the well-known Hoffman type. There is nothing unusual about the installation besides the above. The lighting of this works is by carbon filament lamps; the wiring of the lighting and power circuits was carried out by Mann, Egerton & Co., Ltd., of Norwich. It is interesting to note that the average charge for power for these works for the last quarter worked out at 1⅝d. per unit.

In the Arden Press building there are in all 12 motors, aggregating 33 h.p. Six of the motors drive large printing machines, fitted with tumbler-switch automatic control. Two of these are controlled by the automatic gear manufactured by the Adams Manufacturing Co., and described in our issue of September 17th in connection with Messrs. W. H. Smith & Sons' London premises. The motors were manufactured by Electromotors, Ltd. The other four machines are belt driven from Johnson-Lundell motors, and are controlled by means of an automatic gear, which is a special development of the standard lift control gear of Messrs. A. W. Penrose & Co., adapted for use with printing machines. A photograph of one of these starters is given in Fig. 5, and a diagrammatic sketch, illustrating the mode of working is shown in Fig. 6. In this diagram A is the controlling tumbler switch, situated on the machine itself; on closing this switch a circuit is made from the positive main through the solenoid of the main switch, the low resistance C, the contacts D (only if the lever is in the starting position as shown), and the contact pieces E and F to the

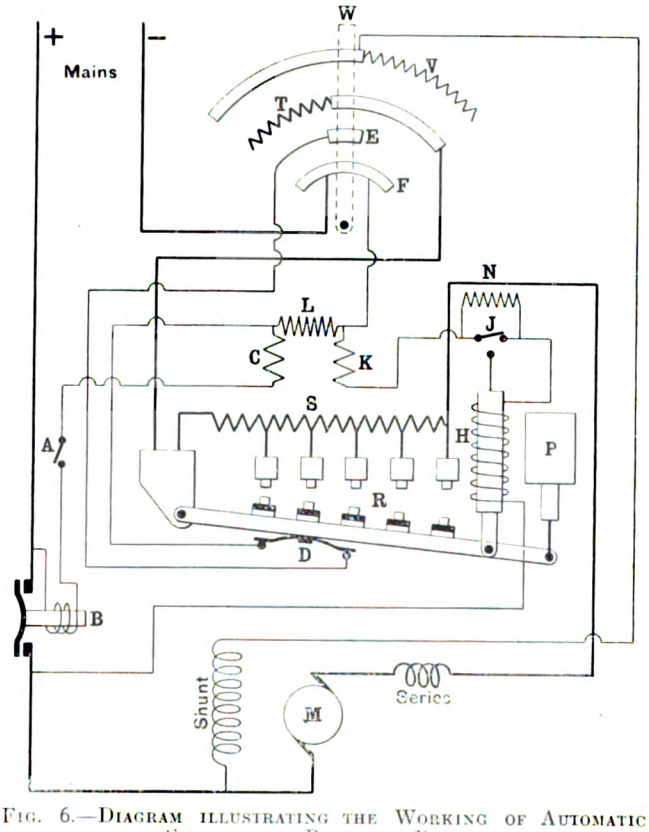

Fig. 6.—Diagram illustrating the Working of Automatic Starter for Printing Press.

negative main. It will be noted that the arm W of the speed regulator must be in the position of maximum shunt field in order to bridge across the contact pieces E and F. If the arm is not in this position there is a circuit through the high resistance L to F; this per-

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mits a current to flow, which, although strong enough to hold up the plunger B, is not strong enough to raise it and close the switch when it is open. When running this reduced solenoid current flows through C and L, the other circuit being open at both D and E. The main switch having closed, the circuit through this to the starter solenoid H and from there through the low resistance K to the negative main is made. As the starting lever rises the starting resistance S is cut out gradually by means of the carbon contacts R, which make contact in succession. The movement of the lever is controlled by means of the dash-pot P. When all the resistance is cut out the plunger of the starting solenoid opens the switch J; this puts the resistance N in circuit and cuts down the current to an amount sufficient to hold up the plunger only. The motor will now be running at normal speed with full field, and the current in both control circuits will be cut down to the minimum amount on account of the opening of the switches D and J respectively. In order to raise the speed of the motor, the arm W is moved to the right, thus inserting a portion of the resistance V in the shunt-field circuit; to lower the speed the arm is moved to the left, and a portion of the resistance T is put in series with the armature. To stop the machine the tumbler-switch A is thrown; this breaks the main switch solenoid circuit and opens the main circuit. As mentioned above, it is impossible to start the motor again until the speed regulator arm is returned to the middle position. A machine fitted with one of these starters is illustrated in Fig. 7. The tumbler switch is just visible almost vertically above the jockey pulley. This latter is fixed on a pivoted lever, which is attached to the frame by means of a spring, and thus holds the belt in tension and gives a larger contact area on both pulleys. The average charge for power for these works amounted to rather less than 1⅛d. per unit last quarter.

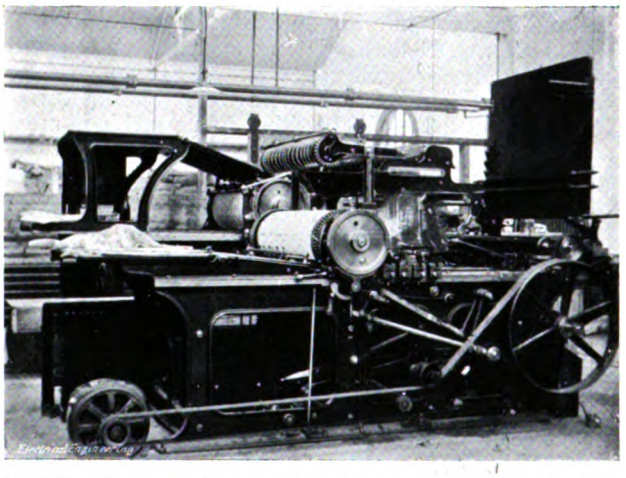

Fig. 7.—Printing Press with Automatic Tumbler-Switch Control.

The second printing works is that of the Garden City Press Ltd. In this works there are two large printing machines geared to electric motors of 4 and 2 h.p. respectively; these are provided with Adams controlling gear. There are in all five motors, with a total horse-power of 17 h.p. At the saw-mills there is a 15 h.p. motor, and at the tapestry works a 2 h.p. motor. These, together with the 20 h.p. motor at the pumping station, bring up the total to 117 h.p. connected.

We are indebted to the firms mentioned for permission to inspect their works, and to Mr. A. W. E. Bullmore, the chief engineer to First Garden City, Ltd., for facilities afforded. Our thanks are also due to Messrs. O'Gorman & Cozens-Hardy, the consulting engineers.

A STORAGE BATTERY FOR REGULATION OF AN ALTERNATING LOAD

A DESCRIPTION of a battery installation for dealing with load variations on an alternating current system at an American power-house at Elmira, N.Y., is described in the *Electrical Review* (New York). The station has a load consisting of traction, power, and lighting. The entire fluctuating load is concentrated on an auxiliary set of bus-bars, the direct-current load being supplied through rotary converters, and treated so far as the regulation control was concerned as an alternating-current load. The battery installed consists of 280 cells of the Gould Storage Battery Co.'s make, having a discharge capacity of 560 amperes for one hour (ultimate capacity when the tanks are filled of 880 amperes for one hour), and capable of delivering momentary discharges up to three times the one-hour rate.

This battery in series with a 140-volt, 600-1,700-ampere booster driven by a 2,200-volt, three-phase, sixty-cycle induction motor, is connected across the direct-current railway bars, the same being supplied from the variable-load alternating-current bars by transformers, and a 750-kilowatt, 600-volt rotary converter. The field of this booster is automatically controlled by an exciter set. The usual regulating field-winding of the booster is replaced by a fine-wire winding controlled by a Gould regulating converter. This converter, which is driven by a small synchronous motor, is fed by a series transformer placed in circuit with the feeder supplying the variable load bus-bars, and delivers a direct-current output proportional to the true energy component of the current in the alternating circuit. An auxiliary series transformer with sectional secondary taps brought to a compensator head mounted on the switchboard is connected in the alternating-current leads of the regulating converter, thus providing means for changing the effective ratio of the series transformer and permitting the average load supplied to the variable-load bus to be changed at will. An increased demand for energy on the variable-load bus causes an increased output from the series transformer in phase with the voltage wave, thus increasing the direct-current output from the regulating converter and causing the battery to discharge, or to charge when the demand on the bus-bar falls below the average for which the adjustable transformer is set. As long as the demand on the direct-current feeders is greater than the battery discharge, the action of the battery is to relieve the station of a portion of the direct-current load, the battery discharging directly to the direct-current feeders and reducing the load on the rotary. When the load conditions are such that the battery discharge is greater than the direct-current demand on the station, the battery first supplies the entire direct-current load and then inverts the surplus through the rotary and transformers to the 2,200-volt, three-phase bus. The ordinary peaks on the station, however, do not often require this actual inversion.

Great Eastern Railway Co.'s Electrical Employees.—Following on the reductions which have recently been made in various other departments, the directors of the Great Eastern Railway Co. have announced a revision in the terms of employment in the electrical engineers' department. From January 1st, 1909, the following alterations will take effect:—Linemen to be reduced 2s. per week for all men having over 34s. per week, exclusive of expenses, 1s. for all men below; assistant linemen to be reduced 1s. per week; foremen to be reduced 4d. per day; wiremen to be reduced 3d. per day; labourers to be reduced 2d. per day; rail contract men and battery men to be reduced 1s. per week; carpenters, smiths, fitters, &c., to be reduced 1s. per week; the arrangement of allowing pay for holidays will be discontinued.

Liability for Tramway Track Repair in London.—At the West London Police Court on Monday, the Hammersmith Borough Council sued the London United Tramways Co., Ltd., for failing to maintain and keep in proper repair the rails and roadway in respect thereof in Uxbridge Road, Goldhawk Road, and King Street. It was claimed on behalf of the Borough Council that the Tramway Company is bound under its Acts to keep the lines in proper repair, failing which the Council has authority to enforce a penalty of £5 per day during which the repairs are not carried out, through a Court of common jurisdiction. An objection was taken on behalf of the company, however, that under Section 33 of the Tramways Act of 1870, jurisdiction was removed from a Court of Summary Jurisdiction and placed in the hands of a Board of Trade arbitrator. The penalty of £5 per day could only be enforced after an award by the arbitrator. The company has already applied to the Board of Trade for an arbitrator. The magistrate, however, held that he had jurisdiction, but the case being a difficult and important one, he adjourned the summonses *sine die* for the decision of a higher court to be taken.

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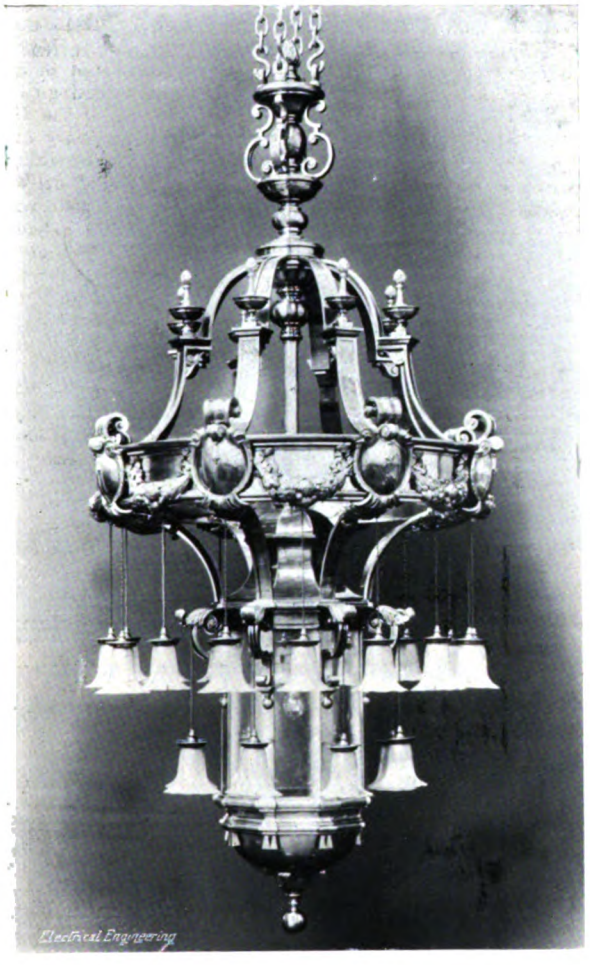
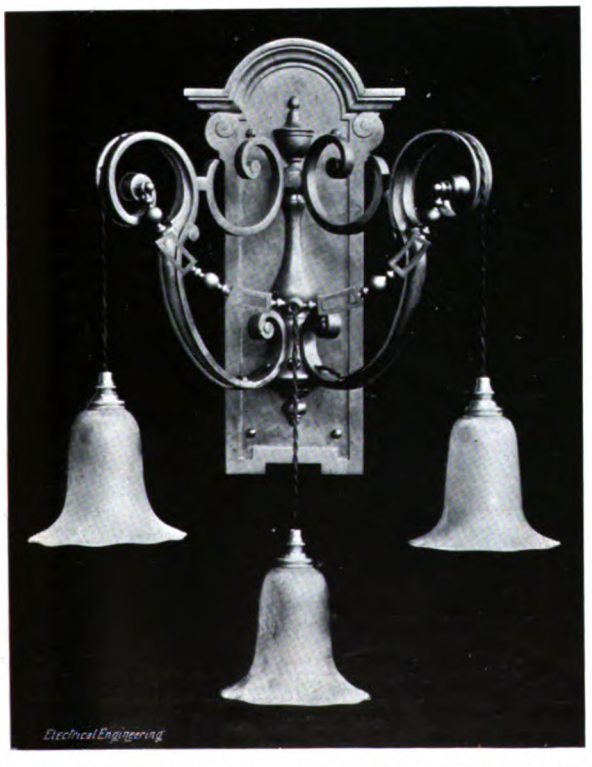
FITTINGS AT THE NEW HOLBORN BOROUGH COUNCIL OFFICES

THE accompanying illustrations represent some very artistic and effective fittings which have been supplied by Messrs. J. W. Singer & Sons, Ltd., of Frome, Somerset, to the new Holborn Borough Council offices, where they are placed in the Council Chamber. The building is electrically lighted throughout, and extensive use is made of metal filament lamps. The whole electrical installation, which is very complete, was carried out by Messrs. Foote & Milne, of Victoria Street, and the architects to the building, which is to be opened during the coming week by the Lord Mayor, are Messrs. Warwick & Hall.





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AN ELECTRIC FERRY-BOAT ON THE RHINE

By Dr. M. Erb

AN electric ferry-boat has been put into service on the Rhine this year to provide a regular service between Godesberg and Niederdollendorf. It is the first of its type to be employed on this river, and is the largest electrically-propelled boat in use on any German waters. The boat, an illustration of which is given in Fig. 1, is licensed to carry 645 persons, and

Fig. 1.—Electrically-Propelled Ferry-Boat on the Rhine.

there is sufficient free space on the wooden fore-deck to accommodate four completely harnessed vehicles. The following are the leading dimensions of the boat, which draws about 2 ft. 9½ in. of water:—Length between perpendiculars, 98 ft. 5 in.; greatest breadth, 26 ft. 3 in.; height to main iron deck, 6 ft. 2¾ in.; length of free deck, 49 ft. 2½ in.; breadth of deck, 31 ft. 2 in.; and height to top of wooden deck, 7 ft. 6½ in.

The hulk is constructed of Siemens-Martin steel, and contains the following compartments between bow and stern:—Collision space; cabin with bunks for the crew; battery-room; and store-room. Behind the fore-deck, which is used for the accommodation of horse-drawn and motor vehicles, the deck is raised a few steps, and on this higher part a deck-house, consisting of a wooden framework covered with sheet steel, is erected. The back part of the deck-house is fitted as a saloon, while the front part contains the navigating cabin, toilet compartments, and the entrance to the motor-room. The surrounding deck is provided with seating accommodation, and is covered by a canopy projecting from the roof of the deck-house. From the navigating cabin, which is built of teak, and contains the helm, the motor-starting switches, and measuring instruments, a free outlook in all directions is obtained. Access to it is provided by means of a stairway on either side of the deck-house, as may be seen from Fig. 1. A longitudinal section of the boat, showing the arrangement and relative proportions of these compartments, is given in Fig. 2. Electrically-operated hinged landing gangways, 26 ft. 3 in. by 2 ft. 11½ in., constructed of iron and boarded with pitch-pine, are attached to either side of the boat. When raised they form a continuation of the guard railing encircling the deck. These gangways and the motors for operating them can be seen in one of the transverse sections given in Fig. 2.

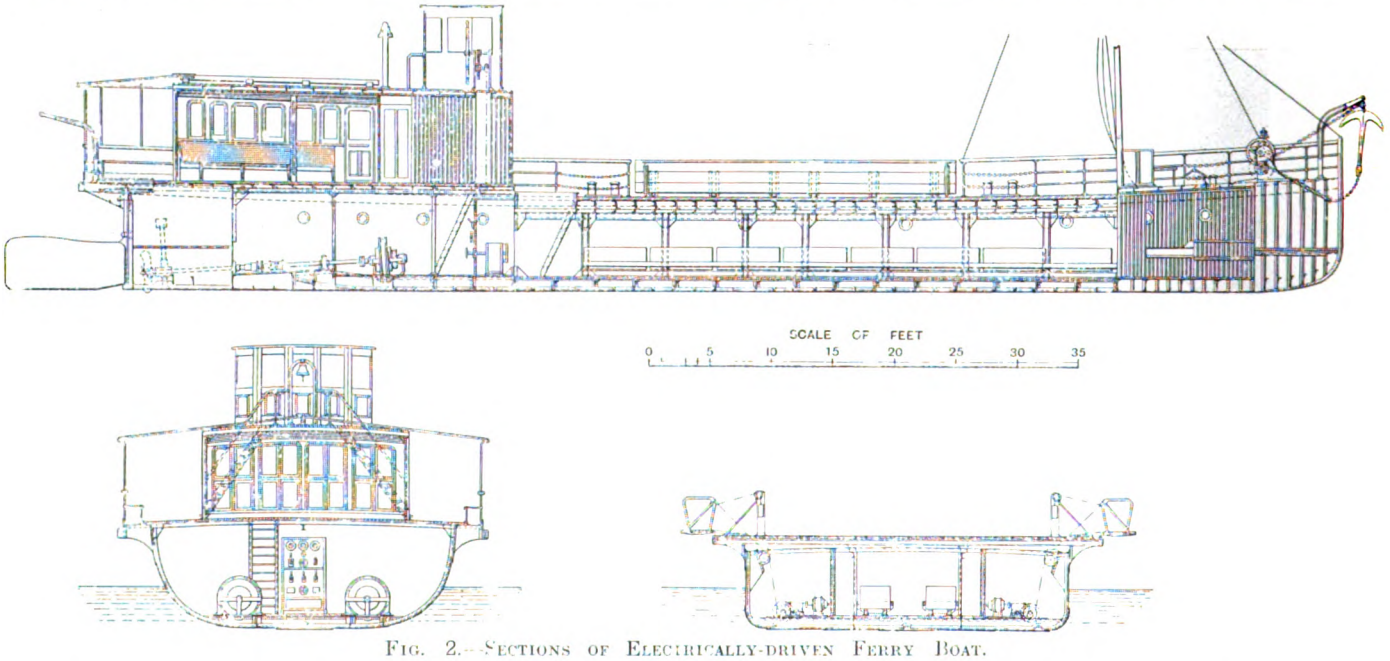

Fig. 2.—Sections of Electrically-driven Ferry Boat.

The boat is propelled by two screws, each of which is driven by an open-type interpole series motor directly coupled to the propeller shaft. The motors, one of which is shown in Fig. 3, are rated at 50 h.p. each, at 300 volts and 300 revolutions per minute, and are of very compact and light construction, being especially designed for the work. The magnet frames are of cast

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steel, and the necessary stiffness is obtained by making them of U-section. The outer bearings of the motor are bracketed to the magnet frame, and the provision of a special bed-plate is thus rendered unnecessary.

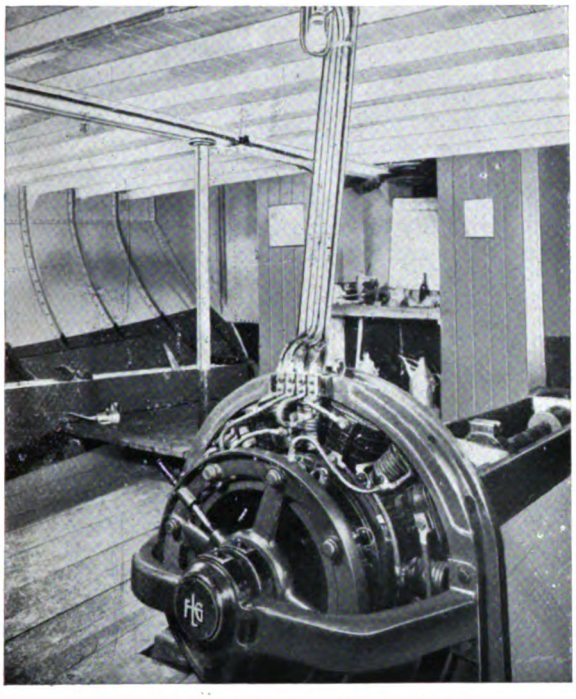

Fig. 3.—50-h.p. Interpole Series Motor.

The motors are equipped with commutating poles, by means of which it is possible to vary the speed within the widest limits and to reverse the direction of rotation suddenly without causing sparking at the brushes.

The starting and regulating apparatus for the motors is contained in the navigating cabin, the interior of which is shown in Figs. 4 and 5. Two reversing controllers are fastened to the wall of the cabin, and are

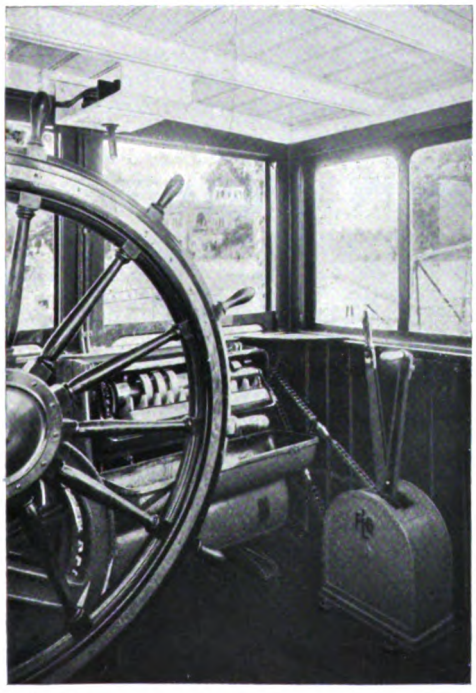

Fig. 4.—Interior of Navigating Cabin, showing Starting Levers and Reversing Controllers.

actuated through chain gearing by the levers seen to the right of the helm in Fig. 4. By imparting a forward or backward motion to either of the levers alone, the corresponding propeller motor is started up in the direction to cause forward or backward motion of the boat. To operate both motors together a stud at the top of the straight-handled lever is pressed down, and a catch is thereby brought into play by

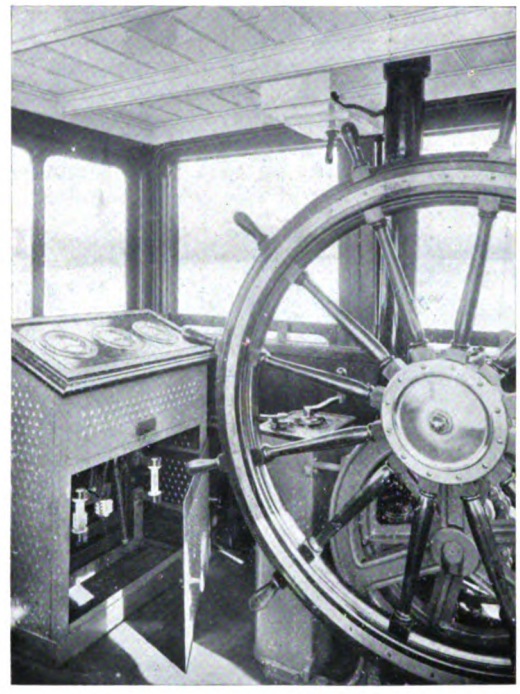

Fig. 5.—Interior of Navigating Cabin, showing Main Fuses, Instrument, Desk-Panel, and Controller for Landing-Flap Motors.

means of which the two levers are locked together. In addition to the two controllers for the propeller motors, the cabin contains a third, employed to operate either of the two small motors actuating the landing gangways. Fig. 5 also shows the instrument desk-panel, on which are mounted a voltmeter and two ammeters in the propeller-motor circuits. Two overload circuit-breakers, one for each motor-circuit, are mounted on the ceiling of the cabin.

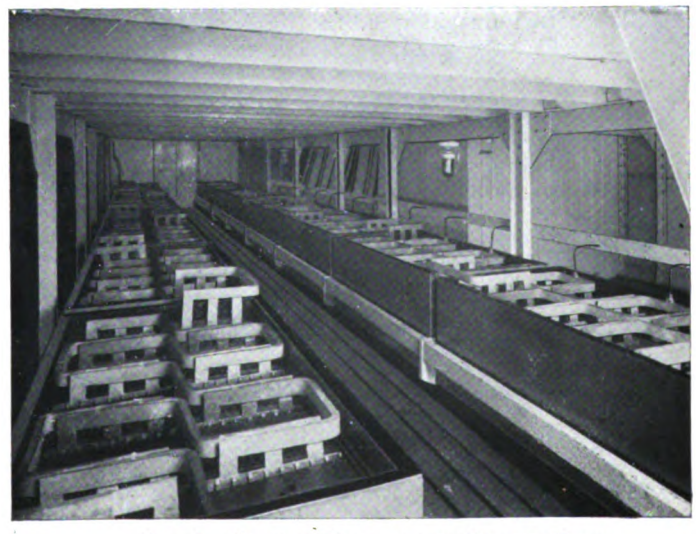

Fig. 6.—General View of the Battery Room.

The motors derive their current from a battery located below deck, consisting of 160 cells mounted in vulcanite cases, which are arranged in sixteen sets of ten each, each set being contained in a wooden trough. The battery has a capacity of 335 ampere-hours on a one-hour discharge rating, the pressure averaging 290/300 volts. The battery-room is thoroughly ventilated by numerous port-holes and

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outlet pipes. A general view of the battery-room is given in Fig. 6. The two small motors—each of 3 h.p.—which operate the landing gangways are installed in the battery-room, and in order to protect them from acid fumes they are enclosed in a wooden casing. The battery is charged on the left bank of the river, current being taken from the Godesberg Electricity Works. Plug contacts are provided for the purpose on the landing-stage and on the boat, an armoured cable being carried on the boat to make the connection. These are shown in use in Fig. 7.

The main switchboard, on which are mounted the battery charging switch and the switches and fuses for

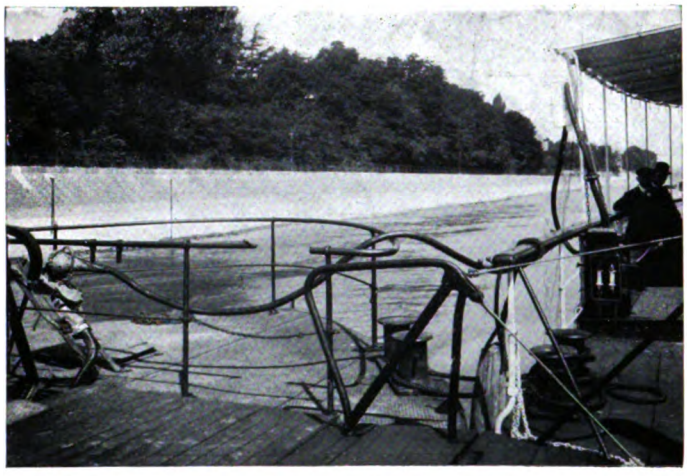


Fig. 7.—Plug Contacts in use at Landing-Stage for Charging.

the various lighting circuits, is erected in the machine-room, in which the motor-controller resistances are also located. For pumping out the boat a small pump, driven by a motor through a "Centrator" reduction gear, is provided. This is capable of dealing with 1,050 gallons of water per hour, and is also employed to supply with water the cisterns in connection with the toilet and washing arrangements. The scheme of lighting comprises twenty-eight incandescent lamps, suitably distributed in the various parts of the boat. The interior appointments of the passenger saloon are tastefully carried out in oak, in the Viennese style. There are eight large windows, which may be lowered in fine weather. The floor is laid with parquet linoleum, and a stove is provided to heat the saloon in winter.

The landing stages on either side of the river each consist of a pontoon, 52 ft. 6 in. by 16 ft. 5 in., connected to the shore by means of a bridge 82 ft. long and 26 ft. 3 in. wide on the Godesberg side, and 82 ft. by 13 ft. 1½ in. on the Niederdollendorf side. The ferry-boat was constructed to the designs of the firm of Ewald Berninghaus, Duisburg, and the complete electrical equipment was supplied by the Felten & Guilleaume-Lahmeyerwerke A.-G., of Frankfort-on-Main. Before its introduction, the cross-river traffic was dealt with by a cable ferry, which frequently obstructed the water-way, to the no small annoyance of other users of the river. This has now been done away with without creating a fresh nuisance in the shape of smoke from a steam-propelled ferry.

In conclusion may be given the average results of a number of tests which were made on July 27th, when the ferry-boat was put into service:—

(1) Crossing from Godesberg to Niederdollendorf—

Port screw working, about ...	70 seconds.
Starboard screw working, about	150 ,,
Time occupied on journey ...	4 minutes.
Average current taken by port motor	145 amperes.
Average current taken by starboard motor	134 ,,

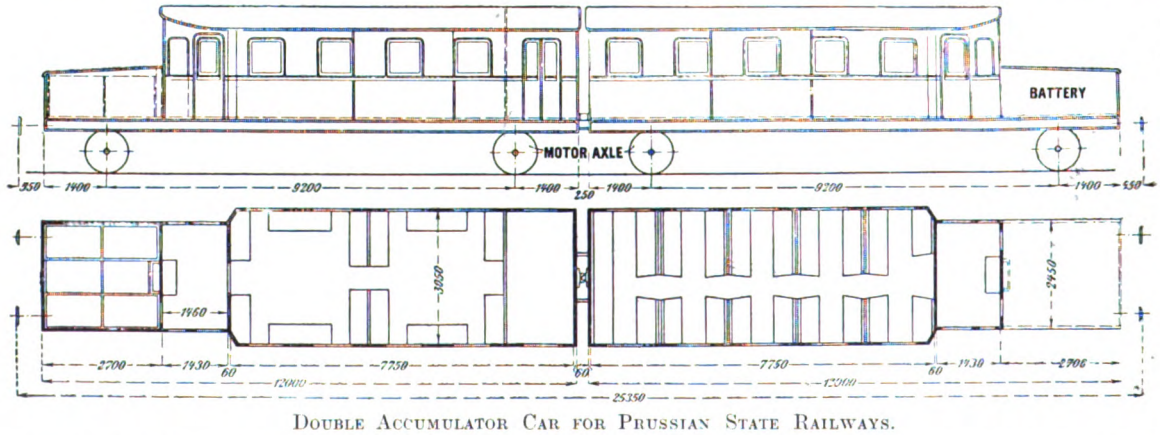
(2) Crossing from Niederdollendorf to Godesberg—

Port screw working, about ...	130 seconds.
Starboard screw working, about	180 ,,
Time occupied on journey ...	5 minutes.
Average current taken by port motor	137 amperes.
Average current taken by starboard motor	142 ,,

The motor current amounted in each case to about 50 amperes upon closing the circuit, and rose to 150 or 160 amperes when the starting resistances were short-circuited, as was always the case upon the open river, no speed regulation proving necessary. The speed of the motors was 320 revolutions per minute. The specific gravity of the battery acid was 1·25 at the commencement of discharge, and 1·15 after the eighth double trip.

ACCUMULATOR RAILWAY CARS IN GERMANY

About eighteen months ago five accumulator railway cars were put into service by the Prussian State Railways, in the neighbourhood of Mainz. Some particulars of these cars were published in Electrical Engineering, Vol. II., p. 206, and the results of the first year of working, with detail costs of running, expressed in pence per car-mile, were given in Electrical Engineering, Vol. III., p. 470. These results were so satisfactory that the Prussian State Railways ordered 57 new double cars of a new pattern, 19 each from the Allgemeine Elektricitäts Ges., Siemens-Schuckert Werke, and Felten & Guilleaume-Lahmeyerwerke. The cars have been designed, however, by Oberbaurat Wittfeld, of the State Railway Department



Double Accumulator Car for Prussian State Railways.

Two of these double cars have, according to the *Elektrotechnische Zeitschrift*, been delivered by the first-mentioned firm, and are running between Tempelhof and Zossen. The cars are to be used for the purpose of supplementing the service provided

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by the heavy through-running trains, for suburban traffic, especially for connecting outlying districts with the stations at which the through-running trains stop, and for districts where the traffic is not sufficient to cause a steam service to be remunerative.

The units which have just been put in service each consist of two four-wheel cars coupled together, as shown in the figure opposite. Each car carries half the battery in a special shallow compartment in front of the driver's cabin, which overlooks it. This arrangement is preferable to that in which the cells are arranged under the seats, as it was found impossible to avoid damage to the car fittings by the acid and the gases evolved. The fumes from the cells also made it unpleasant for the passengers. Including a certain amount of standing room, the double car can carry one hundred passengers. Entrance to each car is through the driver's cabin. The electrical equipment of the complete combination consists of two interpole series motors, one on each car, rated at 50 h.p. each for two hours, or 80 h.p. on the one-hour rating basis. Series-parallel control is effected from either of the two drivers' cabins. The battery, consisting of 168 cells, 84 in each compartment, gives a total pressure of at least 310 volts, and has a capacity of 368 ampere-hours. The total weight of the double car is about 55 tons. A distance of at least 100 kilometres (62 miles) can be run on one charge, and a maximum speed of 50 kilometres per hour (31 miles per hour) can be attained on the level. The cars are provided with compressed air brakes, one motor compressor sufficing for both cars. Each controller has the usual "dead-man's" handle, which, if released, causes the current to be cut off and the brakes applied in whatever position the controller may be. The starting resistances are placed under the cars. The batteries for these cars were supplied by the Akkumulatorenfabrik Akt.-Ges, of Berlin, who, it will be remembered, supplied the batteries for the Mainz cars, and agreed to keep them all in good condition for a period of five years, and to replace all parts damaged through use under normal conditions, for an inclusive charge of 1·55d. per car-mile.

Similar cars to the above, also to be supplied by the Allgemeine Elektricitäts Ges., will be run on the local line from Königsberg to Insterburg. The 19 cars from the Felten & Guilleaume-Lahmeyerwerke will be put in service on the lines Cologne-Remagen, Cologne-Aix-la-Chapelle, and Cologne-Niederlahnstein. Accumulator cars with a seating capacity of 80, and capable of running a distance of 50 to 70 kilometres (31 to 44 miles) on one charge, are being run on the lines Osterfeld-Heissen, and Heissen-Hattingen, in the Ruhr district. During the winter similar cars will be put in service on the line from München Gladbach to Düren, near Cologne.

POWER SUPPLY AND ITS EFFECT ON THE NORTH-EAST COAST

SEVERAL speakers took part in the discussion on the Paper read by Mr. C. H. Merz on the above subject at the Middlesbrough meeting of the Iron and Steel Institute. In the Paper itself, which was given in an abridged form in our last issue, the author gave some particulars of the growth of the undertaking of the Newcastle-upon-Tyne Electric Supply Co., which now works in connection with the Durham Electrical Power Distribution Co. and the Cleveland and Durham Electric Power Co., part of the plant of which has been altered to be of the same frequency. The whole scheme now combines eight generating stations aggregating 136,550 h.p. (including three waste heat stations), and three representing an additional 34,000 h.p. are under construction. The Paper considered the questions of utilising the waste heat from coke ovens and blast furnaces, &c., and pointed out the advantages of co-operation with a power company in this direction.

The discussion may be said to have added very little of interest to the contents of the Paper. Mr. T. Westgarth announced himself as an enthusiastic believer in gas engines, and criticised the absence of reference to gas engines in the Paper. Low as is the cost of production in the waste heat stations at the present time by the use of gas engines, he said considerably more power would be produced. The fuel economy is greater and the other running costs of a gas engine station need not be more than that of a steam plant. As regards the reliability of gas engines it was quite true that in the earlier days, at Hickman's, at Froddingham's, and at Cochran's works there has been a certain amount of trouble, but in spite of this fact they continue to extend their gas engine plant, while at Barrow and at Coltness gas engines are being put down for dynamos and blowing engines.

Mr. Greiner, of Cockerell & Cie., Seraing, described how in his works the various departments deal with the matter of charging for electric power. The departments are all separate, and the electric power department buys the power in the first case from the steel department, and then, having converted it into electricity, sells it to the different departments. He said that there were 11,000 h.p. of gas engines in the works, producing electricity, but as there was no power company in the neighbourhood a co-operative scheme of the kind described in the Paper was impossible to them. If they had an opportunity of co-operating with an outside company who would buy all their excess power, they would only be too glad to do so, more especially with the object of counteracting the effect of trade fluctuations upon the output of power.

M. Goubet also spoke in favour of gas engines and the cost of maintenance, provided the gas is properly cleaned.

Mr. Selby Bigge, after congratulating the author upon his success in bringing unification about on the North-East Coast, dwelt upon the fact that only 15 per cent. of the total power of the power companies was to be found in the waste heat stations, though doubtless the output in units was more. He mentioned that in Silesia current was generated at ¼d. a unit from waste heat all told, which compared apparently with 0·35d. per unit in the coal-fired stations in this district. He mentioned a case where 15,000 h.p. of gas engines was installed, and where 5,000 was used for neighbouring collieries, 1,000 for other purposes about the furnaces, and the rest sold.

Mr. Carnegie (Samuel Osborne & Co.), of Sheffield, agreed with what the author said about small users doing better to buy current than to generate it. He wished to know what size of private plant it would pay to put down. He said that they had a rolling mill which was driven by power supplied by the Sheffield Corporation, the price of current being on a sliding scale working out at about 0·6d. per unit.

Mr. Merz, in reply, pointed out that although the waste heat stations at the present only represented 15 per cent. of the total power installed, they would next year, owing to their higher load factor, produce nearly half the total output. The relative merits of gas and steam had nothing to do with the relative merits of co-operation for independent plants. If gas engines ultimately proved the cheapest form of production they could be put down in the co-operative waste heat stations just as easily as in private plants. With regard to the question of when it paid to put in a private plant, such a question could, of course, only arise in the case of people who possessed waste heat. Where there was no waste heat no one but a crank in that district would think of putting down a private plant, but where there was waste heat, each case had to be judged upon its merits, and in every case some co-operative scheme would be found more advantageous than an independent scheme.

The President (Sir Hugh Bell), in a short speech at the close, said that while it was very interesting listening to relative merits of gas and steam, the only thing people need bother about in that district was, whenever buying electrical apparatus or installing private plants, to be sure to see that their frequency and voltage are the same as that of the power company. Then, if they had more power than they wanted, the power company would be glad to buy it from them; if they had less power than they wanted, the power company could sell it to them.

The Institution Dinner.—The annual dinner of the Institution of Electrical Engineers will be held on Thursday, October 22nd, at 7 for 7.30 p.m., in the Grand Hall of the Hotel Cecil, Strand, London.

Proposed London Electric Railways.—It is stated that a syndicate has been formed to promote a Bill in Parliament for the construction of a tube railway from Victoria and Charing Cross to the Crystal Palace. The proposed route is by way of Peckham, Forest Hill, and Upper Sydenham, to the north-west end of the Crystal Palace.

An extension of the Putney and Wimbledon branch of the District Railway to Sutton is under consideration.

Davy Arc Lamps.—With reference to the article on page 489 of our last issue upon the new works of Arc Lamps, Ltd., at St. Albans, we are asked to point out that these were erected from the designs and under the supervision of Mr. R. A. Briggs, C.E. A.M.I.M.E., of Harpenden, and partner in the firm of Messrs. Frank Matcham & Co., of 9 Warwick Court, Holborn, London.

Obituary.—We regret to announce the death of Mr. Bennett H. Brough, the secretary of the Iron and Steel Institute. Mr. Brough had been in attendance at the Middlesbrough meeting of the Institute, but was seized with illness at the close, and was removed to Newcastle, where an operation proved fatal. Mr. Brough became secretary of the Iron and Steel Institute in 1895, and it was as his assistant that Mr. G. C. Lloyd was working when appointed to the secretaryship of the Institution of Electrical Engineers.

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ACCIDENT AT CHELSEA GENERATING STATION OF THE UNDERGROUND ELECTRIC RAILWAYS COMPANY OF LONDON

By the courtesy of Mr. J. R. Chapman, Chief Engineer of the Underground Electric Railways Co. of London, we are able to publish a full account of the cause of the accident at the Lots Road power-house on Saturday last, which resulted in a stoppage of the District Railway and three tube railways for about two hours.

At 2.45 on the afternoon of Saturday, with five 5,500 kw. turbo-generators in service, all carrying approximately full load, one phase was suddenly earthed, bringing into action all the static dischargers and other safety devices in the house, and making it necessary to trip the circuit breakers on the exciters and thus shut down the generators and the 26 sub-stations supplied therefrom.

This brought all trains and lifts to a standstill on the Bakerloo, Piccadilly, and Hampstead Tube Railways, as well as on the District Railway and the Wimbledon and Surbiton sections of the London United Tramways.

A review of the whole situation indicates that the initial cause of the trouble was a "short" as between the primary and secondary windings of a series transformer in one of the conductors between the generator and its oil switch. These transformers, of which there are, of course, three on each generator, are about 8 in. in diameter and 10 in. long; ratio, 100: 1; normal load, 300 amps. Their secondary extends to the control board, and actuates the ammeters, wattmeters, &c., thereon. Each transformer is placed in a brick compartment with one open side, so that if a failure occurs there is ample room for the arc to escape. Such transformers are necessarily weak, and have failed before in both the generating station and in the sub-stations. They have what may be described as a squirrel-cage form of winding, and are accurate within ½ per cent. at all loads. This essential accuracy requires the coils to be very close together, thus increasing the risk of breakdown. The frames of these transformers, also one point in the secondary leading to the control board, are earthed.

The copper earthing strips in the Chelsea generating station are of very large capacity, and, of course, it only took a few seconds to develop sufficient internal pressure in the transformer to cause it to explode. After passing through the transformer the machine cable is carried vertically through porcelain insulators in the concrete floor above and into brick compartments containing the oil switch. In this instance the force of the explosion drove the arc and flame up through the insulators, thus short circuiting the cables leading to and from the base of the oil switch. The opening of this switch failed to disconnect the machine cables from the 'bus bars. These 'bus bars are divided into five sections, and oil switches of large capacity couple these sections.

The surge of current, however, owing to the earthing of one phase, was so great that a number of the static dischargers on the feeder cables were overtaxed and bridged, so that it became necessary to shut down completely in order to clear up the earth connections through the safety devices. The total damage was trifling; even the oil switch above the transformer was ready for service the next morning, and there were enough spare turbo-generators to carry the whole load, and the isolating switch blades were simply opened on the damaged oil switch. It took some little time, however, to clear up the earth connections on the 186 static discharge panels and thus make sure that it was safe to put 11,000 volts on the 'bus bars again. Two similar series transformers failed on feeder cables, and one feeder oil switch out of 33 that were in service at the time was slightly damaged.

All sub-stations are supplied through duplicate cables, and, of course, the first supposition was that such a heavy surge might have damaged the cables which were in service, hence all sub-stations were started with the cables which had not been in service at the time of the accident. The rotary converters in nearly all the sub-stations were reversed, hence, generally, the load was taken by the machines which were previously idle, and the polarity of the other machines was thus made normal. A few rotaries flashed over, but that was the extent of the damage in the sub-stations. Of the 357 miles of three-phase cable leading to the sub-stations, there was not a single failure.

There were no personal injuries of any kind, either in the generating station or in the sub-stations.

The accident proves that 2½ feet of free air space and a six-inch concrete floor are not sufficient between one of these series transformers and the oil switch, hence this will be increased to eight feet. Further, that all space between the cable and the inside walls of the insulator should be caulked tight, and with a view of limiting the field of influence when one of these little transformers fail, they will be enclosed in a somewhat larger brick chamber with one side open as at present.

The neutral point of all the generators is earthed through a cast-iron grid resistance of about 7 ohms resistance and 2,000 amperes capacity.

The static discharge panels are each 5 ft. long, have eight gaps of 0·0047 in. each, and a carbon resistance rod ¾ in. diameter and 33 in. long, its resistance being 375 megohms.

NEW PUBLICATIONS

Transactions of the Glasgow Technical College Scientific Society. Parts 5, 6, and 7. Vol. IV., Session 1907-1908. (Glasgow: The Technical College.) Price 2s. each.

"Science Abstracts." September. Section A.: Physics. Section B.: Electrical Engineering. (London: E. & F. N. Spon.) 1s. 6d. each.

"An Elementary Manual of Radio-Telegraphy & Radio-Telephony." By Prof. J. A. Fleming, F.R.S. (London: Longmans, Green & Co.) 7s. 6d. net.

The London Electric Power Bills.—*The Daily Chronicle* reports that a conference of local authorities in London and district took place at the Shoreditch Town Hall, on Thursday, for the purpose of considering the London and District Electricity Supply Bill and the London Electric Supply Companies Bill, now before Parliament. The authorities represented comprised Fulham, Finchley, Hornsey, Croydon, St. Pancras, Barnes, Wimbledon, Shoreditch, Camberwell, Islington, Battersea, and Bethnal Green. On the proposition of the Town Clerk of Camberwell, seconded by Councillor Windus (Camberwell), a resolution was adopted protesting against the principles contained in the London and District Bill, but expressing the opinion that in the event of the measure becoming law the purchase clause should be amended so as to provide that if the undertaking is purchased in 1931 or 1936, the amount paid for goodwill in addition to the then value of the land, buildings, works, &c., shall not exceed twenty years' compensation, based upon the net annual profits as shown by the accounts of the company during the period of the concession already expired. Mr. Tagg also moved in regard to the London Electric Supply Companies Bill that a sterilisation clause similar to that imposed upon the water companies be inserted for the protection of London ratepayers, together with another condition prohibiting the companies from receiving compensation in respect of severance. The resolution was adopted. It was further decided to ask Mr. Winston Churchill, the President of the Board of Trade, to receive a deputation for the purpose of placing before him the case of the borough councils for being given linking up powers.

The above is the wording of the resolution, as reported, but we may point out that Clause 67 of the London and District Electricity Supply Bill provides for purchase in the year 1931, 1941, or 1951. The purchase terms are to be "the then value" of the undertaking should the purchase not take place until 1951, but should the London County Council decide to put its powers into force in 1931 or 1941, as it is empowered to do under the Bill as it now stands, there will, in addition, have to be paid a sum as compensation, which must be determined by arbitration if no agreement can be come to. The word "goodwill" does not occur in the clause.

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LOCAL NOTES

ABERDEEN: *Supply for Wireless Telegraphy.*—With reference to the agreement between the Corporation and the Admiralty for the supply of electrical energy to the new wireless telegraph station at Stoneywood, the Admiralty have asked for a clause to the effect that the agreement may be renewed on agreed terms upon its expiration, and, failing agreement, a new agreement should be submitted to arbitration. The Corporation have consented to this. The present agreement remains in force for five years.

ACCRINGTON: *Electric Lighting Provisional Orders.*—The Corporation is to apply for electric lighting provisional orders for the districts of Church and Clayton-le-Moor.

BELFAST: *Automatic Point Controllers.*—All the automatic point controllers which it was recently decided to install upon the tramways, have now been fitted, and it is estimated that a saving of £1,500 per annum will be effected, as compared with the cost of the old manual system.

BIRMINGHAM: *Tramway Extension.*—Differences of opinion still continue regarding the proposed tramway extension to Stechford. The latest development is that the Yardley Rural District Council has passed a resolution against the extension.

Water Purification.—The Paterson Engineering Co. inform us that at the Corporation generating station all the mechanical oil separators in the 2,000 kw. sets have been replaced by a Paterson oil eliminator of 350,000 lb. hourly capacity. We believe that this is the largest plant of its kind, and the results of tests (based on six months' working) by Mr. R. A. Chattock, the City Electrical Engineer, shows that the total cost for chemical reagents was proved to be 3d. per thousand gallons purified. The temperature of the water leaving the purifier was 4–5° higher than when entering, owing to the fact that one or two traps on the steam gauge discharged into the filter tanks. The public analyst's report on the water as discharged by the Paterson purifier stated that it was absolutely free from all trace of oil.

BLACKBURN: *Tramway Extensions.*—The Corporation has decided that the tramway extensions authorised by the Blackburn Corporation Act, 1908, with one exception, shall be proceeded with.

Electricity Charges.—The Corporation has referred to a subcommittee the question of making a reduction in the charge for electric current to electrical contractors for the purpose of exhibiting and displaying electrical apparatus.

CARDIFF: *Electricity and Tramway Finances.*—A statement has been issued by the elective auditor, in which he states that, since his last report, funds have been created in connection with the electric lighting undertaking to provide for depreciation and renewals, although at the time he drew attention to the need for such provision the correctness of his statement was challenged and the department held to be in a flourishing condition. With regard to the tramways, it is mentioned that particular attention has now been paid to provision for depreciation, and with improved finances consequent on increased revenue and decreased expenditure, there is every reason to believe that the accounts will now be placed on a sound basis. For the year 1907 the net profit was £994 0s. 3d., and for 1908 £8,807 13s. Both those sums have been rightly appropriated, with other moneys, for depreciation.

Electricity Canvasser.—A councillor's recommendation that a canvasser should be appointed to the electricity undertaking has been defeated. Mr. Arthur Ellis, the engineer and manager, said that a regular system of canvassing exists, and an alteration in the present methods is not desirable.

CLEETHORPES: *Electric Lighting Provisional Order.*—The Board of Trade have communicated with the Council with regard to their electric lighting Provisional Order which was granted in 1900. After discussion, it has been decided to ask the Board to grant an extension order, to include certain powers now embodied in Provisional Orders, but which were not inserted in the Council's original order.

COLCHESTER: *Tramway Accounts.*—At the last meeting of the Corporation it was announced that the deficit on the half-year's working of the municipal tramways would be £1,928, which exceeds the deficit on the corresponding period of last year by £589.

DOVER: *Admiralty Supply.*—The draft agreement with the Admiralty for a supply of electrical energy has been considered by the Council. Arrangements are being made for a temporary supply to the Admiralty Pier extension signal station.

Electric Lighting Loan.—As the Local Government Board has adhered to their decision, given a short while ago, not to grant a loan of £1,190 in connection with the St. Margaret's extension, the communication has been sent by the Corporation pointing out that the loan would only be for a short period, and would be repaid to the bank by annual instalments.

EPSOM: *Electricity Finances.*—According to the electric lighting estimates for the period ending March 31st, 1909, the general district fund will have to provide approximately £479.

ERITH: *London Electric Power Bills.*—Mr. James Rowlands, M.P. for the district, has asked to be furnished with latest information concerning the Council's electricity undertaking. The Council has decided to furnish Mr. Rowlands with copies of the reports and accounts for the past three years, and any further information he may require.

Departmental Administration.—In May last, a committee was appointed by the Council to consider the administrative expenditure of the various departments, and to report. The following comments are made upon the lighting and tramways departments:—"Electric lighting and tramways departments.—(1) Electric lighting: In the electric lighting department the committee finds that the system of book-keeping duplicates, to a considerable extent, the work done in the accountant's department, and that such duplication is unnecessary. (2) Tramways department: Certain books kept in the tramways department might more properly be kept in the accountant's department, and there is also some unnecessary duplication in this department of work done in the accountant's department. (3) Management of undertakings: The committee is of opinion, after carefully reviewing the administration of the electric lighting and tramways departments, that considerable economy, and at the same time increased efficiency in administration would be effected if the management of the two undertakings was vested in one officer." The report has been adopted, and the committee authorised to draw up a scheme of reorganisation.

GREENOCK.—*Electricity Accounts.*—The annual report of Mr. J. A. Robertson, the burgh electrical engineer, states that the total output increased from 2,681,805 units to 3,275,018 units. The average price received for lighting was 2·95d., against 3·05d. last year; for power purposes 1·16d., against 1·17d., and for traction 1·40d., against 1·37d. The gross profits, after meeting working expenses, amount to £8,967.

HORNSEY: *Electric Supply.*—The electrical engineer has reported that the number of consumers connected at July 31st, 1908, was 1,359, and that there had since been a net increase of 19. The number of 8-c.p. lamps connected was 71,922, a net increase of 591. From April to August mains had been laid in 12 roads. The engineer was authorised to arrange for the exhibition of posters at a cost not exceeding £25 per annum.—A ten days' show of electrical stoves, &c., is to be held at Muswell Hill, the cost to be limited to £5.

HULL: *Municipal Telephone System.*—The whole of the necessary works for establishing intercommunication between the municipal and company's telephone systems have now been completed. The cost to the Corporation alone has been £700 in alterations to the subscribers' instruments.

ITALY: *Water-Power Concessions.*—The Acting British Consul at Palermo (Mr. W. A. Morrison) reports that a concession has been granted by the Italian Government to the "Società Elettrica della Sicilia Orientale" (of Milan) for the appropriation of water from the River Cassibile for a term of 30 years, for the generation of electric power. The river derives its supply of water from the mountains of Canicattini Bagni, and empties into the sea near the village of Cassibile between Syracuse and Avola. The difference of level is 300 metres, and the supply of water is calculated to develop a force of 5,000 horse-power. The objects of the "Società" are to supply electric power for private enterprise, and to construct and work electric tramways between Syracuse and some of the towns in that province. The necessary outlay for the purchase of plant and the construction of canals and reservoirs is estimated at two million lire (about £80,000). The work is to be completed by the end of 1909.

Electric Supply.—According to a British Consular report, the Valdarno Mining and Electrical Company, which has a capital of £240,000, works some extensive lignite mines in the commune of Cavriglia, and large electric works have recently been erected for the purpose of using their own coal as fuel for the production of electrical power to be distributed for lighting, &c., to the neighbouring cities. Electrical current will be conveyed to Florence, Prato, Siena and Arezzo by means of cables, which are now being laid. The current is on the three-wire system at 33,000 volts. The machinery has been partly supplied by the Westinghouse Company and partly by German firms; the engines, supports, gauge tracks, &c., are of Italian manufacture. Its output of lignite is at present about 180,000 tons. There is a briquette factory adjoining.

KOREA: *Electric Railway.*—A British Consular report upon the trade of Korea for the year 1907, states that the Chemulpo Electric Company proposes to construct an electric tramway to run past the jetty of the General Foreign Settlement to various parts of the Japanese Settlement and outside districts.

LAUNCESTON (TASMANIA): *Electricity Supply.*—In consequence of the exceedingly rapid increase in the demand for electrical energy, the Council have, says the *Australian Mining Standard*, called for reports from the City Electrical Engineer

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and the City Engineer with regard to extensions. The matter of extending the electric light plant involves an application to Parliament for further borrowing power, which, at the present time, has been exceeded by about £8,000. The Council has Parliamentary sanction to borrow £160,000 on electric light account, but to date its capital expenditure is approaching £170,000. The increase in the use of electric power is very marked. At the end of 1906, 641 h.p. was in use, an improvement for the twelve months of 217. At the end of last year the horse-power had crept up to 799; to-day it is about 1,000 h.p. Messrs. Strike & David, the Council's engineers, will be asked to advise as to what additional power can be obtained from the river, by what means, and at what cost.

LEICESTER: *Electricity Accounts.*—The report of the Electric Lighting Committee was adopted at the last Council meeting. The expenditure during the year amounted to £6,698 and the revenue to £15,847. After meeting capital charges there is a net profit of £2,739, or £673 less than for the previous year. It was pointed out that although the number of consumers has increased by 77, the consumption has decreased owing to the greater use of metal filament lamps.

LIVERPOOL: *Electricity Charges.*—A demand is being made for a reduction in the charges now made for electrical energy for lighting and power purposes, and the coming elections in November are likely to be fought mainly on this matter. Comparisons are being made between Liverpool and other towns, mention being specifically made of Manchester, which has had a much lower power rate for many years. Quite recently Warrington has brought into use a reduced scale of charges for power users, viz., 2d. for the first 1,000 units, and 1d. per unit after, with a discount, and this is being contrasted with Liverpool's 2d. for the first 3,000 units, 1½d. per unit for the succeeding 7,000 units, and 1d. per unit for all consumption afterwards. Further, Liverpool still charge meter rents, which are being abolished in so many other places, whilst the practice of allowing a percentage of the power consumption for lighting at the power rates has not yet been instituted.

Lister Drive Steam Turbines.—Mr. A. Bromley Holmes, the Consulting Engineer to the Corporation, has now presented his final report upon the four turbo-alternators supplied by the Westinghouse Co. for the Lister Drive power station. It appears that the machines came up to specification with the exception of steam consumption per kilowatt hour, and after fully considering the position, the contractors decided to re-make the rotor of each turbine at considerable expense, and for this purpose the machines were handed over to the contractors one at a time. The result of the re-construction has proved very satisfactory, as in each case the steam consumption per kilowatt-hour named in the specification has been attained.

LONDON: *Islington: Tramways.*—The London County Council have intimated that in the next Session of Parliament they again propose to apply for powers to construct a single line of tramways from Essex Road to Kingsland Road *via* Englefield Road, and remind the Council that in the session 1907-8 they consented to the construction of the proposed tramways, but owing to the opposition of the Hackney Council the lines could not be proceeded with.

Kensington: Tramways.—The Works Committee recommend the Borough Council to inform the London County Council that they are not prepared to give their consent to the proposed tramways from Battersea Bridge to Shepherd's Bush. The Borough Council are also requesting the Chelsea Borough Council to withhold their consent to the scheme. A ratepayers' meeting has also been held protesting against the proposed tramways.

Lambeth: London Power Bills.—The General Purposes Committee object to the purchasing powers proposed to be conferred on the L.C.C. by the London Electric Supply Bills on account of its effect on the Borough Council's power of purchase of the South London Electric Supply Corporation. The Council has therefore decided to lodge petitions against the Bills.

Lewisham: Tramcar Mishap.—The axle of a fully loaded London County Council tramcar broke on Wednesday week at the top of Loampit Hill, Lewisham.

Paddington: London Electric Power Bills.—The Parliamentary Committee of the Borough Council, in reporting on the London Electric Power Bills, urged the Council to resist anything which will affect their powers of purchase of the portion of the Metropolitan Electric Supply Co.'s undertaking, under the company's Electric Lighting Order of 1890. They recommend petitions to be presented against both Bills in the House of Commons.

LUTON: *Meter Rents.*—A proposition to abolish meter rents was put before the Council last week, but the Chairman of the Electricity Committee stated that they would view this with favour when the undertaking was in a little more flourishing condition. At present meter rents were responsible for a revenue of £60 per annum. The proposition has, therefore, been deferred.

MANCHESTER: *The Mutual Telephone Syndicate.*—Notice of the following resolution has been given by Councillor Skinner:—"That a Special Committee be appointed to consider and report upon the position of the Mutual Telephone Syndicate, Limited, and the Corporation, and as to whether or not any payments should be made by the Corporation to reimburse to some extent the expenditure incurred by the Syndicate in their efforts to promote for the City of Manchester a cheaper and more efficient telephone service." Resolutions to the contrary were passed by the City Council in March and May of this year, but it is proposed that these should be rescinded. The present resolution is signed by 10 aldermen and 35 councillors.

MIDDLETON: *Tramways Lease.*—Notice is given of the intention of the Corporation to lease certain tramways to the Manchester Corporation for a period of 21 years, commencing from December 24th, 1902. The rent has been agreed upon at £9,549 19s. 10d. for the period between December 24th, 1902, and June 24th, 1908, and afterwards £1,736 7s. 3d. per annum.

SPAIN: *Electric Tramways.*—A British Consular report upon the trade of Spain in 1907, states that the promised electric tramways have not yet appeared in Corunna. It is hoped, however, that so soon as the necessary formalities have been completed by the Belgian company interested in the scheme and the local authorities, new lines will be constructed, not only in Corunna but also in Vigo and other towns in this district.

Electric Cranes.—A large electric tip, erected at a heavy cost, has already begun to work at the Port of Musel (Gijon), about the capacity of which at this date it is not advisable to hazard a statement, and alterations are already talked of as necessary. The coal and minerals are tipped from the railway trucks into hoppers, which shoot their contents into large buckets carried on electric trolleys running on the low level, which, on arrival at the ship's side, are picked up by a crane or transporter with a horizontal jib or arm and carried over the ship's hatches. Another loading tip is in course of construction which is of a more simple kind, as it will shoot the coal direct into the ship's hold. It is expected to be ready for operations at the end of 1908.

TOTTENHAM: *Centre Pole Lighting.*—The District Council have entered into a contract with the North Metropolitan Electric Power Supply Co. to light the tramway centre poles in the Green Lanes and High Road, but as the lighting will cost £700 a year, and the estimates have been sent back to the various Committees to be reduced, it is not probable that the lighting will be effected this winter.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ECCLES.—The local Co-operative Society are thinking of installing electrical plant in certain of their depôts.

FARNWORTH.—We understand that Messrs. Prestwichs, of the Pandora Mills, and Messrs. Pilkethean, of the Cawdor Street, are thinking of putting down certain electrical plant.

LONDON: *London County Council.*—Tenders are invited for the supply of 12 water-tube boilers, with mechanical stokers and superheaters, each boiler capable of evaporating 15,000 lb. of water per hour. Particulars from the Clerk to the Council (fee £2 returnable), and tenders by October 27th.

Stepney.—The Finance Committee have applied to the L.C.C. for a loan of £7,000, as a supplemental estimate, towards defraying the cost of the erection of the generating station at Blyth's Wharf.

ROCHDALE.—The Guardians invite tenders for the erection of an overhead bare copper cable at their workhouse. Particulars from the Clerk, and tenders by the 15th inst.

SALFORD.—The Electricity Committee invites tenders for the supply and delivery at the Frederick Road generating station of vertical steam and feed pumps. Particulars from the Electrical Engineer, Mr. V. A. H. McCowen, and tenders to the Town Clerk by October 12th.

SWINTON.—Among a number of firms who are contemplating electrical installation are Messrs. Holdsworth & Gibbs, Moorside Road Mills; Messrs. Partington's, Hazlehurst Mill; and Messrs. Bolds, of the Swinton Hall Road Mill.

TWICKENHAM.—Tenders are invited for an electrical installation at the Council's isolation hospital, Whilton. The works include a steam engine and dynamo, cable, battery, motor transformer, switchboard, regulating appliances, together with wiring and fittings complete the four blocks of building now erected. Particulars from Mr. William Fairley, Civil Engi-

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neer, 69 Victoria Street, Westminster, S.W.; or at the office of Mr. Fred W. Pearce, Surveyor to the Council, Town Hall, Twickenham. Fee, two guineas (returnable), and tenders to the Clerk by October 14th.

Miscellaneous

ABERDEEN.—An expenditure of £112 is to be incurred in the provision of lamps and standards for the Culter special lighting district.

AUSTRALIA.—The Melbourne City Council requires 60 direct current flame arc lamps. Particulars from McIlwraith, McEachern & Co., Proprietary, Ltd., Billiter Square Buildings, London, E.C., to whom tenders by October 20th.

BELGIUM.—The "Bulletin Commercial" (Brussels) of September 26th notifies that tenders will be opened at the Bourse de Commerce (Salle de l'Union syndicale), Brussels, at 11 a.m. on October 14th, for the supply of galvanised iron wire, copper wire, cables, rods, screws, ironwork, iron bolts, porcelain insulators &c., &c., for the use of the Belgian Telegraph Administration. The conditions, &c., may be obtained at the Bureau des Adjudications, Rue des Augustins 15, Brussels.

EPSOM.—The Lighting Committee of the Urban Council has included in its draft estimates £300 for the purchase of a new battery. The Engineer has submitted a list of proposed public lighting improvements, estimated to cost £54.

GREAT WESTERN RAILWAY CO.—Tenders are invited for stores, including telegraph instruments, insulators, wires, and cables, electric light carbons, lamps, &c. Specifications, &c., from the Stores Superintendent, London, and tenders by October 20th.

LEEDS.—The construction of the Yeadon and Guiseley tramway is to be proceeded with during the ensuing winter, in addition to the extension from Horsforth to Guiseley.

LONDON: *Islington.*—The electric battery at Highgate Hill Infirmary is defective, and estimates are to be received for 100 to 120 plates.

NORWICH.—Tenders are invited for the supply of two vertical spindle motors with automatic starters, &c., for the Sewerage Committee. Particulars from the City Engineer, and tenders by October 20th.

ROTHERHAM.—The Electrical Engineer has been authorised to lay down additional cable in Doncaster Gate at an estimated cost of £130.

SPAIN.—The "Gacetas de Madrid" announces calls for tenders for working the telephone systems (*a*) of Jerez de la Frontera and (*b*) of the town of Almeria, for a period of 15 years. The concessionaires will be authorised to modify and extend either system, as may be necessary, within a radius of 15 kiloms. Tenders will be received at the Dirección general de Correos y Telégrafos, Madrid, until noon on October 26th for the first contract, and on October 27th for the second. A deposit of 2,000 pesetas will be required in each case. Local represenation is necessary. The "Gacetas," containing further information, may be consulted by British firms interested, on application at the Commercial Intelligence Branch of the Board of Trade.

WHITWORTH.—The Rochdale Corporation have decided to extend their electric car service into the Whitworth district.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations, and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Motor garage at Glicksten's Timber Yard, Poplar. Builders, Taylor Bros., 45 Rothbury Road, Hackney, N.E.

S.E.—New branch in High Street, Eltham, for London & South-Western Banking Co., 170 Fenchurch Street, E.C.

Two double houses, Elizabeth Street, Woolwich. W. Harris, steam joinery works, North Woolwich.

Enlarging Maitland Cottage Sanatorium. W. F. D. Smith, M.P. (chairman of committee), 3 Grosvenor Place, S.W.

Alterations to "Falconwood," Shooters Hill, for Baroness d'Erlange, per G. F. Dean, 9 South Molton Street, W.

Church and Presbytery, Abbey Grove, Abbey Wood. Benedict Williamson and J. H. Beart Fors, 27A Sackville Street, Piccadilly, W.

S.W.—Shop, Brompton Road, on site of All Saints' School. Architect, C. H. Townsend, 32 Gt. George Street, S.W.

Alterations and additions at de Never's Rubber Tyre Co.'s works, Bendon Valley, Springfield. Builder, W. Harbrow, South Bermondsey Station, S.E.

Additions at Windsor Works, Venn Street, Clapham North. Builders, H. Somerford & Son, Manor Street, Clapham, S.W.

Eleven houses, Southfield. Woodley Bros., merchants, Wimbledon Road, Tooting Graveney.

PROVINCES.

BARNSLEY.—Out patients' rooms, Beckett Hospital. Governors, Beckett Hospital.

BEDFORD.—Additions to Conservative Club, St. Peter's Street.

BIRMINGHAM.—Extensions in Lone Lane and Lister Street of premises of Extruded Metals Co.

Alterations and additions to premises in Tennal Road, of Harborne Golf Club, Ltd.

BRADFORD.—One hundred and thirty-two houses. Surveyor, J. H. Cox, Bradford Corporation.

CHADDERTON (Lancs).—Club premises at Middleton Junction for the Bowling Club.

CHELMSFORD.—Education offices for County Education Committee (£3,900). Builders, Thomas Parkington & Son, Crown Street, Ipswich.

DUDLEY.—Training college, Castle View, for Corporation. J. Gammage, Surveyor, Borough Council.

Alterations to works, Charlotte Street, for Co-operative Wholesale Society, Ltd.

Extension of bakery, Stafford Street, for S. Rhodes.

DUNDEE.—Proposed reading rooms. City Architect, Town House.

DURHAM.—Secondary school, Blaydon. Architect, County Education Committee.

Training College, Neville's Cross. Architect, County Education Committee.

EALING.—Lammas Council School, for Education Committee (£15,969). Builders, Spencer, Santo & Co., 22 Kensington High Street, W.

EAST AND WEST ARDSLEY (Yorks).—Small-pox hospital for Urban District Council. E. Brooke, Surveyor, Urban District Council.

GLOUCESTERSHIRE.—New school at Cinderford for Education Committee. Architect, R. S. Phillips, Midland Bank Chambers, The Cross.

HORNSEY.—Seventeen houses, Southwood Lawn Road, Highgate. Surveyor, A. G. Shearing, 12 Fortess Road, N.W.

Laying out Northwood estate. Builder, J. C. Hill, 55 Glenmore Road.

HULL.—Infants' school, Craven Street. Joseph H. Hirst, City Architect.

ILFORD.—Alterations and additions (£640) to school, Beehive Lane. Architect, C. J. Dawson, 11 Cranbrook Street.

KILBURN.—Baptist church (£1,309). Architect, R. Argyle, Alfred Street, Ripley, Derby.

KINGSTON-ON-THAMES.—Pavilion for Corporation. Surveyor, R. Hampton Clucas, Kingston Corporation.

LEYTON.—Addition to workshop. Builder, F. J. Coxhead, Bulmer Road, E.

Sheds, stores, &c., at London Electric Wire Co.'s premises, Church Road. Architect, A. W. Hudson, 87 Finsbury Pavement, E.C.

Institute in connection with Christ Church. Builders, Mattock Bros., Winkfield Road, Wood Green, N.

Shop, stores, and house, High Road, for Stratford Co-operative Society.

LINCOLN.—Proposed church, St. Swithin's. Vicar, St. Swithin's.

LIVERPOOL.—Workmen's dwellings on Combermere Street (Toxteth) and Burlington Street (£38,000). J. T. Alexander, Surveyor, Town Council.

MANCHESTER.—Car-shed, Princess Road, Moss Side (250 cars). T. de Courcy Meade, City Surveyor.

MARGATE.—Kursaal, to include baths, concert hall, conservatories (£64,000). Edward Brooke, Town Clerk.

MORTLAKE.—New ward block (£2,150) at Isolation Hospital. Surveyor, G. Bruce Tomes, Urban District Council House, High Street.

NEWCASTLE-ON-TYNE.—Two storey shed in connection with quay improvement for City Council. F. H. Holford, Property Surveyor, City Council.

NORTHAMPTON.—Additions Masonic Hall, Princess Street, for Masonic Club Co.

NORTHAMPTON.—Garage, Abington Street, for J. Brown.

OXFORD.—Twelve bathrooms, drying-room, dressing-room, and heating chamber for Magdalen College.

Additions, "Blanche's Laundry," Islip Road. Builder, J. Simms & Son, 18 Kingston Road, Oxford.

ROTHERHAM.—Additions Rother ironworks. Owen & Dyson.

Alterations and additions to Guardians' premises, Northfield Road. Clerk to Board of Guardians.

ROWLEY REGIS (Staffs).—Public library (£2,630). W. H. Brettell, Surveyor, Urban District Council. Builders, W. Willetts & Sons, Old Hill.

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RUGBY.—Workshop, lower school of Lawrence Sheriff for the Governors.

SALFORD.—Extension to church, Bowker Street, Broughton.
Addition Trafford Mill, Cobden Street, Pendleton.
Extension to corn mill, Peel Street, Pendleton.

SUNDERLAND.—Children's Hospital (£20,000). Architects, W. & T. R. Milburn, Fawcett Street. Builder, Joseph Huntley, Athol Road.

WARRINGTON.—Extension bottling store for Greenall, Whitley & Co., Ltd.
Galvanising and tinning sheds for Rylands Bros., Ltd.

WIMBLEDON.—Pavilion at Royal Wimbledon Golf Club.
Alterations and additions to Wimbledon Town Golf Club house.

WORCESTER.—The Markets Committee recommend a scheme of electric lighting for the butter market at an estimated cost of £103 4s.

TENDERS RECEIVED AND ACCEPTED

BLACKBURN.—A contract has been entered into with Messrs. Walter Scott, Ltd., for the supply of permanent way materials for the tramways.

BOGGLESHOLE COLLIERY.—Messrs. James Dunlop & Co., Ltd., have placed an order with Messrs. Johnson & Phillips for the supply and erection of shaft cables.

BURY.—Subject to the sanction of the Local Government Board with regard to borrowing powers, the tender of Messrs. John Musgrave & Sons, of Bolton, for a 2,000-kw. Zoelly turbine, in connection with a Siemens alternator, has been accepted. The Sub-Committee from the Corporation have visited Messrs. Musgrave & Sons' works, and inspected the working of various plants.

DUBLIN.—The tender of Messrs. Babcock & Wilcox for boiler plant and accessories, at £6,423, has been accepted.
The Lighting Committee have provisionally accepted the tender of the General Electric Co., Ltd., for the supply of electricity meters for twelve months.

ERITH.—The tender of Messrs. Mason & Jacob, Ltd., at 16s. 2d. per 1,000 car miles run per annum, on a three years' agreement, for the advertising rights on the tramcars has been accepted.
The tender of the Woodville Electricity Co., for the supply of fire alarm bells to St. Augustine's boys' and girls' departments, and to the Central School, has been accepted by the Education Committee.

HORNSEY.—The Council has accepted the tender of Messrs. Charrington, Sells, Dale & Co., for the supply of Brynteg Welsh coal at £1 0s. 6d. per ton.

HULL.—The tender of Messrs. McMillan & Co. (London), amounting to £568 for the supply of 200 telephone instruments, has been accepted. The tender of Messrs. Bullers, Ltd., for ironwork, in connection with the municipal telephone undertaking, at £60, has been accepted.
The tender of Messrs. Siemens Bros. Dynamo Works, Ltd., for a new generating set at the Tramway Power Station has been accepted at £5,926, and for a new condensing plant, that of Messrs. Amos & Smith at £895. The tender of Messrs. Hadfield's Steel Foundry Co. for additional work for tramway extensions has also been accepted at £1,213.

IPSWICH.—The tender of Messrs. Mann, Egerton & Co. for repairs to cable connections from the dynamos to the main switchboard at the workhouse generating station, has been accepted.

LAMBETH.—An agreement has been sealed between the Borough Council and the National Telephone Co., Ltd., for the installation of a public telephone service, in connection with the new Town Hall, depôts, &c. The agreement which sets up a yearly tenancy of a number of telephone lines, provides an unlimited service, and message-rate service, at a total estimate annual rental of £165 10s.

LEEDS.—The Corporation have accepted the tender of Mr. T. W. Matthews for the supply of 2,200 Osram electric lamps for the town hall and municipal buildings. It has been decided to purchase 70 magnets for brakes from the Electric Mechanical Brake and Engineering Co., at £11 10s. each.
A contract has been entered into with the Middleton Estate & Colliery Co., Ltd., for 30,000 yards of cable troughing and covers.
The construction of the Yeadon and Guiseley tramway is to be proceeded with during the ensuing winter, in addition to the extension from Horsforth to Guiseley.

LEYTON.—The question of placing the District Council schools in communication with the fire stations has been considered by the Education Committee, and the following quotations have been received for fitting up fire alarms:—National Telephone Co., £216, for sale outright, or £60 per annum for a term of not less than five years on rental, or £251 10s. for sale outright, each line to run direct from switchboard to instruments instead of being granted, or £68 per annum for a term of five years rental; Messrs. Stuart & Moore, purchase scheme amounting to £434 16s., or hire-purchase scheme at £125 per annum; Messrs. Headland & Headland, telephones to fire stations £393, fire alarms £335, and connecting schools with nearest fire post £210. Having regard to the heavy expense no further action is to be taken.
The Urban District Council having considered prices in existing contracts, together with amended prices, has resolved that contracts for the supply of the following tramway stores be extended until June 30th, 1909, as follows:—Electrical accessories: General Electric Co., Ltd., batteries, wet, 1s. 11d.; electric bells, 4s. 9d.; electric bell gongs, 1s. 3d. Asbestos and insulating material: General Electric Co., Ltd., mica, best clear, insulating, 3s. per lb.; vulcanite fibre 5/16 in. wide, 10d.; vulcanite fibre, ⅛ in., 10d.; voltalac, 9s. Armature repairing materials: General Electric Co., Ltd., linen frame tape, 1 in., 7s. per lb.; linen tape (grey), ½ in., 9s.; British Westinghouse Electric & Manufacturing Co., Ltd., mica cones, 12s. 6d. per lb.; mica cones, 7s. each. Cables and wires: General Electric Co., Ltd., 7/16 cable, £3 12s. per 110 yards; 7/20 cable, £1 10s.; 3/22 cable, 15s. 6d.; electric bell wire, 2s. 3d. Controllers, British Westinghouse Electric & Manufacturing Co., Ltd., fingers 8d. each; contacts drum rings, 1s. 3d.; contacts arcing tips, 4d.; power cylinders, £6 10s.; handles, main drum, 12s.; handles, reverse handle, 4s. 6d.; reverse drums, No. 1, 12s. 9d.; motor cut-outs, No. 2, 12s. Cable connectors, British Westinghouse Electric & Manufacturing Co., Ltd., automatic circuit breakers, £3 3s. each; canopy switches, £1 10s.; resistance boxes, Nos. 1 and 2, £4; resistance boxes, Nos. 3 and 4, £2 5s. Motors, British Westinghouse Electric & Manufacturing Co., Ltd., carbon brushholders, £2 2s. each; pinion wheels, 8s. 6d.; gear wheels, £2 18s. 6d. The Council have accepted the following tenders for materials required for the electrical equipment of the portion of the tramway line in Lea Bridge Road within the area of the L.C.C.:—F. Smith, Manchester, trolley wire, £88 4s. 10d.; Spencer, Ltd., poles, £224 7s.; Dick, Kerr & Co., County Council bases, &c., £70 18s. 8d.; Turners & Manville, insulator bolts, £9 16s. 8d.; Bricknell, Munro & Rogers, span brackets, &c., £32 15s. 6d.; Dennis & Co., span wire, &c., £2 14s. 6d.; W. Wood & Co., hangers and ears, £8 11s.

LOCHGELLY.—The Lochgelly Iron and Coal Co., Ltd., have placed an order with Messrs. Johnson & Phillips, for underground switchgear for their Lochgelly pits.

LONDON: *London County Council.*—The following tenders have been received for electric wiring and fitting of the central car repair depôt:—G. E. Taylor & Co. (accepted), £1,275; Tredegar & Co., £1,319; Pinching & Walton, £1,525; W. Mackie & Co., £1,500; Lund Bros & Co., £1,628; C. Pullan, £1,684; W. E. King, £1,904.
Tenders have also been received for laying stoneware cable ducts, repaving, &c., in connection with the Council's tramways, as follows: J. Mowlem & Co. (accepted), £17,476; Reid Bros., £17,498; Dick, Kerr & Co., £17,904; W. Muirhead & Co., £18,211; J. & A. Ewart, £18,589.
The following tenders have been received for the supply of seven motor-generators for tramways sub-stations: British Westinghouse Electric & Manufacturing Co. (accepted), £11,632; Phœnix Dynamo Manufacturing Co., £12,077; Dick, Kerr & Co., £12,234; General Electric Co., £12,282; Union Electric Co., £12,541; Siemens Bros. Dynamo Works, £13,808; Electric Construction Co., £16,473.
For the supply and erection of high and low tension switchgear for tramway sub-stations, the following tenders have been received:—Johnson & Phillips (accepted), £3,807; Spagnoletti, Ltd., £4,019; Whipp & Bourne, £4,119; Switchgear Co., £4,229; British Westinghouse Electric & Manufacturing Co., £4,301; Ferranti, Ltd., £4,553; General Electric Co., £5,105; Union Electric Co., £5,605.
For the supply of stoneware ducts for the Council's tramways, the following have been received:—Stanley Bros. (accepted), £2,250; Doulton & Co., £2,250; Robinson & Dowler, £2,250; H. R. Mansfield, £2,266; H. Tugby & Co., £2,266; T. Wragg & Sons, £2,400; Gibbs & Canning, £2,450; Donington Sanitary Pipe and Firebrick Co., £2,500; Ensor & Co., £2,500; North Bitchburn Coal Co., £2,800; Sutton & Co., £2,900; J. Stiff & Sons (for 100,000 ducts), £1,170; G. Skey & Co. (for 75,000 ducts), £923; Oates & Green (for 10,000 ducts), £250.
Islington.—A tender of the Medical Supply Co., at £14 14s., for a switchboard and interrupter in connection with the X-ray apparatus at the Highgate Hill infirmary has been accepted. Supply is to be taken from the Borough Council.

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Woolwich.—The Borough Council has received the following tenders for the supply of cable required for extensions :—

Western Electric Co. (accepted), £1,450. Time for completion, 6 weeks.

Johnson & Phillips, Ltd., £1,468 7s. 6d. Time for completion 7–8 weeks.

W. T. Glover & Co., Ltd., £1,471. Time for completion, 8 weeks.

W. T. Henley's Telegraph Works Co., Ltd., £1,484 10s. Time for completion, 7 weeks.

Siemens Bros. & Co., Ltd., £1,489. Time for completion, 8 weeks.

Callenders Cable & Cons. Co., £1,498 5s. Time for completion, 6 weeks.

British Insulated and Helsby Cables, Ltd., £1,526. Time for completion, 3 weeks.

St. Helen's Cable & Rubber Co., £1,535. Time for completion, 8 weeks.

Sun Electrical Co., Ltd., £1,541 15s. 9d. Time for completion, 8 weeks.

For 110 yards of 3-core ·05 lead sheathed and armoured cable recently required urgently to connect up existing applications and for stock purposes, the following tenders were obtained :—

Callender's Cable & Cons. Co., Ltd. ...	£22	3	9
Western Electric Co. (accepted)	22	3	9
W. T. Henley's Telegraph Works Co., Ltd.	23	1	0
Siemens Bros. & Co., Ltd.	23	10	0

POST OFFICE POWER STATION.—In addition to the tender for generating plant which has been let to Messrs. Willans & Robinson, with Messrs. Dick, Kerr & Co., as sub-contractors, the contract for boilers at the Post Office power station at Blackfriars has been let to the Stirling Boiler Co. There will be seven boilers, three of the land type, and four marine type, each with an evaporative capacity of about 17,500 lb. of water per hour.

ROTHERHAM.—The Electric Light and Tramways Committee has accepted the tender of Jas Cooper, at £127, for the foundations for a turbo-generator.

SALFORD.—The Corporation have, on the recommendation of the Electricity Committee, accepted the tender of the British Insulated & Helsby Cable Co., for the supply of feeder pillars.

WIMBLEDON.—An offer by Messrs. E. Green & Son, to re-erect the economiser at the electricity works for the sum of £21, has been accepted.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5, Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., quoted on Tuesday night, was £61 15s. to £62 5s. per ton (last week, £62 to £62 10s.).

LEA RECORDERS.—The business of Mr. J. E. Lea, 28 Deansgate, Manchester, will in future be carried on under the style of the Lea Recorder Co.

THE JOHNSON-LUNDELL WORKS.—The manufacturing business of the Johnson-Lundell Electric Traction Co., Ltd., and the freehold factory at Southall, together with plant, machine tools, patterns, drawings, etc., has been purchased by the J. L. Manufacturing Co., Ltd., who will now continue to manufacture under licence the patent "Johnson-Lundell" laminated field motors and dynamos, and will carry on a general electrical engineering business. The new company are now prepared to execute orders on the shortest notice, and hope to be favoured with the support of past customers, and the enquiries of new ones.

NEW AGENCY.—Messrs. E. Lomer & Co., Ltd., 110 Fenchurch Street,, London, E.C., have been appointed sole agents in the United Kingdom by the Brückenbau Flender, A. G., of Benrath, near Düsseldorf, for constructional material of all kinds, bridge work, and steel structures.

NICKEL TUBING.—Messrs. Wm. Geipel & Co., Vulcan Works, St. Thomas Street, S.E., who are sole European agents for Benedict nickel tubing, advise us that improvements have recently been made which enable them to put upon the market a tube having a silvery-white colour which is maintained through the whole of the thickness. This tubing is specially suitable for condenser and cooling apparatus, as well as sanitary, plumbing, and decorative purposes, for which are used at present plated brass and other metal tubes that have the disadvantage that the nickel plating rapidly wears away when cleaned.

PIGGOTT ELECTRICAL CO.—Messrs. G. Piggott & Co., who will in future trade as the Piggott Electrical Co., have removed from 110 Cannon Street, London, E.C., to 24 New Bridge Street, London, E.C. The firm's telephone number is also changed to Holborn 2208.

WIRELESS CLUSTER FITTINGS.—The Benjamin Electric, Ltd., 1A Rosebery Avenue, London, E.C., have brought out a new line of cluster fittings and lighting specialities which cover the grouping idea completely, with a wide range of types and sizes, adapting them for any purpose. The distinguishing feature of these fittings is the "wireless" principle, which eliminates all separate wiring connections to the lamp-holders. The wireless cluster fitting consists primarily of a body shell with detachable back for supporting cluster to stem or attaching direct to surface. Complete lamp-holders of a special design are permanently attached to the body shell. These holders are connected internally by means of conductor rings carrying binding screws for attaching leads from the "live" circuit. Mr. Charles F. Trippe, 36 Brooke Street, Holborn, E.C., is sole agent for the United Kingdom.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Notice is given of an intended dividend in the bankruptcy of Walter Wardle, electrician, 14 Osborne Road, Levenshulme, Manchester. The last day for receiving proofs is October 17th, and the trustee is Mr. J. G. Gibson, Byrom Street, Manchester.

The first meeting of creditors of the Electrical Instruments Manufacturers, Ltd., of Waltham Cross, Hertfordshire, was held on 2nd inst. at the offices of the Official Receiver, 14 Bedford Row, London, E.C. No statement of affairs had been filed, but it was stated that the unsecured creditors amount to about £1,200, and the assets to £121, but that these latter are covered by debentures. An adjournment was ordered to enable a proper statement of affairs to be filed.

The Gould Storage Battery Co., Ltd., is to be wound up voluntarily. Mr. E. A. Locock, 25 Regent Street, London, W., is liquidator. Particulars of claims by October 31st.
can be used.

NEW COMPANIES

H. T. BOOTHROYD.—This company was registered on October 2nd, with a capital of £16,000 in £1 shares (5,000 preference), to acquire the business of electrical engineers carried on by H. T. Boothroyd as "H. T. Boothroyd, Hyslop & Co.," at Akenside, Bootle. The subscribers are : H. T. Boothroyd, Woodthorpe, Crosby, Lancs., engineer (1 share); Mrs. E. Boothroyd, Woodthorpe, Crosby, Lancs. (1 share). Private company. H. T. Boothroyd is permanent governing director, with £500 per annum. Registered by J. Sykes, 9 King's Bench Walk, Temple, E.C.

DAVIS ELECTRICAL CO.—This company was registered on October 2nd, with a capital of £3.000 in £1 shares (1,000 preference), to acquire the business of manufacturers of and dealers in electric and other lamps and electrical accessories carried on by H. E. Davis at 17 Moor Street, Cambridge Circus, W., and to carry on the same and the business of motor and electrical engineers, &c. The subscribers are : H. E. Davis, 17 Moor Street, Cambridge Circus, W., electrical engineer (1 share); H. N. Howlett, 59 Manor Road, Brockley, S.E., electrical engineer (1 share). Private company. The number of directors is not to be more than three; the first are H. E. Davis (managing director) H. N. Howlett, and C. Levy (chairman). Qualification, £10. Remuneration as fixed by the company. Registered office : 17 Moor Street, Cambridge Circus, W.

PETERBOROUGH CITY GARAGE CO.—This company was registered on October 2nd, with a capital of £2,000 in £1 shares, to acquire the business of motor and motor cycle manufacturers, and motor, electrical, and general engineers, carried on at 14 Lincoln Road Peterborough, and the business of the Peterborough City Garage Co., carried on at 31 Cowgate, Peterborough. Private company. The number of directors is not to be less than two nor more than five; the first are J. Rowe and R. H. Gale. Registered office : 31 Cowgate, Peterborough.

SAN SEBASTIAN DEVELOPMENT SYNDICATE.—This company was registered on September 26th, with a capital of £5.000 in 4,975 ordinary shares of £1 each, and 500 founders' shares of 1s. each, to carry on in Spain or elsewhere the business of hotel, restaurant, café, tavern, beerhouse, refreshment room, and lodging-house keepers, billiard room, music-hall, lecture hall, concert room and ball-room proprietors, licensed victuallers, tobacconists, jobmasters, bath and bathing machine proprietors, laundrymen, hairdressers, agents, printers, publishers, ball and rout furnishers, carriers, suppliers of electric light and power, &c. Private company. The first directors are the Rt. Hon. Lord Suffield, G.C.V.O., K.C.B., the Rt. Hon. Lord Rosmead, Sir Theodore Fry, Bart., Sir Henry E. Dering, Bt., and Major J. Eustace Jameson, J.P. Qualification and remuneration as fixed by the company. Registered office : 15 George Street, Mansion House, E.C.

LAMPLOUGH & SON.—This company was registered on September 28th, with a capital of £2.000 in £1 shares, to carry on the business of mechanical, electrical, and general engineers, machinists, fitters, millwrights, smiths, founders, tyre and rim manufacturers, &c. The subscribers are : F. Lamplough, Mrs. H. Lamplough, L. Lamplough, and T. Cording. Private company. The number of directors is not to be less than two nor more than five; the first are F. Lamplough, Mrs. H. Lamplough, and T. Cording. Qualification, £100. Registered office : Cumberland Park, Willesden Junction, N.W.

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APPOINTMENTS AND PERSONAL NOTES

Mr. E. J. Meachell, M.I.E.E., A.M.I.Mech.E., has been appointed general manager in succession to Mr. S. B. Cottrell, whose resignation we announced last week.

The Colne Town Council have decided to ask Councillor John Smith to be Mayor. For five years Councillor Smith has occupied the position of chairman of the Electricity Committee.

Mr. W. H. Taylor has been promoted as assistant electrical engineer to the Walthamstow Urban District Council.

Mr. R. M. Neilson has severed his connection with Messrs. Richardsons, Westgarth & Co., Ltd., Hartlepool, and has opened an office as consulting engineer and chartered patent agent at 45 Hope Street, Glasgow.

Mr. J. A. Jeckell has resigned his position as chief engineer and manager to the electrical department of the Coventry Corporation.

A permanent draughtsman is to be appointed by the Wimbledon Council.

COMPANY MORTGAGES

Particulars of mortgages and charges have been filed as under :—

ASHWELL & NESBIT.—Charges, dated March 30th and September 25th, 1894, securing £646 and £346 respectively.

BUDE ELECTRIC SUPPLY CO., LTD.—Particulars of £2,500 debentures created by resolution of April 14th, 1908, have been filed pursuant to section 10 (3) of the Companies' Act, 1907, the amount of the present issue being £700. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

KEIGHLEY ELECTRICAL ENGINEERING CO.—Mortgage, dated September 21st, 1899, securing £3,000.

LISBON ELECTRIC TRAMWAYS.—Particulars of £500,000 debentures created by resolution of November 5th, and secured by a trust deed dated November 22nd, 1899, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £90,000. Property charged—Lease of tramways in Lisbon and the company's undertaking and property, present and future. Trustees—L. Breitmeyer and C. Rube.

MOUNTAIN & GIBSON.—Issue on August 25th, of £200, and on September 11th of £5,000 debentures, part of series of which particulars have already been filed.

NAIROBI ELECTRIC POWER & LIGHTING CO.—Issue on September 9th, of £600, part of series of which particulars have already been filed.

MISCELLANEOUS CITY NOTES

ANGLO-AMERICAN TELEGRAPH CO.—After placing £5,000 to the credit of the renewal fund, the directors have declared an interim dividend for the quarter ended September 30th of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, less tax, payable on November 2nd. A year ago the dividends were at the same rate.

BRISBANE TRAMWAYS INVESTMENT. The directors have decided on the payment of the following interim dividends on November 2nd, in respect of the profits for the half-year to June 30th :—The usual half-yearly dividend of 2s. 6d. per share on the preference shares, and a dividend of 2s. 6d. per share free of income tax, on the ordinary shares.

CALCUTTA TRAMWAYS CO.—An interim dividend of 2s. per share on the ordinary shares (being at the rate of 4 per cent. per annum, free of tax) has been declared by the directors for the half-year to June 30th.

MBARTON BURGH & COUNTY TRAMWAYS CO.—Subscriptions have been invited during the week to an issue of £80,000 five per cent. debenture stock. The stock will be entitled to the benefit of, and subject to the provisions contained in an agreement and deed of trust dated September 25th and 26th, 1908, between the company and The Realisation and Debenture Corporation of Scotland, Ltd. This deed contains an obligation by the company to pay to the trustees £1,200, being 1½ per cent. on the amount of the stock, annually (first payment being at Whitsunday, 1911), to be increased to the extent of the annual interest upon the amount of stock from time to time redeemed out of the redemption fund thus to be created, and this fund is directed to be applied in redeeming stock, either by drawings at the price of £105 (plus interest) for each £100 of stock, or by purchasing stock at any lower price. The company is entitled to redeem the stock, or any part of it, at any time after three calendar months' notice, and the stock becomes repayable in the event of the company going into voluntary liquidation, whether for reconstruction, amalgamation, or winding up. In both of these cases (viz., repayment by the company, and voluntary liquidation) the stock is to be repaid at the rate of £105 (plus interest) for each £100 of stock.

EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH CO.—An interim dividend of 2s. 6d. per share, free of income tax, has been declared for the quarter ended June 30th.

EASTERN TELEGRAPH CO.—An interim dividend of 1¼ per cent. free of income tax, has been declared for the quarter to June 30th.

LANCASHIRE UNITED TRAMWAYS.—The receipts for the week ended September 30th amounted to £1,423, against £1,440 for the corresponding week of 1907.

METROPOLITAN DISTRICT RAILWAY.—Subscriptions were invited up to yesterday morning for an issue of £550,000 four per cent. prior lien debenture stock, part of £750,000 of such stock, authorised by the Metropolitan District Railway Act, 1908.

MEXICAN LIGHT & POWER CO.—A dividend upon the ordinary shares of one per cent. has been declared.

MEXICO TRAMWAYS CO.—A dividend of 4 per cent. per annum for the quarter ended June 30th is recommended.

SHAWINIGAN WATER AND POWER CO.—A dividend of 1 per cent. for the quarter ended September 30th has been declared on the ordinary shares.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—Warrants for interest on the 4½ per cent. first mortgage debenture stock for the half-year ended September 30th, 1908 (payable October 1st), have been posted.

COMPANIES' MEETINGS AND REPORTS

CLEVELAND & DURHAM ELECTRIC POWER.—The report for the year ended June 30th states that the depression in trade on the North-East Coast, together with labour disputes, affected the demand for electric power, and at the same time demands for the extension of the company's system necessitated large capital expenditure. Agreements have been made with Waste Heat and Gas Electrical Generating Stations, Ltd., for the operation by the Cleveland and Durham Electric Power, Ltd., of power stations erected by that company at the works of the Weardale Steel, Coal, & Coke Company, at Tudhoe, Spennymoor, and Sir Bernard Samuelson & Co., of Newport, Middlesbrough. Arrangements for bulk supply and extension of the mains system to Hartlepool have been completed, and it has lately been decided to link up this company's cable system with those of the companies further north, and an important extension of mains is now proceeding from the North bank of the River Tees to North-East Durham coalfield. A bulk supply to the Corporation of Middlesbrough was commenced in March last, and important contracts have been closed for supply to four new rolling mills under construction in the Cleveland district. The connections to the company's system aggregate 20,105 horse-power, as compared with 9,172 horse-power connected at June 30th last year. Arrangements have also been made for the connecting up of a further 8,850 horse-power. The net revenue for the year, after writing down preliminary expenses by £10,000, amounts to £5,142, to which is added £3,250 brought forward. In April last an interim dividend of 5 per cent. on the preference shares was paid, and it is now proposed to carry forward to next account the balance of £1,252.

ERNEST SCOTT & MOUNTAIN.—There is a profit of £10,191 for the year to June 30th, 1908. This has been applied as follows :—Interest on debentures, bank charges, &c., £3,520; directors' fees and other charges, £795; depreciation of plant, machinery, and bad and doubtful debts, £5,876.

HENRY BERRY & CO.—There is a gross profit on the working for the year ended August 31st, of £17,985, including £5,861 brought forward. A dividend of 20 per cent. upon the ordinary shares is recommended, carrying forward £4,685. The meeting is on the 14th inst.

MESSRS. WILLANS & ROBINSON.—At the ordinary general meeting held in London on Tuesday, the report and accounts given in our last issue were adopted. Mr. Mark Robinson, who was in the chair, referred to the restriction on the part of municipalities with regard to electrical enterprises, and also to the effect on the electrical manufacturing industry by the use of metal filament lamps. In spite of these conditions, and the continued competition, however, the prosperity of the company had been well maintained. They had a large number of important orders in hand for turbines, whilst the extension of their scope of business by cautiously taking up new classes of work was beginning to show good results. For instance, the Diesel engine was now an element in meeting general charges, whilst condensing plants were also forming an important section of their business. It had been decided that the Queen's Ferry works should not be kept open beyond the autumn this year. The works had been offered for sale on September 16th, but the reserve was not reached, and the directors were convinced that the time had come for drastic measures. There was some discussion as to the advisability of declaring the full dividend upon the ordinary shares, and at the request of Sir G. Clayton East the Chairman put a resolution to the meeting "That no dividend be paid upon the ordinary shares." This was lost, only two voting for it. The motion for the adoption of the report and accounts, with the full dividend upon the ordinary shares be paid, was then put to the meeting and carried.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Oct. 1st, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

1907 Patents

20,095. **Motor-Operated Time Limit Switch.** K. Edgcumbe and E. I. Everett. An improvement in the type of time limit switch in which a motor is used, either to close the trip-coil circuit of the circuit-breaker, or to release the tripping mechanism mechanically. Usually the motor works against the force of a spring or weight which is adjustable so as to predetermine the amount of the operating current and of the time to elapse between the instant of overload and the closing of the relay contacts or the releasing of the catch. Since the torque of the motor varies with the current settings, the time will also vary and this renders the adjustment difficult. To overcome this defect the present invention provides for the use of inductive or non-inductive resistances, which may be connected in series with the motor across the secondary of the current transformer. By using these, the same timing scale may be used with different current settings. Three claims, three figures.

25,834. **Insulation of High-Tension Windings of A.C. Machines.** British Thomson-Houston Co. and F. H. Clough. The potential gradient between copper and iron in an armature slot is determined by the same factors as those in the case of the gradient between copper and lead in a lead-covered cable. At a point in the insulation, the potential gradient is inversely proportional to the specific capacity of the insulation at that point. As the usual insulating materials have a specific capacity several times higher than air, and as the fibrous insulation on the conductor itself has a specific capacity approximately the same as air, it follows that the potential gradient may be much higher in the air space and in the fibrous insulation than in the tube. Although the tube may not break down, the electric stress in the air-space and in the fibrous insulation may be sufficient to cause dissociation of the air and the formation of nitric acid which causes corrosion of the insulation. According to the present invention, this defect is overcome by lining the insulating tube with a metallic sheathing in close contact with the inside wall of the tube, and connecting it electrically to one of the conductors. By this arrangement, the whole fall of potential occurs in the insulating tube; and, as the inside air is relieved of practically all electric stress, chemical action will not take place. One claim, one figure.

25,999. **Compound Field Winding for Motors.** Aarhus Dynamo & Elektromotorfabrik and S. P. Johansen. A compound field winding especially adapted for continuous-current motors working cranes or hoists. The poles are wound alternately with shunt and series coils, so connected as to give the proper alternate polarity. The shunt coils are connected in series as a "short shunt" across the armature. A series or wave winding is necessary for the latter. It is claimed that if the resistances are properly proportioned, such a motor can be started under load without any starting resistance, and even suddenly reversed without any resistance being used. When the motor is running light, the current in the series coils will be slight, whereas the shunt current will be relatively strong. Under load the reverse is the case, and it is stated that the relation of the windings may be adjusted so that the speed under load may vary in any required manner. One claim, one figure.

27,412A. **Shunt Coil Protector for Arc Lamps.** H. Bevis and A. E. Angold. A shunt breaking switch for protecting the shunt coil of a shunt or differentially controlled arc lamp. This switch consists of an arm pivoted inside the drum, which carries the carbon suspension chain, the said arm having a lug which extends through the surface of the drum when the chain has been unwound off it. When this happens, another lug on the arm engages a pivoted switch blade and breaks the shunt circuit. On winding back the drum, the arm closes the switch again. By this arrangement it is possible to use a rubbing metal contact switch which is self-cleaning. One claim, two figures.

1908 Patents

811. **Insulation of Wires and Cables.** J. E. Glenister and G. W. Glenister. According to this invention it is proposed to first cover the copper wires of cables with the usual india-rubber sheath, but to substitute for the stranded cotton an outer cover of paper. This outer cover is made of paper threads or strands consisting of narrow strips of paper which are twisted upon themselves so as to form cylindrical threads of any desired diameter; the threads are braided together in the usual way. Two claims.

4,461. **Filaments of the Rare Earths for Electric Lamps.** G. Michaud and E. Delasson. A filament for use in the atmosphere, and composed of a conducting core and a non-conducting outer envelope. This latter, the radiant part of the filament, is formed of alumina and a mixture of the rare earths thoria and ceria; and a binder of black soap is used. The conducting part may be either carbon, tantalum, or any metal of the tantalum group, mixed with a binder of black soap. The former (radiant envelope) mixture is pressed through a nozzle into the shape of a tube which is dried in the flame of an arc. The conducting mixture is forced through the centre of the nozzle into the tube, and is dried at the same time. Five claims, twenty figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

13,724, Mavor & Mavor & Coulson, Ltd. Electrical transmission of power.
20,347, Watson & Smith. Ignition systems.
20,380, Schneider. Electrical clock.
20,592, Rabbidge. Electric batteries or cells.
20,612, Rose. Automatic circuit breaker.
21,073, Siemens Bros. Dynamo Works, Ltd., & Kloss. Windings of dynamo-electric machines.
21,651, Marconi's Wireless Telegraph Co. & Young. Receivers.
22,485, Simpson. Coin-freed meters.
23,915, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Motor controllers.
25,116, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Dynamo-electric machines.
25,772, Stevens. Means of paralleling the motors of electric and petrol electric cars.
26,195, Petch, Duncan, & King. Electric order telegraphs.
26,399, Pullan. Compound tramway rails.
26,711, Klauser (*Geb. Gierse*). Spanner for insulators.
28,004, Siemens Bros. Dynamo Works, Ltd., & Grimston. Search lights.
28,435, Gardiner. Electric railway signalling system.

1908 Patents

136, Entwistle. Electric lamp and shade holders.
1,250, Jensen (*Jeffrey*). Electrically-driven mining machines.
2,046, Mavor & Mavor & Coulson, Ltd. Means for damping the rolling of ships.
3,670, Fairweather (*Shepherd*). Alarm signalling system.
4,391, Child. Photophonic means for use in telephonic transmission, and production of photographic records.
4,940, D'Varad & Meislinger-Meszlényi. Manufacture of positive storage battery plates.
5,728, Fairburn-Hart (*Electrelle Co.*). Automatic musical instruments.
7,495, Fessenden. Telephonic transmitters or relays.
7,664, Fraser & Chalmers, Ltd., and Whitmore. Safety devices for hoisting apparatus.
8,133, Siemens Bros. Dynamo Works, Ltd., & Kieffer. Fixing commutators.
9,800, Chisholm. Electro-magnetic sound-recording apparatus.
10,184, Buckton. Combined plugs, sockets, and switches.
11,099, Hamilton. Apparatus for transmitting telegraphic signals.
11,128, Hankin, Electric heating apparatus.
13,730, Kitsee. Telegraphy.
16,028, Hutton. Appliances for preventing the overhearing of telephone conversations.
16,136, Harrison & Burns. Electric insulating shield for use by linemen.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

6,029, Company Bismarckhütte. Refining of steel in electric furnaces.
10,626, Anders. Electrical driving devices for clocks.
17,350, Siemens & Halske Akt.-Ges. Process for improving the ductility of tungsten.
18,430, Fessenden. Apparatus for producing high-frequency electric oscillations.
18,500, Wagner. Railway signalling systems.
18,579, Rateau. System of governing low-pressure turbines driving generators coupled in parallel.
19,169, Glühlampenwerk Anker Ges. Process for packing metal filaments.
19,201, Hanl & Waldau. Sparking-plug.
19,263, Felten & Guilleaume-Lahmeyerwerke Akt.-Ges. Insulating process for electrical machines.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	5%*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½%	9½—10	
Do. 6% Cum. Second Pref.	10	6	6%	10⅜—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5⅛	4⅝*	4⅜—4⅝ xd	−⅛
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	96—100	
Brompton & Kensington E. S. Co., Ltd.	5	10	5%*	7—8	
Do. 7% Cum. Pref.	5	7	7%	7—8	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½%*	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3½—4	
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	2⅞—3⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2⅜—3	
Do. 5% Pref.	5	5	5%	3⅜—4⅛ xd	−⅛
County of London Elect. Sup. Co. Ltd.	10	5	—	7⅞—8½	
Do. 6% Cum. Pref.	10	6	6%	10⅝—10⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—¾	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4⅜—5⅛ xd	
Do. 5% Cum. Pref.	5	5	5%	5—5⅛ xd	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L. Co.	5	10	4½*	7¾—8⅛	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4%	96—100 xd	−2
London Electric Supply Corporation	3	2½	—	⅝—1⅜	
Do. 6% Pref.	5	0	6%	4⅛—4⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¼—4⅛	
Do. 4½% Cum. Pref.	5	4½	4½%	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E.Corp.for P. Dist.1st Mt. Db	100 & 500	4½	4½%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply..	5	5	2½%	5¼—5⅜	
Do. £2 Paid	5	8	2½%	3½—3¾	
Do. 5% Pref. (fully paid)	5	5	2½%	5¼—5¾	
Do. £2 Paid	5	5	2½%	3¼—3¾	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7%	11⅜—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅝—6⅛	
Do. 4% Deb. Red.	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	7¼—7⅜	+¼
Do. 7% Non-Cum. Pref.	5	7	7%	7⅛—7⅜	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅛—¾	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅛—2⅜	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	98 -101 xd	−2
Urban Elec. Supply Co., Ltd.	5	5	5%	¼—1 xd	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2⅝ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83 xd	−2
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8—9	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	94—96	
Central London	Stock	3	3%	71—73	+3
Do. 4% Preferred	Stock	4	4%	86—88	+1
Do. Deferred	Stock	2	—	51—54	+1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	85—87	+1
City and South London Cons.	Stock	4¼	1½%	34—35	+1⅛
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	3½%*	7⅞—8½	+¼
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	½	½%	39½—40½	+1
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	75—78	+1
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—78	+1
Metropolitan District	Stock	—	—	13½—14½	+½
Do. 6% Perp. Deb.	Stock	6	6%	125—128	+7
Do. 4% Deb.	Stock	4	4%	82—86	+6
Do. Perp. Extension Pref. (5%)	Stock	—	—	25—30	+4
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	50—52	+2
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	5%	43—47	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅜—½	
Do. 4½% Deb. Red.	Stock	4½	4½%	83—88 xd	−2
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	10	6	6%	3½—4⅛	
Do. 5% Perp. Deb.	Stock	5	5%	93—96 xd	−3
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4⅛—4⅜	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	98—102	+1

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%	%		
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12½—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	—	4⅜—5⅝	−½
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	73—78	−2
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	11—11⅜	
National Elec. Construction Co. Ltd.	1	2/-	—	⅞—1	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅜—⅝	
North Metropolitan Trams Co.	£4 10s.	1/-	—	¼—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—½	
Do. 5% Cum. Pref.	1	5	2½%	½—¾	−⅛
Do. 4½% Deb. Red	Stock	4½	4½%	92—95	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜—5½	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	78—82	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅝—1⅜	
Do. 6% Cum. Pref.	5	—	—	3—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	58—61	
Do. 6% Pref. Ord.	Stock	6	6%*	103½—104½	
Do. Def. Ord.	Stock	1	—	1⅞—17⅛	+½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	88—90 xd	−1
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½ xd	
Do. 10% Cum. Pref.	5	10	10%	8—9 xd	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13¼—13¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—101½	
Do. do. (Mauritius Sub.)	25	4	—	101½—103½	
Eastern Ext. Australasia & China	10	7	6%	12⅞—13½	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	+½
Eastern Telegraph Co.	Stock	7	1½%*	136—139	+½
Do. 3½% Pref.	Stock	3½	3½%	85—87	+½
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—22	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅝—⅞	−⅛
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	+½
Do. Deferred	Stock	6	6%*	118—120	
Do. 6% Cum. 1st Pref.	10	6	6%	10¼—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red.	Stock	4	4%	102—104	−½
Western Telegraph Co., Ltd.	10	7	6%*	13⅝—14½	
Do. 4% Deb.	Stock	4	4%	101½—103½	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	7%	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	10%*	3¾—4 xd	−¼
Do. 6% Pref.	1	6	6%	1⅛—1⅝ xd	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¼—6⅝	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅞—1⅛	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10¾	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅝—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜ xd	−⅛
Do. 6% Cum. Pref.	1	6	6%	1—1¼ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	—	⅜—½	
Do. do. (fully paid)	5	4/2	—	1¼—2½	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	83—85 xd	−2
Electric Construction Co., Ltd.	2	—	—	⅛—⅜	
Do. 7% Cum. Pref.	2	7	—	1½—1¾	−⅛
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—8	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	84—88 xd	−2
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½—11½	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16½—17½	+½
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	—	¾—1¼	
Do. 6% Cum. Pref.	5	6	6%	2¾—3½	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS

ON the invitation of the British Government, an International Conference on Electrical Units and Standards will, as already announced, be held in London at the rooms of the Royal Society during October. Eighteen countries are sending delegates to the Conference, the names being given below.

The first meeting of the Conference will be held on Monday next, October 12th, at 11.30 a.m., when the delegates will be received by the President of the Board of Trade. In the evening there will be a reception by the Royal Society. The meetings of the Conference are expected to last until October 22nd, but this date is not fixed, as it will entirely depend on the progress made with the work at the Conference.

The main object of the Conference is to obtain International agreement on the three electrical units, the Ohm, the Ampere, and the Volt, so that the realisation of these units in all the countries of the world shall be as near as possible identical. The best method of setting up the Mercury Ohm, the Silver Voltameter, and Cadmium Cell will be considered, and it is hoped that detailed specifications may be issued with the authority of the Conference.

The delegates will be entertained at an official banquet, and will lunch with the Lord Mayor; they will also make an excursion to Cambridge on the invitation of Trinity College, and pay a visit to the Cavendish Laboratory. The Board of Trade Government Standards Laboratory will be open to inspection by the delegates, and the National Physical Laboratory at Teddington will be visited. The delegates will also dine at the Franco-British Exhibition with the "Dynamicables" on Wednesday, October 14th, and are invited to the annual dinner of the Institution of Electrical Engineers on Thursday, October 22nd.

LIST OF DELEGATES.

Belgium.—Monsieur Gérard, Director of the Montefiore Electro-technical Institution and President of the Consultative Commission on Electricity; Monsieur Clément, Secretary of the Consultative Commission on Electricity.

Denmark and Sweden.—Professor S. A. Arrhenius, Nobel Institute, Stockholm.

Ecuador.—Señor Don Celso Nevares, Consul-General.

France.—Monsieur Lippmann, Member of the Institute and Professor at the Sorbonne.

Germany.—Dr. Warburg, President of the Imperial Physico-Technical Institute; Dr. Jaeger, Member of the Imperial Physico-Technical Institute; Dr. Lindeck, Member of the Imperial Physico-Technical Institute.

Great Britain.—The Rt. Hon. Lord Rayleigh, President of the Royal Society; Prof. J. J. Thomson, F.R.S.; Sir John Gavey, C.B.; Dr. R. T. Glazebrook, F.R.S.; Director of the National Physical Laboratory; Major W. A. J. O'Meara, C.M.G., Engineer-in-Chief, General Post Office; Mr. A. P. Trotter, Electrical Adviser to the Board of Trade.

Guatemala.—Dr. Francisco de Arce, Diplomatic Representative, London and Paris.

Italy.—Professor Antonio Roiti, of Florence.

Japan.—Mr. Osuko Asano, Doctor of Engineering, Official Expert of the Department of Communication, Tokyo; Mr. Shigeru Kondo, Official Expert of the Department of Communication, Tokyo.

Mexico.—Don Alfonso Castello, Don Jose Maria Perez.

Netherlands.—Dr. H. Haga, Professor at the University, Groningen.

Paraguay.—M. Maximo Groskey.

Spain.—Don Jose Maria Madariaga, Professor of Electricity and Physics at the School of Mines, Madrid.

Switzerland.—Dr. F. Weber, Professor of the Swiss Polytechnic school at Zurich; Dr. Pierre Chappuis, of Bale; Dr. J. Laudry, Professor of Electricity in the School of Engineers, Lausanne.

United States.—Dr. Henry S. Carhart, Professor of Physics at the University of Michigan; Dr. S. W. Stratton, Director, Bureau of Standards, Washington; Dr. E. B. Rosa, Physicist, Bureau of Standards, Washington.

Australia.—Mr. Cecil Darley, Prof. Threlfall.

Canada.—Mr. Ormond Higman, Chief Electrical Engineer, Inland Revenue, Ottawa.

Crown Colonies.—Major P. Cardew, Electrical Adviser.

India.—Mr. M. G. Simpson, Electrician of the Indian Telegraph Department.

Berlin Underground Railway.—The new underground section of the Berlin Elevated and Underground Railway was opened on Thursday, the section extending from the power terminus at the Potsdamer-Platz to the Spittelmarkt, which is in the centre of the city. There are three stations on the new line, which has been laid as a shallow surface railway, and is reached by short flights of stairs. Further extensions to the north and north-west are contemplated.

Obituary.—The death is announced of Mr. William Trotter, J.P., a director of the United Electric Tramways of Montevideo.

CATALOGUES AND PAMPHLETS RECEIVED

ALTERNATING-CURRENT METERS.—An extensive new list has been published by Messrs. Ferranti, Ltd., of alternating-current meters. These are of the induction type of simple and robust construction. Very clear illustrations and descriptions of the various parts are given. The load current passes through series coils, wound-wave or lap-winding in the slots of an iron armature. The shunt current passes through the shunt coil wound on a bobbin placed on the iron core of a separate system. The magnetism due to the load current is practically in phase with the load current, but the magnetism acting upon the disc, due to the shunt current, lags 90° behind the E.M.F. impressed upon the terminals of the shunt coil. The interaction of these two magnetic fluxes causes an aluminium disc to rotate as in a two-phase induction motor. The driving torque is strictly proportional to the watts passing through the meter, and a retarding torque proportional to the speed of rotation is provided by a permanent magnet in the usual way. The moving part weighs 23 grammes, and the torque at full load is 2-gramme centimetres. The integrating gear is of the cyclometer type, specially arranged so that the change-over of figures does not throw any load on the meter. The list gives full instructions for testing and adjusting, and the installation and connecting-up of single-phase two-wire and three-wire meters, and polyphase meters, and some views are given of the meter departments of the Holinwood works. These meters have the official approval of the Board of Trade, and every meter is calibrated at the works to the following limits of accuracy:—1½ per cent. from $\frac{1}{10}$th to full load, and 2½ per cent. from $\frac{1}{20}$th to $\frac{1}{10}$th load; the accuracy is stated not to be affected by a short circuit through a fuse of double the capacity of the meter.

ARC LAMP CARBONS.—A price sheet is to hand from the Union Electric Co., of carbons for use with excello and other patterns of flame arc lamp. Among the advantages claimed for carbons of this make are the regularity of mechanical construction, the high efficiency and regular illumination obtainable, and the low resistance secured by the metal cores.

ELECTRICAL ACCESSORIES.—A new catalogue of electrical accessories has been issued by Simplex Conduits, Ltd. Several patterns of the firm's tumbler switch, with laminated brush contacts, are included, both of the surface and flush types. Other branch switches are the rectangular sliding lever switch, and a turn switch of very low projection. Other special switches include "pear" switches for flexible cords, and a push-button switch. Other items in the list are ceiling roses, counter-weights, wall sockets, and plugs, lamp-holders, adapters, and a few simple fittings. A novelty is the simplex electric candle, in which an elongated lamp with the filament at one end is used and the opal tube is slipped over this. This tube has an outer glass bulb at its upper end which fits over the lamp itself. The whole fits into an ordinary lamp-holder and not only has a remarkably good effect of soft lighting, but always remains upright in the fitting.

ELECTRIC HAULAGE GEARS.—A new pamphlet from the Electric Construction Co. deals with a series of standard designs of electric haulage gears for underground work. These are specially constructed to withstand the arduous conditions of mining work for alternating and direct current, in sizes ranging from 25 to 100 B.H.P., arranged either for endless rope, main and tail haulage or with single drum.

GILBERT ARC LAMPS.—Particulars of the three types of lamp made by the Gilbert Arc Lamp Co., Ltd., of Chingford, are given in a pamphlet just issued. These are the four converging type, the two converging type, and the magazine type. A patent has been applied for for a new "feeding" mechanism, by which it is claimed that it is impossible to "overfeed," as with a brake wheel or clutch, or even clockwork.

LEAKAGE INDICATORS.—Messrs. Everett Edgcumbe & Co., Ltd., have sent us an advance copy of a new pamphlet which they are getting out on leakage indicators. The present pamphlet refers to instruments for low-tension networks, but it is made very clear that a different kind of instrument is required for each different type of network, and the various cases are all mentioned. One of the most frequent applications of these leakage indicators is for mining installations. In Clause 6 of the Home Office regulations for installation and use of electricity in mining, it is stated that the installation of every complete circuit, other than telephone or signal wires, used for the supply of energy shall be so maintained that the leakage shall, so far as is reasonably practicable, not exceed one-thousandth of the maximum supply current, and suitable means shall be provided for the immediate localisation of a leakage. Clause 7 states that earth or fault detectors are to be connected up to show immediately any defect in the insulation, and that readings of these instruments will be recorded daily in a log-book. In the apparatus supplied for D.C. two-wire systems with mains completely insulated, there is a three-way switch, and when this is in the normal position the pointer stands at zero so long as the insulation is perfect, and it deflects to the right or left when there is a fault. The instrument is then being used as the fault detector required under Clause 7 cited above. A daily test to ascertain if the insulation of the system is up to the standard required in the Clause 6 is taken by moving the switch in turn to the other

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two positions and taking a reading, and from these two readings both the insulation resistance of, and the leakage current from, each main is ascertained by reference to a table supplied with the instrument. Modified instruments are made for three-wire systems with and without permanently earthed middle wires, and other patterns of instruments are supplied for three-phase networks, both three-wire and four-wire, and also for single-phase systems. Messrs. Everett, Edgcumbe & Co. have evidently made a very complete study of the subject of leakage indicators, and we recommend our readers to read this pamphlet carefully before ordering.

SIMPLEX CONDUITS.—An attractively prepared list dealing with the well-known Simplex conduits has been sent us by Simplex Conduits, Ltd. Special attention should be drawn to the material reductions which have been made in the prices of both conduits and fittings, frequently amounting to 20 per cent. or more, although the firm assures its customers that these reductions have not been made at the expense of quality. Another feature of the list is the pricing of galvanised material, which the firm has been led to introduce by the increasing tendency towards the use of higher class material in installation work. This conduit, &c., is offered at but a small percentage increase on the cost of ordinary enamelled. Large extensions are being carried out at Garrison Lane Works, Birmingham, and at various branches in different parts of the country.

STEAM TURBINES.—A handsome illustrated catalogue has just been issued by Messrs. John Musgrave & Sons, Ltd., of Bolton, dealing with the Zoelly steam turbine which they manufacture in this country under license from the inventor. We recently described and illustrated a fine example of these machines which the firm have erected at the Falcon Spinning Mill (Electrical Engineering, September 24th, page 459). The chief feature of the Zoelly turbine is that, as it is purely an impulse, large clearances can be employed both axially and radially. The catalogue contains a full illustrated description of the working and construction of the turbine, showing the great mechanical solidity of the blading and the arrangement of governor adopted. Tables are given of dimensions, weights, and guarantee steam consumptions of standard from 50 to 10,000 B.H.P., and particulars are given of exhaust steam and mixed pressure machines. A number of excellent illustrations of actual installations are included, and a useful feature of the catalogue is a collection of tables of the properties system and other engineering quantities

SMALL TRANSFORMERS.—The Union Electric Co. are issuing a new list of small transformers for use with low-voltage metal filament lamps running at ordinary alternating supply circuits and for arc lamps. The transformers are suitable from 40 to 100~ per second, and have secondary ampere ratings in the case of arc lamps up to 30 amperes, and in the case of metallic filament lamps up to 80 amperes. The transformers are roughly divisible into two main classes, viz., with single-circuit secondaries and with multiple-circuit secondaries. Care has been taken in the design to secure high efficiency on load and low no-load losses, and the method of winding ensures that the variation of voltage on the secondary circuit is a minimum.

THE HELION LAMP

On more than one occasion we have referred to the high efficiency lamp developed in America by Messrs. H. C. Parker and W. G. Clark, and known as the Helion lamp. (Electrical Engineering, Vol. I., p. 213, and July 9th, p. 69.) Some further particulars relating to the lamp, which, it will be remembered, has a filament made from a preparation containing silicon, are given in a recent article by the inventors in the *Electrical World* (New York).

The first Helion filaments on which a satisfactory life was secured, and which were exhibited early in 1907, were extremely sensitive to the slightest trace of gas in the lamp bulb. It was extremely difficult to exhaust the bulbs to the necessarily high vacuum, and if the lamps were burned with only a slight trace of gas in the bulbs, in the course of time there was set up between two points of the filament near the terminals a cathode discharge, which would burn out the filaments near one of the leading-in wires.

The gas which caused trouble was that contained in the cement, and which it was very difficult to remove, but after experimenting with a great many cements of widely different composition, by a method of elimination, one was secured best suited to the purpose. The development of vacuum apparatus was also carried out to the point which the characteristics of the filament demanded, but, realising the difficulties entailed in making such a process commercial, a series of experiments was started on the filament in an endeavour to reduce its sensitiveness to the presence of gas, so that it might be used in a vacuum at a slightly higher pressure than that at which the cathode rays started.

Much attention has also been devoted to obtaining filaments of uniform composition and standardising methods under which they were produced, and it is only recently that it could be said with certainty that invariable results were obtained. That the filament has been rendered less sensitive to the presence of gas is evidenced by the fact that it may now be operated at a specific consumption of from 2·5 to 4 watts per candle in the open air without any enclosing glassware whatever. Where the heat is retained by reducing the convection current, the efficiency increases very rapidly and the filament exhibits many interesting physical properties, in some instances differing from the original Helion filament.

It has been necessary to conduct almost countless experiments to determine the cement best suited to the requirements, the degree of vacuum to which the globes should be exhausted to obtain the best results, the particular gas in which the filament operates most satisfactorily, the character of the surface of the filament by which the highest efficiency is obtained, the ratio of core diameter to diameter of finished filament, and a vast number of experiments on commercialising the methods pursued. Filaments are now produced having a much higher resistivity than the original filaments, so that either 110-volt or 220-volt filaments can be constructed in a single loop of moderate length and comparatively great cross-section.

A most striking property of the filament is its wonderful resistance to oxidisation. It may be maintained at a bright incandescence for many hours without deterioration at a temperature aproximating 1800 deg. C. When atmospheric dust is kept away from the filament there appears to be no surface change whatever, but particles of dust in the atmosphere coming in contact with the hot filament are fused and stick to it, so that in the course of time the filament begins to show excrescences, the rate at which this accumulation is acquired being dependent entirely upon the amount of dust coming in contact with the filament. After burning for a number of hours in air a slight progressional change in the luminosity of the filament appears at one terminal and gradually continues around the entire length. This has been found to be due to the burning out of the carbon core on which the filament is formed. As the core burns out the tube remaining is a tube of the pure Helion composition, and, as the only portion of core exposed is the end within this tube, the rate of oxidisation is very slow, but when the carbon core is entirely burned out the conductivity of the filament is decreased by an amount equal to the original conductivity of the carbon core. This effect can be prevented by sealing the terminals of the filament to prevent oxidisation. When this is done the filament will operate in air for many hundreds if not thousands of hours.

When the temperature of the filament is raised sufficiently high—about 2500 deg. C.—the silicon on the surface of the filament combines with the oxygen of the air and burns off, forming silicon dioxide, which may be collected by holding a glass plate over the filament when the burning takes place. This burning off does not destroy the filament, but only increases its resistance by the amount of material removed from the surface; upon again raising the temperature by increasing the potential applied, the surface may again be burned off, and this may be repeated a number of times before the filament is destroyed. If the incandescent filament is plunged in water there is no apparent effect on the filament other than the cooling down produced by the water, and it is possible to cut through pieces of glass by allowing the filament to melt its way through the glass, which it does without any apparent injury to the filament.

An interesting property of the filament is its high specific resistance, which is nearly 50 times that of the carbon filament and several hundred times that of tungsten. The filament is also very hard, it being possible to scratch glass with small particles of it under the thumb-nail. When operating the filament in air great difficulty was encountered in obtaining a cement which would resist oxidisation, but a metallic cement which appears to be entirely satisfactory for this purpose has been developed. A heating at the negative terminal, probably due to the thermo-electric action between the cement and the filament, was the troublesome point, but this has been overcome by the use of a combination of materials which balanced the thermo-electric action.

A most unexpected phenomenon was observed when the new filaments were mounted in a high vacuum and operated at a high temperature; although the filament gave no indications of softening at even the highest temperatures, the globes would suddenly become coated with a most beautiful mirror, which analysis showed to be pure silicon, due to an intense ionisation. This action was overcome, however, by giving the filament a slight coating of another material, which entirely prevented the ionisation. Further experiments along this line are being conducted at present, and the results are extremely promising.

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Supplement to "Electrical Engineering" of Oct. 8, 1908.

THE MANCHESTER ELECTRICAL EXHIBITION OF 1908

PART II.

Published by

THE PROPRIETORS OF "ELECTRICAL ENGINEERING," 203-206 TEMPLE CHAMBERS, LONDON, E.C.

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Metal Filament Lamps.

THE "METALIK"

THE BEST 200-250 VOLT LAMP

Please write for particulars of the SPECIAL DISCOUNTS we have arranged for CORPORATIONS and the TRADE.

Messrs. G. M. BODDY & Co.,
Newington Works, LIVERPOOL. *June 23rd, 1908.*

Dear Sirs,

Answering your last letter we can tell you that the lamp No. 3 is now burning **3,170** hours and is still in good condition (sloping position, alternating current, 220 volts). As we have not made any photometric test on this lamp we cannot say exactly how many per cent. the candle power decreased, but we do not think it is much.

We remain, dear Sirs,
Yours truly,
.....*Manager, Electricity Works.*

The originals of the following letters are in the hands of the Editor of "ELECTRICAL ENGINEERING."

Messrs. G. M. Boddy & Co.,
Liverpool. *June 6th*, 1908.

Dear Sirs,

In reply to your letter of the 4th inst., we beg to inform you that we tested three "METALIK" lamps 220 volt, 50 c.p. in a sloping position burning with alternating current. These lamps were burning continually without switching in and out more than about once every 100 hours. The life of the first lamp was 970 hours, of the second 1,856 hours, while the **third lamp is already burning 2,775 hours,** and is *still in good condition.* The light of the lamps is not materially less than as they were new. The blackening of these lamps is practically so slight that we may say there is no blackening.

Electricity Offices
Messrs. G. M. Boddy & Co., *March 9th*, 1908.
Liverpool.

Dear Sirs,

Some time ago we had two samples 50 c.p. "METALIK" Lamps from you for testing purposes. These lamps have an average life of 1,407 hours, and would have run longer had not the filaments become shorted by twisting.

We shall be glad to have your best price for the supply and delivery carriage paid at our .....Stores of "METALIK" lamps in the 32 c.p. size suitable for series burning on a 230 volt direct current circuit.

Yours faithfully,
.....*City Electrical Engineer.*

Corporation Electricity Works,
Messrs. G. M. Boddy & Co., ..., *May 28th*, 1908.
Liverpool.

Dear Sirs,

In reply to yours of the 27th inst., so far your "METALIK" lamps have been burning very satisfactorily and shall be obliged if you will quote me your best price for 100 lamps, as we shall probably be wanting some more before long. Yours faithfully,
.....*City Electrical Engineer.*

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Price H.V. 6/- L.V. 4/-

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THE MANCHESTER ELECTRICAL EXHIBITION OF 1908

(SECOND NOTICE.)

THE Electrical Exhibition at Manchester was opened to the public on Saturday last, on which day representatives of the technical and lay Press were invited to inspect it. Throughout the day, and especially in the evening, there was a large attendance. The total number of visitors who paid for admission was between 2,500 and 3,000, in spite of a large number of tickets having been sent out by the Manchester and Salford Corporations. In view of the fact that there was a formal "opening" by the Lord Mayor of Manchester on Monday, the large number of visitors on the first day was somewhat of a surprise, but it may be accounted for by the fact that the members of the public, who attended earlier in the day, found that the exhibits were almost completed, and when this became known the numbers swelled considerably towards evening. Up to a late hour on Friday there was a large amount to do at practically every stand to bring the exhibits to a state of completion, and it is a compliment to the Press that exhibitors and their staffs worked with a will up to the small hours of Saturday morning in order to finish their displays of machinery and apparatus. Particular mention must be made of the ungrudging help of the staff of the Manchester Corporation electricity department, led by Mr. S. L. Pearce, the engineer-in-chief, who all worked unremittedly during the night testing and connecting up the exhibitors' installations as soon as they were ready. Owing to the intentional exclusion of daylight practically all the stands—a total of nearly 300—were electrically lighted, and a large proportion also utilised electric power, so that the task was no light one, and it is satisfactory to note that this enormous mass of temporary wiring work was joined up to the Corporation sub-station in the exhibition without any serious hitch well up to time. It was inevitable that there should be a few cases in which the installations were not sufficiently complete to be supplied with current, but these were so scarce as not to be noticeable among the lines of completed exhibits.

THE OPENING CEREMONY.

Apparently no exhibition is considered complete without an opening ceremony, and on this occasion it was certainly no more than a formality, as the Exhibition had been very effectively opened to the public on Saturday without the personal assistance of the Lord Mayor of Manchester, who, after an hour's inspection of the exhibits on Monday, slipped on his chain of office and declared the Exhibition open, expressing at the same time a hope that the development of the electrical industry would assist to bring about a solution of the problem of the unemployed.

The function was welcome, however, as enabling the Exhibition Committee to show some hospitality to the Mayors of those Corporations who had contributed to the funds of the Exhibition, and the restricted space in the dining hall was subsequently taxed to the utmost. Several of the Mayors were accompanied by their Borough Electrical Engineers, who, needless to say, were made very welcome at the exhibitors' stands which they visited both before and after the inaugural luncheon.

The Lord Mayor of Manchester (Alderman Holt), responding to the toast of the Corporations of Manchester and Salford, and the other local authorities represented—proposed by Mr. Walter Musgrave—said that Manchester was the largest producer of electricity in the United Kingdom. He thought that the extended application of electricity would mean a large reduction in working expenses for the various trades of Manchester, but the present moment was, perhaps, not an opportune one for the Lord Mayor of Manchester to express himself in love with labour-saving machinery. Nevertheless, it was necessary to use such means to reduce the cost of manufacture in order that we might compete successfully with other European countries. Finally, he expressed the view that every large town should hold an electrical exhibition once a year, and he referred to the advisability of retaining open spaces near the large towns for such purposes.

Other speakers were Mr. Walter Musgrave, Sir William Stephens, and Mr. William Kay (chairman of the Executive Committee of the Exhibition and deputy chairman of the Manchester Electricity Committee). Mr. Kay, in his speech, paid a tribute to the good work done by the staff of the Manchester Electricity Department, particularly Mr. S. L. Pearce, the engineer-in-chief, to whose assistance the instantaneous success of the exhibition has been largely due.

SOME OF THE EXHIBITS

THE MODEL HOME

Equipped by Messrs. Goodalls, Messrs. Drake & Gorham, the General Electric Co., Messrs. Elkington & Co., Ltd., the Harper Electric Piano Co., Ltd., &c. (Stand No. 163.)

The Model Home is a miniature house which has been built to demonstrate the various ways in which the applications of electricity can minister to domestic comfort, luxury, and cleanliness. Built by Messrs. Goodalls, of Manchester, in the bungalow style, in one story, of rough cast, painted white, and covered with trellis-work, it has a very effective appearance with its red-tiled roof, overhanging door, and canopy surmounted with the heraldic device of former owners of Platt Hall. The visitor enters by an automatic Sesamé door, which opens of itself when he steps upon the mat and closes quietly when he steps off. The hall is furnished in dark oak, and lighted from a hammered-metal electric chandelier in the centre. An electric radiator is provided in the fireplace. On the left is the dining-room, oak panelled in the Tudor style, with furniture chiefly in the Sheraton manner. The lighting is entirely from handsome silver-plate candle fittings, supplied by Messrs. Elkington, including a magnificent 16-light hanging chandelier in the centre, and the various candelabra on the dining-table and about the room. Those on the table, which is shown completely laid for dinner, include two for three lights and one four lights, standing on one of Messrs. Drake & Gorham's electric table-cloths, with which contact can be made at any point by two small pins. As in all the other rooms, electric heaters are provided. The drawing-room on the other side of the hall is in the later English Renaissance style of William and Mary, and it is pleasant to think that electric lighting has made such delicate and harmonious decorative schemes possible. The lighting here again is principally from tasteful candle fittings, and we notice here, as in the other rooms, simple, unobtrusive flush switches are used. A Harper electric piano stands in the corner of the room. The bedroom is equally restful, and in the simpler styles of the eighteenth century. Beautifully soft general lighting is obtained from a centre pendant, with the lamps contained in an obscured glass dish. The dressing-table is lighted by a pair of handsome candelabra, and at each side of the bed are arrangements of plugs for table lamps and switches on flexible cords. The electric heating appliances include the usual radiator, a warming pan, a shaving pot, and a curling-iron heater with automatic switch, which cuts off the current when the iron is withdrawn. One of the most interesting parts of the home is the kitchen, equipped by the General Electric Co., but a full description of this must be deferred until it is complete. It may be said, however, that the cooking equipment is designed to cook a full

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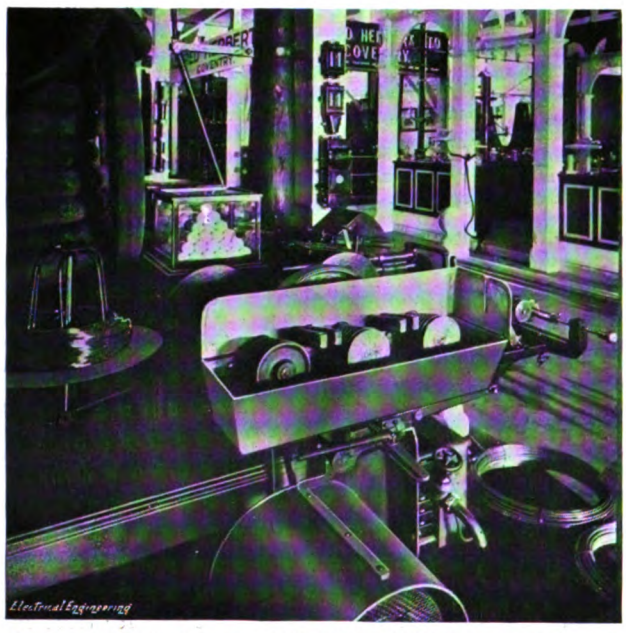
dinner for eight or ten persons at a cost of current (at 1d. per unit) of 4¾d., and a first cost complete of £18 10s.

The house is wired with Messrs. Drake & Gorham's system of grip conduit, in which ordinary unscrewed tube is slipped through the half-couplings, flanged by a special tool and coupled up. The lighting is entirely by 25-volt Osram lamps, and the supply is from the extremely compact generating plant on Messrs. Drake & Gorham's stand adjoining. This consists of a 3-h.p. single cylinder horizontal running on paraffin, but starting on petrol, direct coupled to a shunt-wound dynamo for 25 to 40 volts, used in conjunction with a 14-cell battery by the D.P. Battery Co., of 360 ampere hours' capacity on the six-hour rate.

British Insulated & Helsby Cables, Ltd.,

Prescot, Lancashire. (Stand Nos. 28 & 41.)

Wire-drawing Machine.—This wire-drawing machine is shown in actual operation, and is one of the most interesting specimens of running machinery at the Exhibition. It is what is known as a "17-die cone machine," and has diamond dies. Those who are accustomed to the old style of wire-drawing machines will wonder at its extreme compactness, and also at the high speed at which it runs. The wire is drawn consecutively through the 17 diamond dies, and gradually reduced in size and extended in length. The machine is capable of drawing down copper wire in one process from 0·0084 in. in diameter to 0·0018 in., but in running at the Exhibition the machine is only shown drawing down the wire from 0·004 in. in diameter to 0·0018 in. It is run by a one horse-power motor from the 200-volt D.C. mains. The wire passes backwards and forwards over the "cones" clearly seen in the illustration, and is wound up automatically on a spool at the end of the machine after passing through the last die.

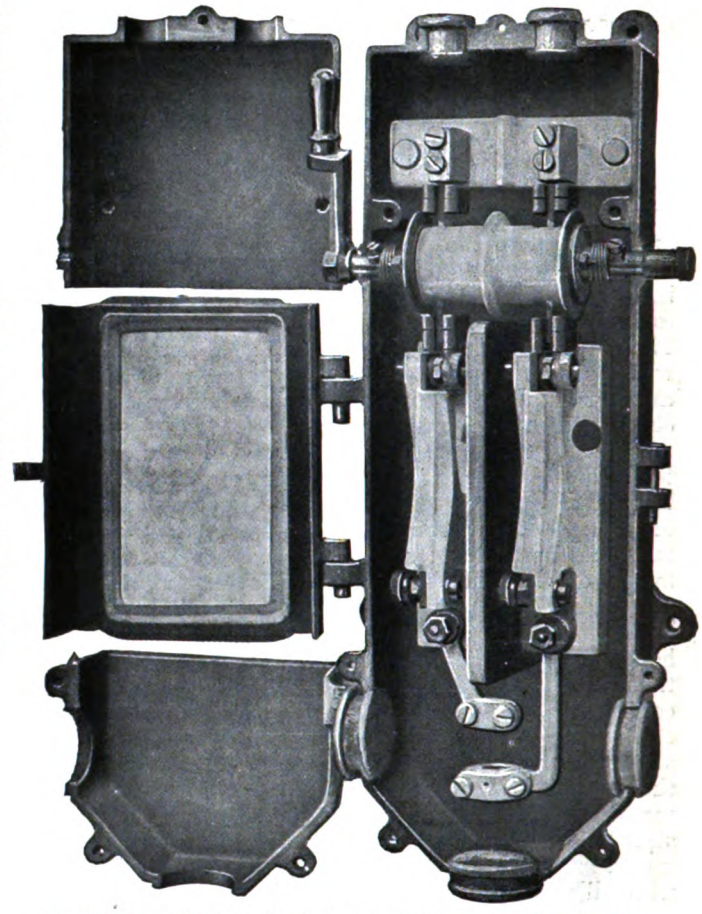


17-Cone Wire Drawing Machine (British Insulated and Helsby Cables, Ltd.).

House-Service Boxes.—A very representative collection of these is on view. One of the most interesting types is that known as the "Barrow" combined switch and fuse box, which was made to the design of Mr. Burnett, Borough Electrical Engineer of Barrow-in-Furness. As seen in the illustration in the next column, a novel feature is the construction of the switch, the body of which consists of a porcelain drum through which the switch blades pass. The spindle upon which the switch rotates is extended at each side of the cast-iron box, so that the handle for turning may be fixed on either side.

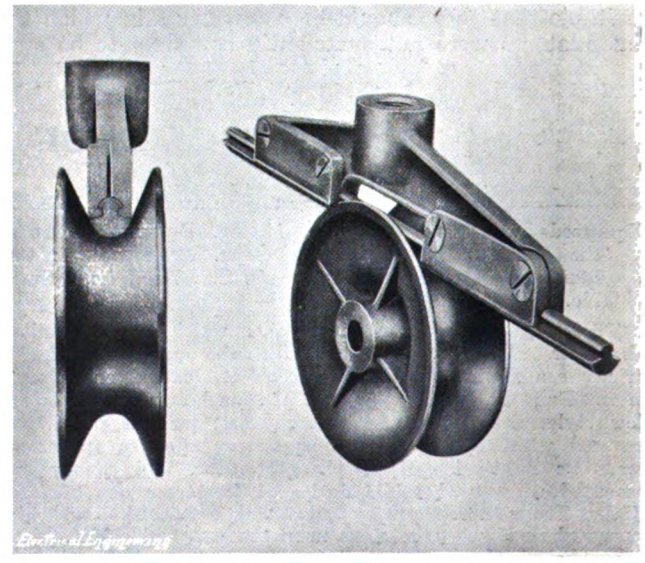
Overhead Tramway Gear.—The company has recently been developing its "non-fouling" trolley wire and fittings. The feature of this wire is that it is a modified "figure of eight" section. As will be seen from the illustration below, the top part of the wire above the groove is considerably smaller than the lower half, and the ear is arranged so that it does not project beyond the wire. Various fittings for use on this wire are shown, including the Carty section insulator adapted for use with it, as used on the Newcastle trams.

Other Exhibits.—Among the large collection of other fittings which the British Insulated & Helsby Cables Co. show is a section of an overhead power transmission line for 20,000 volts three-phase, as supplied and erected by the company in various



"Barrow" Type Switch and Fuse Box made by the British Insulated and Helsby Cables, Ltd.

parts of the world. To demonstrate the difference in size between copper and aluminium wire, two of the wires on this are of copper and one of aluminium of equivalent sections, the diameters being respectively 0·372 in. and 0·480 in. A 360 lb. copper ingot, which is lying in a prominent position on the



"Non-fouling" Wire and Mechanical Ear.

stand, is longer than is customary for use in copper rolling mills, as a longer length is desirable when rolling heavy troiley wire. This is rolled to ¼ in. diameter in the company's rolling-mill plant, passing through the rolls about 20 times. This brings it down to ¼ in. diameter, and coils of the black and

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"pickled" half-inch rod are exhibited. The rod is then drawn down to wire in the wire-drawing machines. Some particularly well-finished switches, plugs, and other fittings made for the Admiralty are also on view, and a large exhibit of telephone plant, a description of which will be reserved for a future issue.

The British Thomson-Houston Co., Ltd.,

RUGBY. (STAND NOS. 48, 49, & 50.)

Horizontal Curtis Turbo-alternator.—The most interesting exhibit of the British Thomson-Houston Co. is a complete generating set, consisting of the first horizontal Curtis turbine to be manufactured in this country, coupled to a 1,000 kw. three-phase alternator for 2,600 volts 50 cycles, and designed to run at 3,000 r.p.m. We hope to be able to give some further details of this interesting set at a later date, but may remark that it is remarkably compact, as the overall dimensions are only 16 ft. by 6 ft. The turbine is of the two-stage type, with five rows of blades, and the blading is of an entirely different construction from that in the older vertical form of Curtis turbine in that separate blades are employed, dovetailed by a special method into the rotor discs instead of being machined out of the solid. An important point in the design is that the bearings can be placed very close together, and the shaft kept very short and consequently rigid. One of the bearings is a thrust bearing, but the function of this is principally to prevent end play, as the thrust is almost entirely balanced by the action of the steam. The governing is on the same principle as employed in the vertical designs, and is effected primarily by shutting off a varying number of the six main nozzles by valves operated by water or oil pressure. A further auxiliary nozzle is provided on which a fine adjustment can be obtained by throttling, and this alone is open at times of very light load. A point that may be mentioned with regard to the alternator is that the ventilation is from the exciter end, so that hot air from the turbine cannot enter the machine.

Metal-filament lamps.—A good deal of attention will also be directed to the new B.T.-H. tungsten lamp made at Rugby, which is shown in the following sizes :—40 c.p. for 100-125 volts, 16 c.p. for 50 volts, and 10 and 16 c.p. for 25 volts. The 40 c.p. takes 50 watts, giving an "efficiency" of 1·25 watts per British mean horizontal candle-power. It is claimed that the method of manufacture of the filaments, in which a mercury amalgam is used as a binder instead of a mucillaginous compound, gives a filament of much greater uniformity and tensile strength. An improved method of support, in which the filament is constantly held taut by springs, is therefore possible, with the result that not only are the lamps much less liable to damage in transport, but the spring will take up expansion, so that the lamps can be run in any position without liability of the filaments to sag.

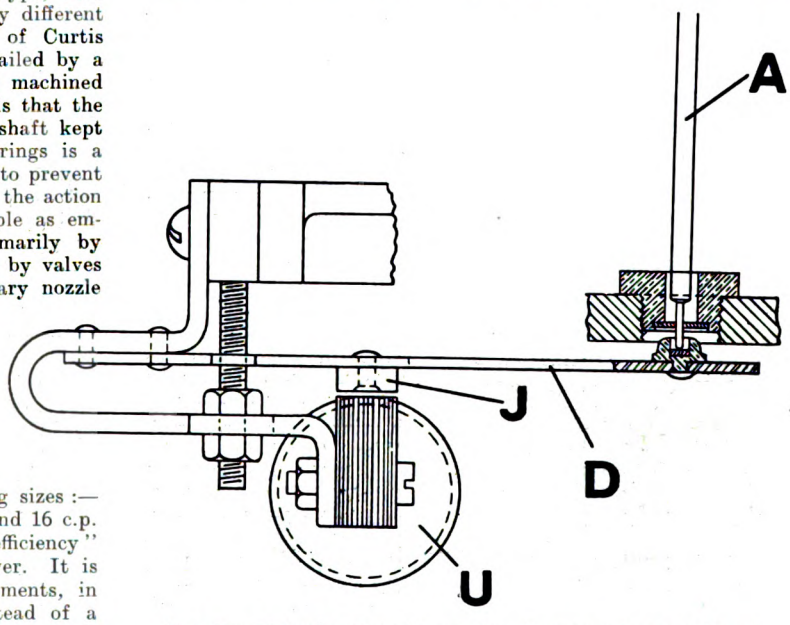
Driving of Textile Machinery.—The company have paid a great deal of attention to the requirements of driving of textile machinery, and the systems they have developed are exemplified by a complete ring-spinning frame with 52 spindles by Messrs. Brooks and Doxey, with a five-inch lift driven by a B.T.-H. three-phase constant speed squirrel-cage induction motor of 7½ b.h.p. through a Whittaker Hall friction clutch. The motor runs at 960 r.p.m., which corresponds to a spindle speed of about 9,500 to 10,000 r.p.m.

Motor Controllers, Heating Apparatus, and other Exhibits.—It is unnecessary to particularise the representative collection of the standard motor starters, controllers, &c., shown. Among them should be mentioned, however, a compact form of compensator starter for squirrel-cage motors, fully enclosed and combined with main oil switch. In this apparatus separate fuses of different capacities are provided in the starting and running circuits, so that a considerable starting current is permitted without sacrificing close protection when run up to speed. A new upright form of tramcar resistance is shown, which will sometimes be more convenient than mounting resistances under the car frame, and examples are shown of the very complete line of automatic circuit breakers with auxiliary carbon break recently brought out by the firm. It may be mentioned that all the coils of this class of apparatus, and indeed practically all arc-lamp coils and a large proportion of motor field coils, are now wound with enamel-covered wire. It is interesting to note that the first purpose to which the company applied these kinds of wire was for the solenoids of the original electrically operated Curtis turbine governing gear, and its success under these extreme conditions of heat and damp led to its more extensive adoption. The heating and cooking appliances of the British Thomson-Houston Co. have often been described in our columns, and are widely known and appreciated. The representative collection exhibited comprises ovens, percolators, kettles, water-heaters, hot-plates, hot-water cans, flat-irons, and other articles for domestic use. Some of the later patterns are fitted with more complete switching arrangements for varying the degree of heat than formerly. Other exhibits shown include small transformers for metal-filament lamps, measuring instruments, and several patterns of flame and other arc lamps.

Siemens Bros. Dynamo Works Co., Ltd.,

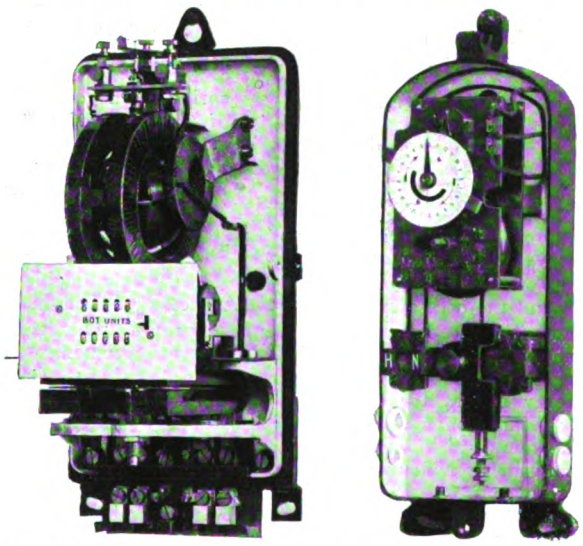
YORK MANSIONS, LONDON, S.W.; 196 DEANSGATE, MANCHESTER; AND STAFFORD. (STAND NOS. 86 & 94.)

Cotton Singeing Machine.—This interesting machine, which is shown in operation, is a development of the so-called gassing frame, in which the cotton thread is passed at a high speed through a gas flame in order to singe off the superfluous fluff.



Bearing Vibrator for Alternating-Current Energy Meter.

In the present machine the cotton is passed at a speed of over 20 ft. per second through narrow split platinum tubes, which are raised to a white heat by the electric current. Each tube



Double Tariff Meter and Clock Switch for changing over the Counting Mechanism.

carries a maximum current of 35 amperes at a pressure of from 3 to 5 volts. Owing to the high speed with which the cotton passes through the tube, it does not burn, although it may touch the sides of the tube. The fumes produced are drawn away from the tube by means of a current of air. A small centrifugal fan is provided for this purpose.

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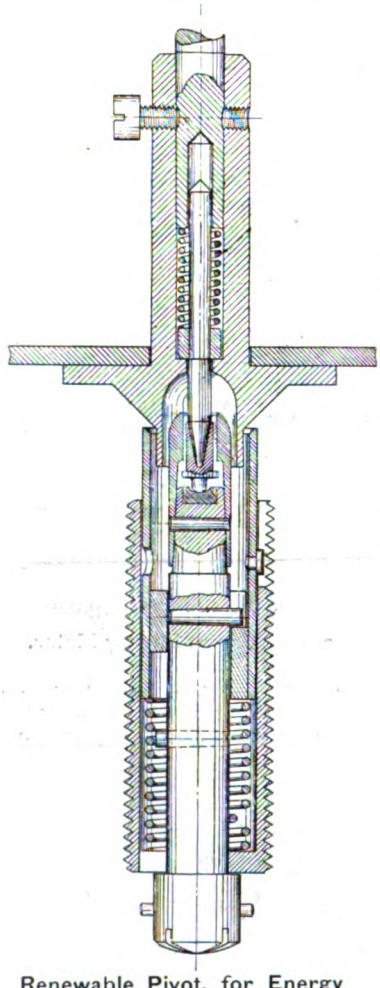
Electrically-driven Loom.—This is one of Messrs. R. Hall & Co.'s looms, driven by a Siemens three-phase motor rated at ½ b.h.p. and running at 1,000 revs. per min. The motor is fitted with a spring belt-tightening arrangement, and an interesting point in connection with this machine is that it can be brought up to full speed in about one second.

Motors.—A large selection of both direct- and alternating-current motors are exhibited. A 1½-h.p. series motor, which is shown with a 12½-in. fan, has a range of speed from 500 to 1,300 revs. per min. The controller is of the drum type, and the speed regulation is attained by altering the grouping of the motor field coils. Overload and no-voltage releases, which act independently of one another, are supplied in this controller. A large selection of small shunt motors is also shown. Two 3-phase motors, one with wound rotor and slip rings, and the other with a squirrel-cage rotor, are exhibited. A selection of motor starters includes a capstan switch and an oil-immersed Star delta starter.

Meters.—Meters for use on either alternating-current or direct-current circuits of the pattern used for house services up to 200 amperes and 650 volts are shown. One of the latest improvements in this type of meter is the provision of means whereby the pivot at the lower end of the armature spindle can be quickly renewed. The pivot itself is not part of the armature spindle, but, as can be seen from the accompanying illustration, is separate, and is taken away from the spindle when the jaws containing the sapphire bearing are removed. When the jaws are inserted, the pivot is fixed to the armature spindle merely by friction. An illustration annexed shows the method adopted in the case of tramway meters, to prevent the hammering of the pivot on its bearing when the meter is shaken. This consists in supporting the bearing itself on a spring, and also attaching the pivot to a piston, which enters the hollow armature spindle and is cushioned against another spring. The commutator of this type of meter is also readily removed, and pivot, commutator, and brushes can be renewed in a minute or so.



Renewable Pivot, for Energy Meter, showing Springs to prevent Hammering.

The illustration on page 11 gives views of the interior of a double-tariff meter and the necessary clock switch respectively. The hour for changing the rate is fixed by means of the sliding contacts at the periphery of the clock dial. Only one meter mechanism is required, as the clock switch changes over the counting mechanism.

Energy meters for measuring the input and output respectively of an accumulator battery are made on the same principle as the double-tariff meters; that is, they have a single meter mechanism but a double counting mechanism. In this case the change over from one counting mechanism to the other is performed automatically by the change in the direction of rotation, due to the reversal of current.

Energy meters for integrating accurately the power on unequally loaded polyphase circuits are also shown. Among these are meters for 3-phase 4-wire circuits and 2-phase 4-wire circuits.

In order to ensure that a meter shall start on very small loads, Messrs. Siemens Bros. Dynamo Works Co. have developed a form of automatic bearing vibrator; this is illustrated on page 11. When an alternating current is sent through the coil *U*, the armature *J*, being in an alternating magnetic field, will vibrate. This vibration is communicated to the flat spring *D*, and thence to the jewel bearing and spindle *A*. It will be readily seen that the action is similar to tapping the instrument to get the highest accuracy of the reading. By this means the meter is enabled to start at a very small current, and, the friction being reduced to a minimum, the readings will be extremely accurate on light loads. Special precautions are taken to prevent shunt running. This vibrator should be useful for adaptation to meters used in conjunction with small transformers, as it will ensure that the no-load losses are registered by the meters.

Lamps.—A large number of tantalum lamps are in use all over the Exhibition, and the clusters known as "Holophane Arcs" are very conspicuous both on a few stands and in the dining-room of the Exhibition. A selection of carbon arc lamps, including the small enclosed "Liliput" pattern, are also on view.

The General Electric Co., Ltd.,

71 Queen Victoria Street, E.C. (Stand Nos. 152 & 162.)

The General Electric Co. have a large stand situated in a prominent corner position in one of the main avenues. It is most effectively laid out with exhibits representative of the very large range of electrical plant, machinery, and apparatus manufactured by the company, and tastefully decorated and illuminated with the firm's well-known Osram lamps. The exhibits are too numerous to mention in detail; we will, therefore, not attempt at present to do more than indicate their nature and extent.

Plant and Machinery.—In a prominent position on the stand is a 500 kw. motor generator, which is interesting as being one of three that will be used in the new Osram lamp factory approaching completion at Hammersmith. Alongside this, as a contrast, is shown a small motor-generator charging ignition accumulators in garages. Standard "Witton" motors, both continuous and alternating current, are represented by a selection of about half a dozen sizes, and a special three-phase fully-enclosed gas-tight motor in rectangular case for building into the frame of coal-cutting machines is also shown. This motor has an ingenious arrangement of tubes for increasing the cooling surface. Textile driving is illustrated by a complete Northrop loom in action, driven by a Witton 2 h.p. continuous-current motor with special spring suspension to equalise the tension on the belt. In the centre of this part of the stand is a compact 0·58 kw. generating set, driven by a single-cylinder paraffin engine for country house lighting by 25-volt Osram lamps. Examples of the Fynn single-phase commutator motor are also shown, and the groups of working "Freezor" fans were specially welcome in the temperature of the opening day.

Switchgear and Instruments.—A large quantity of switch apparatus and instruments is shown, among which may be mentioned an interesting exhibit consisting of a new pattern of remote control solenoid operated high-tension oil switch of large size, complete with operating panel with push buttons, instruments, relays, signal lamps, &c. Motor starters and controllers are shown in profusion, including several forms of liquid starter. Among the instruments are examples of Dr. Sumpner's patent wattmeters and phasemeters recently described by him before the Institution of Electrical Engineers, in both the switchboard and portable forms.

Lighting and Heating.—The company's well-known "Angold" flame and other arc lamps are exemplified, and a new pattern of magazine flame lamp is shown for the first time. Modern high efficiency incandescent lighting is, of course, well represented by a fine display of Osram lamps, those festooned about the stand on the new "Pixielight" strip being particularly effective. The accessories for these lamps include a range of small transformers enabling low voltage lamps of moderate candle-power to be used on the ordinary alternating supply voltages. Mention should also be made of the "Striplite" system of showcase lighting by tubular lamps in reflectors. The heating apparatus shown includes cooking and other domestic appliances and heaters, both of the lamp, and what the company designate as the "elevector" type. A mention of the display of arc lamp flame and other carbons made at the company's carbon works at Witton should not be omitted, as these are the only carbons of British manufacture. The attractive working exhibit of Robertson lamps is on an adjoining stand, but lack of space compels a description of this to be reserved for a future issue.

Telephones, Bells, &c.—One side of the main stand is devoted to telephones, and here, in addition to single instruments and apparatus of practically every type, there is a complete private branch exchange board suitable for hotels or large business establishments on the central battery system. Portions of the equipment of the 10,000 line common battery board which is being erected for the Glasgow Post Office Central Exchange are also shown.

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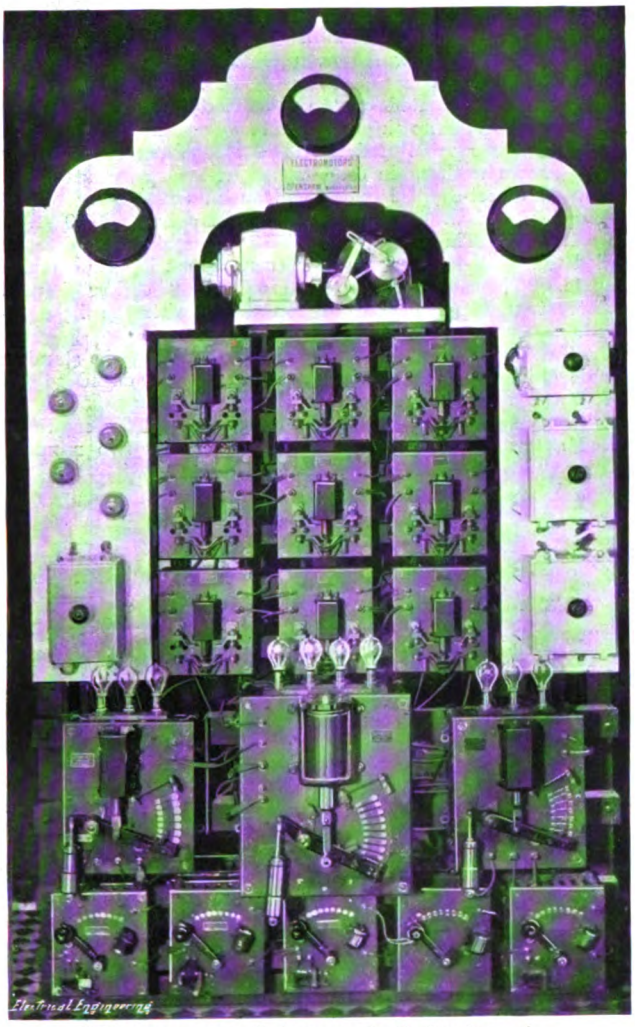
Electromotors, Ltd.,

Louisa Street, Openshaw, Manchester.
(Stand Nos. 133 and 161.)

A New Exhibition Device.—The stand occupied by Electromotors, Ltd., is an excellent example of the effect that can be

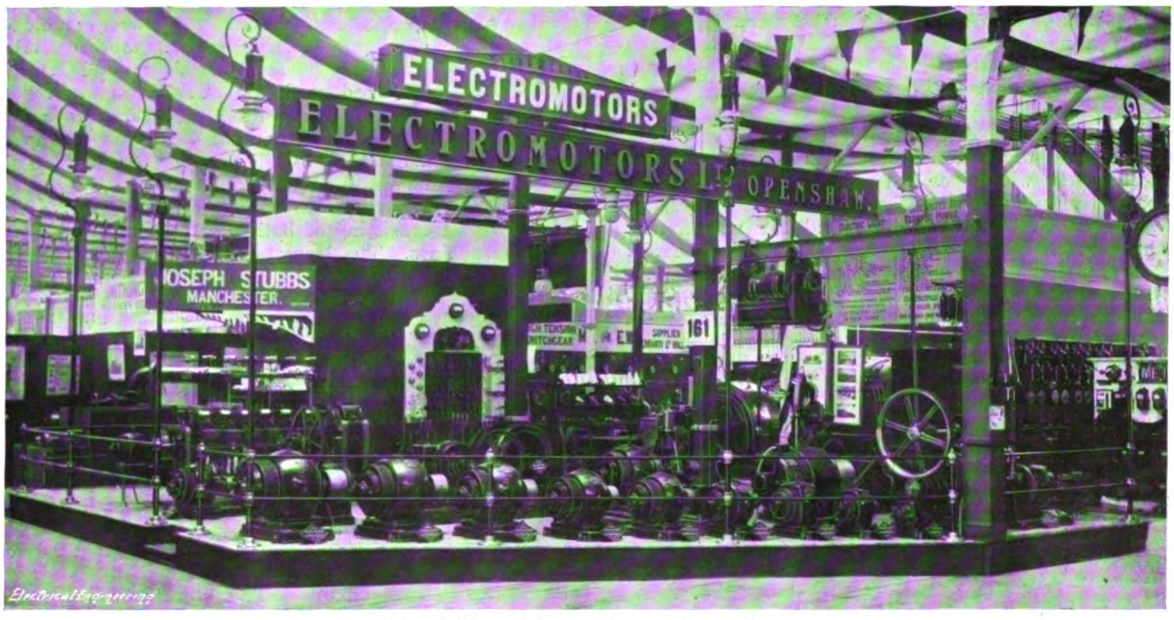


"Electromotors" Automatic Switchboard.

obtained by a skilful arrangement of exhibits. Along the front of the stand, which we illustrate below, twenty motors or motor combinations are placed, and these are connected to an automatic switching arrangement, which puts into operation a different pair of motors every thirty seconds. In front of each of the motors in this row are small illuminated signs, bearing the description of the motor, and the lamp which each contains is connected in parallel with its motor, so that the sign lights up and shows the name in red letters when the motor is running. An illustration of the switchboard is given opposite. At the top of it is seen a small motor with worm gear and a simple ratchet mechanism, which closes the circuit of one of the magnetic switches in the front of the board, switching in a different pair of motors each time, and opening the circuit of the coil holding down the switch of the previous pair. A large "Luxol" sign on the stand, facing each way, bears the name "Electromotors" in large letters, and is a good example of the signs of this class, supplied by Messrs. Krupka & Jacoby. A third useful exhibition device is a small motor driving a set of rotating boards, containing photographs of the firm's shops and manufactures. The drive from the fast-speed horizontal shaft of the motor to the slow-speed vertical spindle of the show frames is a friction drive, and in consequence the frames can be stopped by hand if any visitor desires to examine a particular picture leisurely.

Cotton Machinery.—Messrs. Joseph Stubbs (Mill street Works, Ancoats, Manchester), show two specimens of electrically-driven cotton machinery in connection with Electromotors, Ltd. Both are winding frames. The first is a Foster "camless quick traverse winder," the duty of which is to wind one or more threads from the spools or "cops," which come from the mule, on to larger spools formed on conical paper tubes. These larger spools are employed chiefly in the hosiery and underwear trades. The machine shown has ten cones, which run at a speed of about 1,400 r.p.m., and are driven through spur gearing by a ¾ h.p. motor running at 1,050 r.p.m. It embodies some novel devices from the textile manufacturer's point of view, and runs far more silently than do the majority of such machines. The second is a "quick traverse close winder," for winding one or more threads close together or side by side from the cops or ring bobbins on to parallel "cheeses," which then contain the maximum length of yarn in the minimum bulk. This machine is also comparatively silent, a fact which is a great comfort to the staff of "Electrical Engineering," whose stand is directly facing it.

Motors and Applications.—A complete range of semi-enclosed motors in ten sizes up to 20 h.p., show the firm's standard practice, and an extended range from 20 to 50 h.p. is represented by a 30 h.p. motor on the stand. Among the various motors and applications shown are: A 3 h.p. motor fitted with an enclosed worm reducing-gear with ball thrust bearings and phosphor bronze wheel rim, reducing from 1,100 to 50 r.p.m., the motor and worm gear being mounted together on a substantial bedplate; this combination is suited for the driving of economisers, stokers, organ-blowing, and the driving generally of very slow speed shafting and machinery. A 4½ h.p. lift gear combination, comprising an interpole motor worm reducing-gear, as described above, and an automatic brake, situated between the motor and the worm gear. A 5-cwt. friction hoist, designed to work at 100 ft. per minute, and driven through a combined spur and friction gear by means of a compound wound motor. A main drum haulage set capable of hauling at four miles an hour, direct driven through gearing by a 5 h.p. motor, 850 r.p.m.; this equipment is worked by a reversing drum controller with jaw



General View of "Electromotors" Stand.

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clutch for disengaging the drum and a powerful foot brake, and is designed for hauling up inclines in which the gradient exceeds 2 ins. to the yard.

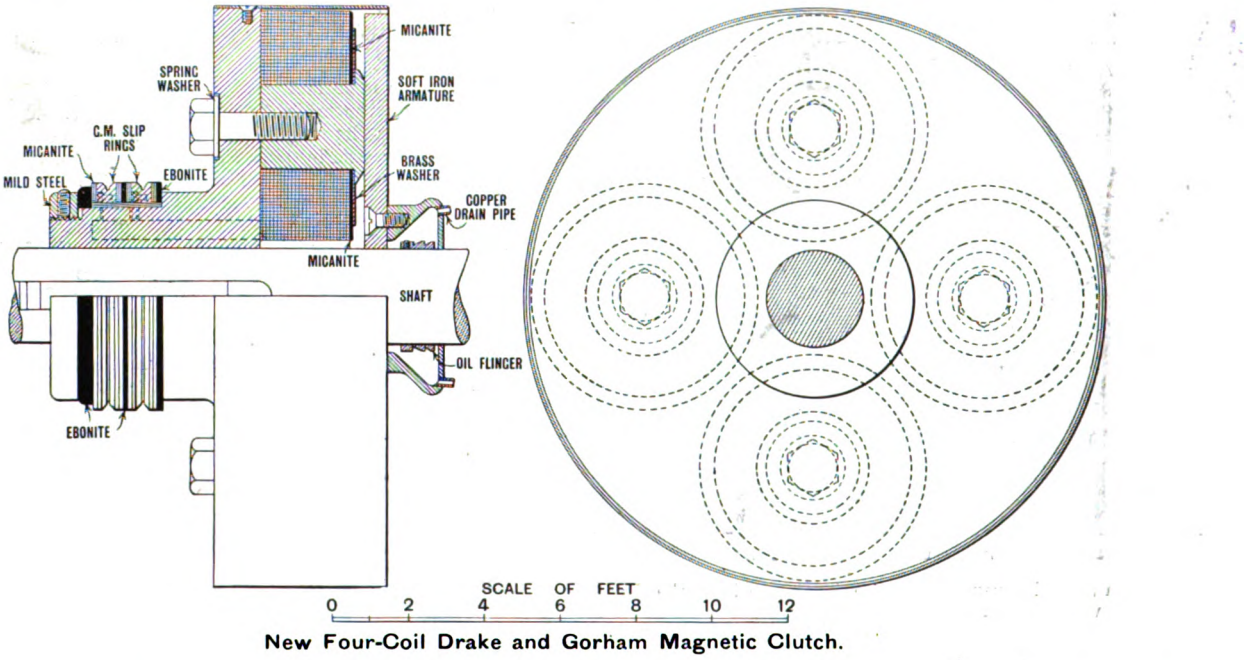
A one-ton electric pulley block of compact design, worked by a self-contained motor, illustrates another of the firm's specialities. These blocks can be supplied of the suspension type with hand-travelling gear or motor travelling gear, for running on the flanges of the single H girder, making an ideal runway for workshops, warehouses, chemical works, and the like.

A petrol dynamo set for private house lighting, by means of a battery and low voltage metal filament lamps, and a 3-kw. steam dynamo, 410 r.p.m., are also exhibited. The latter engine is a 4½-in. by 4-in. open vertical, high-speed, double-acting machine, and is direct-coupled to a compound-wound dynamo on a combination bedplate. These machines are useful for shop lighting, and for small country-house installations.

Messrs. Drake & Gorham, Ltd.,

66 Victoria Street, London, S.W. (Stand Nos. 127 & 164.)

Magnetic Clutches.—An interesting object on Messrs. Drake & Gorham's stand is a new pattern of magnetic clutch which they have recently introduced, and which is illustrated in the accompanying figure. This type is known as the Drake & Gorham No. 1 clutch, and the principal features are the use of four coils, any one of which can be taken out for examination or repair without dismounting the shafting. The effect of residual magnetism, which is troublesome in some forms of clutch, is done away with by the automatic momentary reversal of current. As will be seen, the clutch is very compact. We understand that a number have already been supplied to the Admiralty.



New Four-Coil Drake and Gorham Magnetic Clutch.

Lamps, Switchgear, &c.—A good selection of switchgear, &c., manufactured at the company's own works, is shown. Among these may be mentioned a "fool-proof" battery charge and discharge switch, with two concentric arms interlocked, so that they cannot lie in the wrong position relatively to each other. A 1,000-ampere change-over switch, as supplied through H.M. Office of Works to Buckingham Palace and the new Public Offices, is also shown, and several types of distribution boards.

In front of the stand are two examples of the Jandus regenerative flame arc lamp (described in Electrical Engineering, Vol. III., page 299), and on the stand itself are shown a number of fittings specially made for metal-filament lamps, including examples of effective clusters with holophane glass ware. An interesting exhibit is also the case showing the various stages of manufacture of the tantalum lamp from the wire-drawn "filament" to the complete article. Surface wiring is represented by the two-part grip insulator, and in connection with conduit work a convenient form of earthing clip, fitting any size of tube, is of interest. This was illustrated in Electrical Engineering, Vol. II., page 986. It is impossible to particularise all the useful appliances shown, but attention should be drawn to the excellent display of heating and cooking apparatus. Messrs. Drake and Gorham carried out the wiring and provided the generating plant for the "Model Home" adjoining their stand, which is described elsewhere, and supplied the greater part of the fittings therein.

Union Electric Co., Ltd.,

Park Street, Southwark, London, S.E.

Motor-driven Pumps.—A very striking and representative exhibit has been arranged by this well-known firm. The first item to attract the attention of the passer-by is a complete pumping outfit for a works or private house. This consists of a three-cylinder pressure pump with 3 in. diameter and 6 in. stroke cylinders mounted on the same bedplate with a motor which drives the pump through double reduction gearing. The pump, which is capable of delivering 1,375 gallons of water per hour, is shown working in combination with an automatic float switch. A direct-coupled centrifugal pump, suitable for throwing 80 gallons of water per minute against a head of 80 ft. is also exhibited. The pump, which is shown working, is directly coupled to a Union motor; and the complete set is on a common bedplate. The motor is provided with a "Fortiter" speed regulator to vary the speed in accordance with the head required.

Paraffin Generating Set.—An interesting item on the stand is a single 4 in. by 4 in. cylinder paraffin engine designed to run at 900 r.p.m., and directly coupled to a dynamo. This set forms a safe unit for private house lighting. This engine is started as a petrol motor and runs so for about five minutes, after which the paraffin is turned on. Since the introduction of low-voltage metal filament lamps, enabling the necessary number of storage cells to be reduced, a considerable demand has sprung up for small electric plant, suitable for use in the smaller sizes of country houses. In many cases small petrol motors have been used, with the disadvantage of considerable fire risks. The paraffin motor diminishes this risk, and besides reducing very considerably the cost of working, simplifies the attendance. This little set will supply current for 60 16-c.p. metal filament lamps.

Motors.—A representative exhibit of motors is to be found on the stand, consisting of both direct-current and alternating-current machines. The largest of these is a 440-volt, 110 h.p. motor, running at about 150 r.p.m.; this machine is of the very latest type with end shields, and is fitted with reversing poles. The pole pieces are of laminated iron, securely bolted to the turned cast-steel magnet ring. A large number of small machines, suitable for automatic signs, winding apparatus, hand driving, &c., are shown; these are of the totally enclosed type, and are constructed to run for long periods without any attention whatsoever. Among the three-phase machines are the following:— an 11 h.p. motor with slip-rings, brush raising gear, and short-circuiting device; an 8½ h.p. motor with wound rotor and slip-rings; and machines of 8½ h.p., 6 h.p., 3½ h.p., and 2½ h.p., with squirrel cage rotors.

Arc Lamps.—In the roof of the stand are fitted 8 Excello arc lamps, 4 being on the direct-current circuit, and 4 on the alternating current circuit. The object of this is to show that the alternating-current lamp is just as efficient and satis-

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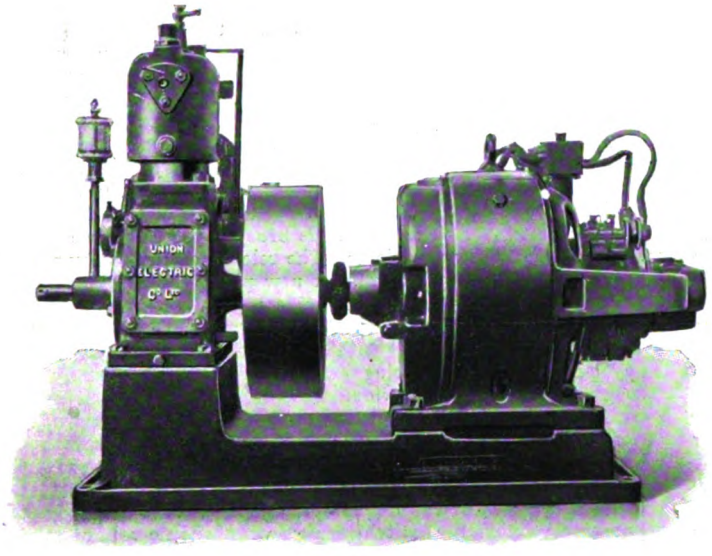
factory for lighting purposes as the direct-current lamp; in fact, the Union Co. claim that the operation of the alternating-current Excello arc lamp is even superior. The Excello arc lamp is shown burning yellow flame carbons, and also white flame carbons. Hanging from the roof of the stand are also to be seen two "Coltru" arc lamps for colour true illumination, such as is required in many factories, and in practically all large shops and warehouses. One of these with downward illumination is shown in the accompanying figure. The vital element of the "Coltru" daylight lamp is the light filter. This is a special type of glass arranged to diffuse the light, and spectroscopically selected to absorb those light rays which cause difference in colour values. The Union Co.'s standard pattern of inverted arc lamp is exhibited, and some lamps, with the carbons in the normal position, but with an open bowl of translucent glass below the arc are shown. This is what is known as the indirect lighting system, in which means part of the light passes upwards, and part through the reflecting bowl. This lamp has the advantage of casting no shadow either up or down, and although not quite so efficient as the truly inverted lamp, it has certain artistic advantages. The accompanying illustration shows a view of one of these lamps. At each apex of each of the eight arches at the entrances to the stand are Kohinoor enclosed arc lamps of the new type produced by the company, which are said to have all the advantages of colour truth appertaining to open type pure carbon arc lamps, with, at the same time, long burning hours. In the centre of the stand is seen a photographic arc, of the kind used for printing process work and photographic work. Various types of projectors suitable for theatrical or marine work are shown.

Switchboard and Portable Instruments.—Among the electrical instruments, of which there is a large selection, are several examples of the firm's new type of sector flange instrument, which, although it has a wide sector-shaped front and scale, has a circular body. This considerably simplifies the mounting, as it is only necessary to cut a circular hole in the panel of the board. Several of these and other instruments, and a selection of frequency meters, with single and double ranges, are shown, fitted with illuminated dials on a large board. Among the special instruments is a 15 amp. time-meter, for use where current is charged by the time of consumption instead of by Board of Trade units. There are also a couple of time-meters for tramways, to show the period of time that the current has been on the car.

Switchgear.—A comprehensive exhibit of switchgear includes an enclosed three-pole oil break switch with overload and no voltage release, interlocked with a rotor starter of the oil-bath pattern for a 25 h.p. 3,000-volt motor. One of the most interesting of the switch-gear exhibits, which is also illustrated, is a self-contained high-tension switch-pillar. There is a substantial and well-designed oil-break switch, in which both the overload release and the time-limit control are adjustable from outside the case. One of the most striking low-tension exhibits is that of the marine pattern water-tight switches, tested under air pressure, and ranging up to as large a capacity as 400 amps.

Speed Indicating and Recording Apparatus.—A particularly interesting exhibit is that of a number of speed indicating and recording devices. Some of these are on the voltmeter principle, really indicating or recording the pressure generated by a constant field magneto-generator, driven from the axle of the vehicle or machine, the speed of which it is required to record. The scales are divided off into revs. per min., or miles per hour, as desired. Others work on the principle of the vibrating tongue frequency meters, and the speed is indicated by the vibration of the tongues. These are supplied with current from small alternating-current generators driven from the axle. They may have rotating field or rotating armature. As permanent magnets are used, no slip-rings of any kind are required in the former case.



Small Paraffin Generating Set.

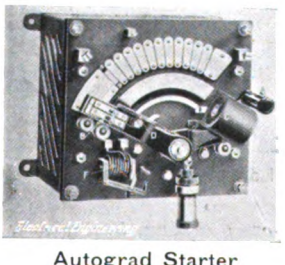
"Coltin" Lamp for downward Illumination.

Enclosed Switch Pillar.

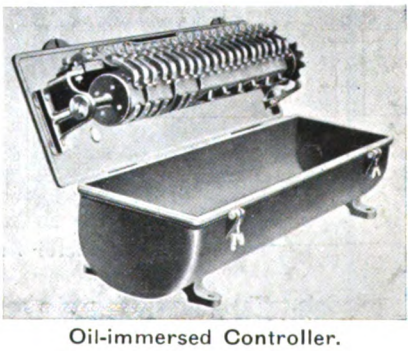
The Electric & Ordinance Accessories Co., Ltd.,

Stellite Works, Cheston Road, Aston, Birmingham.
(Stand No. 1.)

Motor Starters, Controllers, &c.—The exhibits on this stand are representative of a very considerable range of manufactures. A few motors are shown out of the large number of standard patterns made for various branches of industrial work. These are accompanied by a collection of starting and controlling appliances, in which are some interesting patterns. Amongst these is the "Autograd" starter, shown in one of the accompanying figures, in which the handle pulls over the contact arm against a spring by means of an electromagnet. If it is pulled over too quickly the release gear causes the magnet to lose its current, and the contact arm drops back to the off position. Failure of voltage has the same effect. Other controllers include the oil-immersed, three-phase controller, shown in another illustration, and a special controller of the tramway



Autograd Starter (Booker's Patent).



Oil-immersed Controller.

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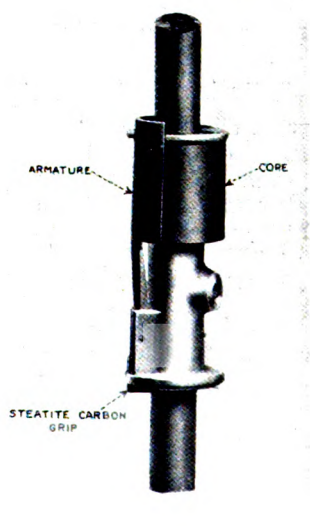
type, combined with an interlocked main switch, with automatic release, and a speed-controlling shunt rheostat, which comes into action when the motion of the handle is continued beyond the last series resistance step. The controller is so designed that in the event of either of the releases acting, the circuit can only be closed again by bringing the handle back to the off position. Other special types of controller include the lift controller, illustrated, and examples of a long series of standard starters and controllers are shown. These are built to give good results even when used in damp places; the arc shields and spark guards are of non-hydroscopic material, and no wood or fibre is used in their construction. Samples of an improved type of grid resistance, built up entirely of standard interchangeable parts, and insulated only with mica, are shown, and there is a good display of porcelain bobbins for resistances, and other parts for miscellaneous electrical purposes, made in the company's own factories at Hanley. Other exhibits on the stand include radiators, both of the lamp and convector type, the latter being constructed with a special resistance in the form of a net. In addition to the ordinary types of heater for use in private houses, offices, &c., the firm manufacture special heaters for factories and for trains and tramcars.

Another interesting exhibit on the stand is the Warner Autometer, which is a speed indicator combined with a distance recorder for use on motor cars, but equally applicable to trains and tramcars. The construction of this is very simple. A circular permanent magnet within the instrument is driven by the usual flexible shaft, and above this there is a copper disc held back by a spiral spring, which is deflected through an angle proportional to the speed, by the torque due to the eddy currents produced by the rotating magnets. The scale is marked on the rim of the disc itself in particularly plain figures, which are visible through an opening in the case. The rotating part is mounted in ball bearings, and jewelled centres are used for the swinging disc. It is claimed that a high degree of accuracy is obtainable at low as well as at high speeds.

The company also show a number of their well-known ventilating fans, both of the centrifugal type, for blast furnaces and other work of a similar nature, where large volumes of air are required under pressure, and the propeller type for moving large volumes of air against free intake and outlet. Several examples of the Victor standard miniature enclosed arc lamps and flame arc lamps are shown. All these lamps are fitted with a special form of clutch, which works on an extremely simple



Clutch of Victor Arc Lamp.

principle. The body consists of a solid brass casting, having a cylindrical hole bored through it, to take the positive carbon, but slotted on the lower end to allow of a soft iron armature with a steatite grip to be pivotted therein. This armature envelops the top half of the clutch body; at the top end there is a soft iron core enveloping the body half-way round. This clutch is supported in the air gap formed between the end of the magnet core and the magnet frame. When the current is switched on, a magnetic pull is exercised on the clutch armature, causing the grip firmly to hold the carbon, and at the same time the whole clutch is drawn up, thus striking the arc. A view of one of these lamps is shown in the accompanying figure, together with details of the clutch action.

A. Reyrolle & Co., Ltd.,

Hebburn-on-Tyne. (Stand No. 95.)

Voltage Detector.—A new and very ingenious device for indicating whether high-pressure mains or terminals are live has been brought out by Messrs. Reyrolle & Co. It is the joint invention of Dr. W. M. Thornton, of the Armstrong College, Newcastle, and Mr. H. W. Clothier, of Messrs. Reyrolle & Co. A long fuse wire is enclosed in a fibre tube and connected at one end to a metal tip, and at the other end to a cylindrical layer of foil, which extends within an inch or two of the tip. This is insulated with "Empire" tape, upon which is another cylindrical layer of foil, and this second layer is again heavily insulated with "Empire" tape. The two layers of foil thus form a condenser, and the outer layer is connected to one point of a spark gap about $\frac{1}{32}$ of an inch long, the other end of which is earthed. The whole apparatus is completed by an insulated handle, and measures 2 ft. 6 in. long and 2 in. diameter. When the live terminal is touched with the metal tip, the condenser is charged and a spark is seen in the spark gap. It is thus possible to ascertain with absolute safety whether the main is charged. Such an apparatus has obvious application in the mains department of every high-tension system. The specimen exhibited will stand a pressure of 20,000 volts with safety.

Switchgear, &c.—The firm have brought out a 3-phase motor-starter with no-voltage release. The release is actuated by a light plunger with gravity control. A new plug for heavy current is also shown, similar in general design to that recently illustrated in our columns (Electrical Engineering, vol. ii., page 1029) which is also on view, but with the addition of a catch to prevent any possibility of the plug being pulled out accidentally; the socket of the plug is provided with a flap, which comes up and covers up the socket immediately the plug is withdrawn. On another panel are shown four motor starters, any of which can be switched on to a motor on the stand in order to show the different action. The first of these is the ordinary single-lever type, the second of the double-lever pattern, that is to say, the pattern in which the switch flies off when the no-voltage release acts, even if the operator's hand is still on the handle. The third is the ordinary drum-type controller, and the fourth a new type of double revolution drum controller. In the latter the first revolution switches on the main switch and takes out the series resistance, and the second revolution cuts in the shunt resistance to speed up the motor further. The mechanism of this is cleverly arranged, and the controller thus combines in a compact form in an iron case, a starting switch, and a regulating switch. The motor used for these demonstrations is fitted with a brake pulley, so that a load may be placed upon it, and an ammeter is provided to show the current taken at the various steps of the several controllers. On another panel one of Messrs. Reyrolle's "wait on the first stop" controller is shown in series with an ammeter. The controller is locked on the first stop, and the attendant switches it straight across the mains, and one can observe in the ammeter the current gradually rising.

The Merz-Price System of Main Protection.—The principle of this system of mains protection was described in our issue of May 21st last, but, as now actually manufactured by Messrs. Reyrolle, there are some slight modifications in it. We may mention that Messrs. Reyrolle manufacture it for the British Insulated & Helsby Cables Co., who are the licensees, and Messrs. Reyrolle also have sub-licences, so that they may provide it in connection with switchgear. The chief difference in the system from that which was described on the date above-mentioned is that, instead of using a shunted transformer, an air-gap transformer is employed; three separate relays, one on each phase, replaces the three-pole relays shown in our former diagram. We understand that at present there are in the north of England approximately 200 miles of high-tension network protected on the Merz-Price system, and we are informed that it has acted instantaneously and efficiently in the case of very severe faults on mains. A board is shown on Messrs. Reyrolle's stand to demonstrate the action of the various devices. Relays for cutting out the mains are screwed on to the board, upon which lines have been painted to represent two sub-stations being supplied from the power station on the ring-main principle. An artificial fault is made by connecting an earthed cable to a stud on one of these mains, and it is seen that only the cable on the one side is switched out, the other relays remaining unaffected. The relays are connected to Messrs. Reyrolle's new ironclad high-tension switchgear, which is, of course, placed well to the front of their stand, as it is one of the firm's latest developments. This switchgear, which is also exhibited at the Franco-British Exhibition, is described in detail in Electrical Engineering for July 2nd, 1908.

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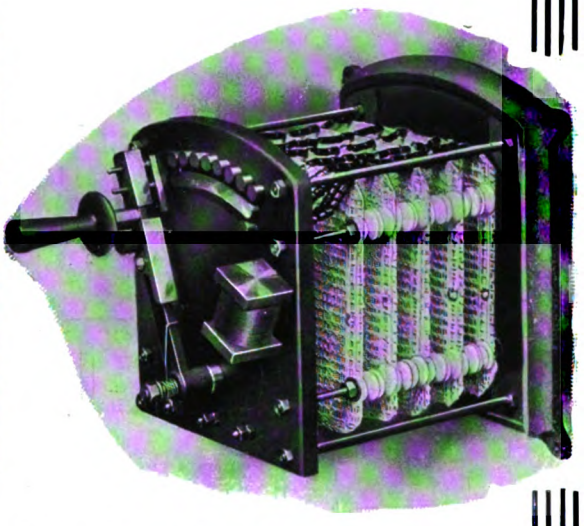

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October 8th, 1908.

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MESSRS. MARPLES, LEACH & CO., Ltd., beg to inform buyers in the Electrical trade that they have decided to supply any of their standard stock motors and dynamos at a special discount of 10 per cent. from their ordinary trade prices, as given in their priced stock list issued on the 1st inst., on the understanding that the order be placed during the next four weeks, that is to say, on or before November 7th.

It is the feature of Messrs. Marples, Leach & Co., Ltd.'s business that a customer once secured is loath to place orders elsewhere for a similar class of machinery; and they are prepared to supply a certain number of machines at cost price in order to open new accounts, which, as experience in the past has shown, are bound to increase in the amount of turnover from year to year.

Buyers are invited to examine the sample machines which are shown at Stands Nos. 104 and 105 Manchester Electrical Exhibition. Should they not have received one of our priced stock lists, they can obtain one on application at these stands, or by sending a postcard to the above address.

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Messrs. Mountain & Gibson, Ltd.,

Elton Fold Works, Bury. (Stand Nos. 56, 57 & 58.)

Tramcar Trucks and Appliances.—The most prominent feature of this stand is a complete maximum traction tramcar truck of the standard type, of which about 1,350 have been supplied for the London County Council tramways. The main features of the construction of these trucks, which are of the centre-bearing swing bolster pattern, are the care with which all joints are machine-fitted and thoroughly interchangeable. The design is such that there is no strain taken by the bolts at any part, so that in the event of looseness of bolts, no deformation can take place. All bolts are accurately turned and fitted, and all parts liable to wear, such as in the brake gear, are fitted with renewable wearing surfaces, bushes, &c. All looseness and rattling can thus be prevented, and the life of the truck indefinitely prolonged. Another pattern of truck shown complete except for motors is an equal wheeled centre-bearing swing bolster truck for cars of the "interurban" type for Montreal, with built-up side frames. A working model of a radial truck is also to be added.

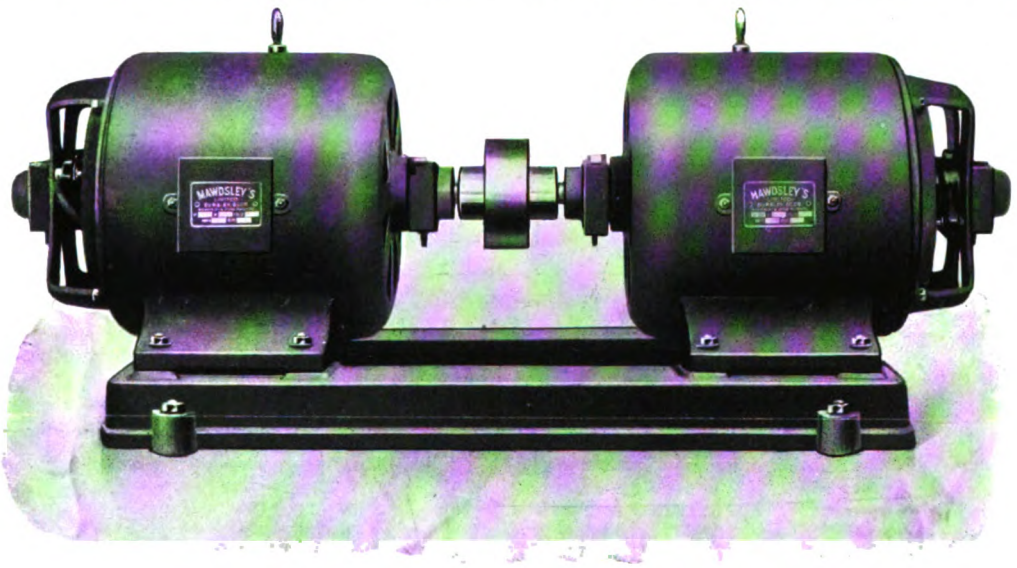
Messrs. Mountain & Gibson also show an example of the Wilson iron roller shutter for car houses, &c., for which they now hold the sole agency for Great Britain, Europe, and the Colonies. Owing to the form of the joints, which are continuous curves entirely without sharp corners, these shutters are particularly easy running. Other tramway appliances shown are the "E. P. D." trolley earthing device and indicator, and the Whittaker sanding device, which is fitted with a special valve arranged to give an instantaneous free passage to the sand and prevent clogging even when the sand is wet.

Mawdsley's, Ltd.,

"Zone" Works, Dursley, Gloucester. (Stand No. 284*a*.)

Dynamos and Motors.—This firm is exhibiting a selection from a line of "Mawdsley's Zone" patent improved motors and dynamos, ranging from ¼ to 12 b.h.p. and from 0·1 to 8 kw., out of a complete range up to 250 b.h.p. and 150 kw. We propose to publish a detailed technical description of these machines, with explanatory diagrams, in an early issue. A 6-h.p. lift motor under a brake load is shown. This motor is controlled by a complete automatic push-button lift-control system. Another 6-h.p. motor, also under brake load, is shown with a controller for crane and hoist work. A 3-h.p. back-geared motor, with a speed reduction of 6 to 1, is working on the stand adjacent, driving a cuff-and-collar ironing machine. One of the most interesting exhibits on the stand is a Mawdsley's patent "Zone" machine taken to pieces to show its construction, and the patented "Zone" winding, whereby the necessity of interpoles is done away with, thus simplifying the design and cheapening the cost of production. All the above machines are shown on the stand of Mr. D. C. Bates, who is the Manchester agent of Messrs. Mawdsley's, Ltd.

A Baby Motor-generator.—The firm is also exhibiting a small motor-generator, which is intended for use on a 200-volt direct-current supply to supply about 30 amperes at 25 volts for running metal filament lamps of low candle-power. An illustration of this set, one-eighth scale, is given below. It runs at 1,500 r.p.m.



Mawdesley 200v./25v. D.C. Motor Generator.

International Electric Co.,

55 Red Cross Street, London, E.C. (Stand No. 183.)

Orieco Metal Filament Lamps, Telephones, &c.—At the International Electric Co.'s stand there is a very effective advertising device. Thirty-two "Orieco" 25-volt metal filament lamps are placed round a frame, in the centre of which is a glass sign. A small motor drives the contact breaker, which lights up the lamps on the frame and the lamps behind the glass sign alternately. The motor is a very small one, and is run through a lamp directly off the lighting circuits. Among the telephones exhibited are some fine loud-speaking telephones for ships' use. Another application of electricity on ship-board is a lamp-signalling system, to replace the bell system on passenger steamers. A passenger presses a button in his cabin, a lamp lights in the steward's pantry, and two other lamps light, one at the end of the passage where the cabin is situated, and the second over the cabin door. This is done by means of relays, and the lamps remain alight until the steward has pressed a button at the cabin lamp. An electrically-worked watchman's tell-tale, which is a new piece of apparatus the company is introducing, is so arranged that the watchman pushes in a button at each station, and a type wheel in connection with a clock is actuated so that the number of the station and the actual time is printed on a strip. The wiring for this need only be a single or double wire, as the type wheel with the number of the station is worked by a step-by-step mechanism. Some large single-stroke bells are arranged for connection to 100- and 200-volt mains, and there is a good show of meters, including a two-rate meter.

E. Green & Son, Ltd.,

2 Exchange Street, Manchester. (Stand No. 111.)

Economisers.—The exhibit of this well-known firm consists of a model of a Green's economiser, containing 72 heating tubes, fitted to a model of a water-tube boiler complete with all feed piping, pumps, valves, and dampers. Another model of an economiser with 96 heating tubes is shown; this is fitted to a model of a Lancashire boiler. The economiser is arranged in two groups of 48 tubes each, and is fitted with all the latest improvements and facilities for easy access to any part of the apparatus. The scraper gearing of both models is actuated by small ¼ h.p. motors, and shows very completely how the heating surface of the economiser is kept free from soot and the full advantage of the heated boiler gases gained. A case of sample tubes, specimen castings, and some tubes which have been burst under a pressure of about 3,000 lbs. per square inch, is also shown.

Robert W. Blackwell & Co., Ltd.,

Parliament Chambers, 14 Great Smith Street, Westminster, S.W. (Stand No. 60.)

Transmission Line and Overhead Traction Material, &c.—The exhibits on this stand cover a considerable range of overhead

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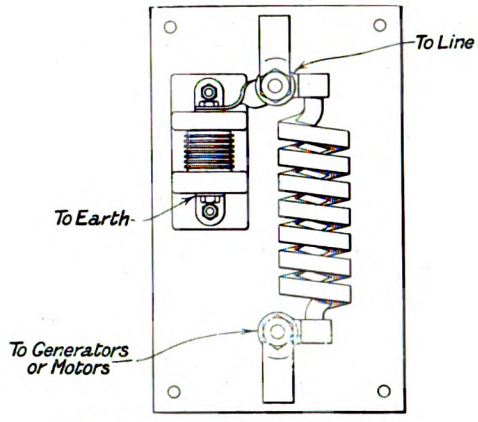
material for traction and transmission. Among these are examples of the actual insulators to be employed on the 65,000-volt transmission lines for the London, Brighton, & South Coast Railway, as shown in the accompanying figure. These are of white porcelain about 11½ ins. high overall, and 7½ ins. and 4¼ ins. minimum and maximum diameter. There is also on view a large selection of the well-known Lima porcelain insulators of the pin and shackle types for voltages up to 100,000 volts. An interesting object in the front of the stand is a complete

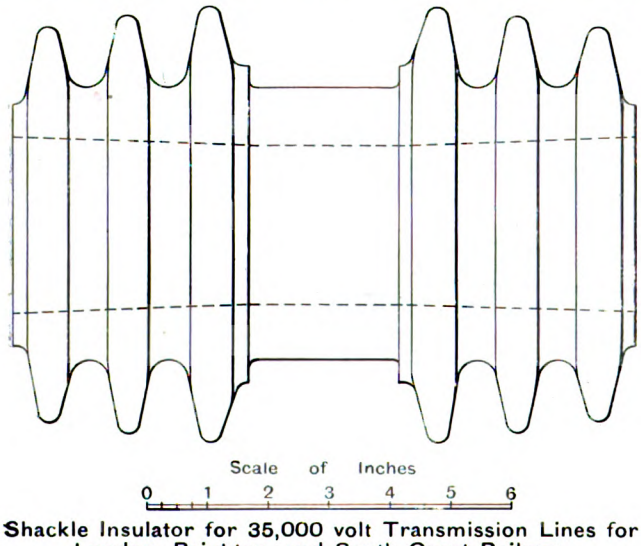


Non-Arcing Lightning Arrester.

A pole as used on the 6,000-volt transmission lines of the Newcastle-upon-Tyne Electric Supply Co., complete with insulators, guard wires, &c.

Several forms of lightning arresters are shown, including the ordinary horn variety, combined with choking coil for use in the open air, and the non-arcing switchboard type shown in the accompanying illustration, in which a pile of discs of a special carbon preparation, separated by mica plates, are used. Some of these are shown enclosed in watertight cast-iron cases. There are also exhibited various patterns of joint boxes, cable "pot-heads," &c.

A number of samples are shown of bitumenised fibre conduit, which has advantages of being non-hygroscopic and entirely non-corrodible, besides being considerably lighter than iron pipe for transport, and very easily laid and jointed. This fibre conduit is different from other forms on the market, in having a thicker wall than usual and a longer joint. It is built up of alternate layers of fibre and asphalt. Among other specialities



Shackle Insulator for 35,000 volt Transmission Lines for London, Brighton, and South Coast Railway.

represented on the stand to which attention may be drawn are a special insulating paint and the new Genasco asphaltic roofing material, with which the office on the stand is covered.

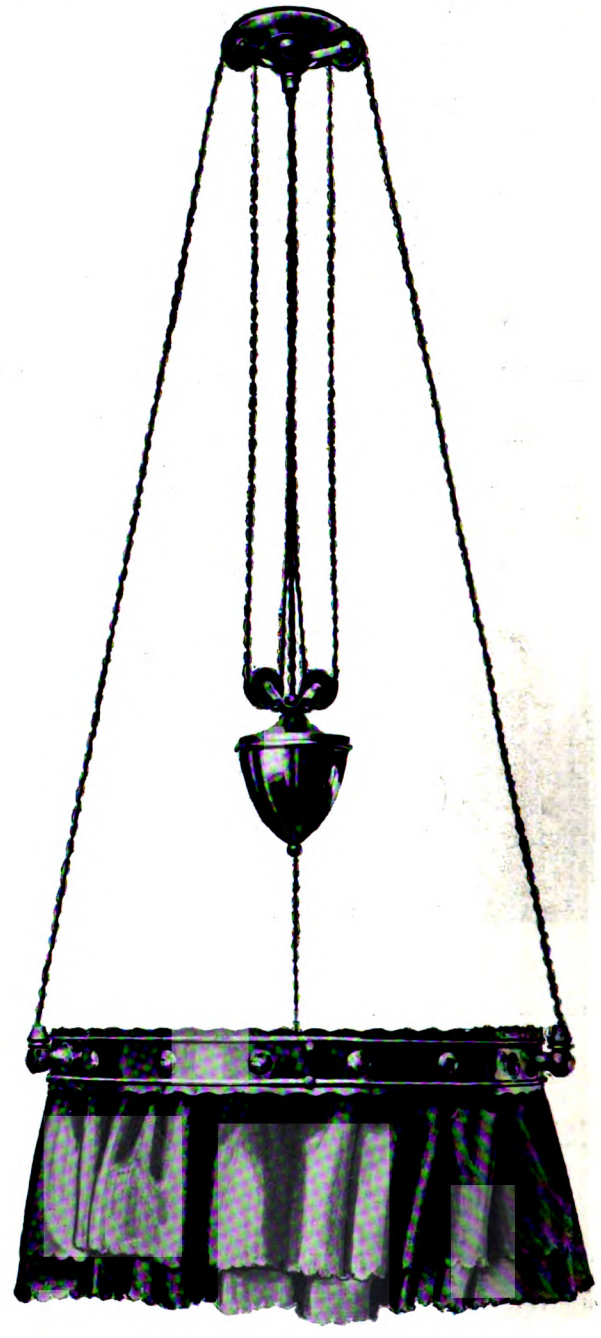
The company have recently introduced a new insulating material known as Litholite, which can either be obtained in sheets, moulded on to metal parts of any kind, or used for such purposes as bobbins for field coils, &c. The material is claimed to be non-hygroscopic, and of much higher insulating quality than fibre. The company now use litholat instead of Aetna material in a number of the standard tramway fittings, such as "Globe" strains, insulated bolts, &c., and in the Fawdry insulator. In these a special coating is electrically deposited on the bolts before the insulating material is moulded on in order to prevent the creeping in of rust.

Some examples are shown of litholite insulation for wireless telegraph aerials, as supplied to the Admiralty. A description of the leading features of the stand would not be complete without a mention of the display of galvanised fittings for pole lines and other overhead work. Messrs. Blackwell are now agents for the "Romapac" system of tramway track, in which the rail is provided with a separate head, which can be removed and replaced by a special machine in place.

The Edison & Swan United Electric Co., Ltd.,

36-37 Queen Street, London, E.C. (Stand Nos. 22 & 46.)

Lamps, Fittings, Instruments, Accessories, &c.—One of the most effective and well-arranged stands in the exhibition is that



Ediswan Counterweight Fitting.

of the Edison & Swan Company, on which are displayed not only the company's well-known Royal Ediswan carbon lamps, but also examples of the new metal filament lamp made at the Ponders End works, which will soon be on the market in large quantities, and is to be known under the name of the Royal Ediswan Metfil lamp. This is shown in the 100-volt 32 and 25 c.p. sizes, as well as for 50 volts as already exhibited at the

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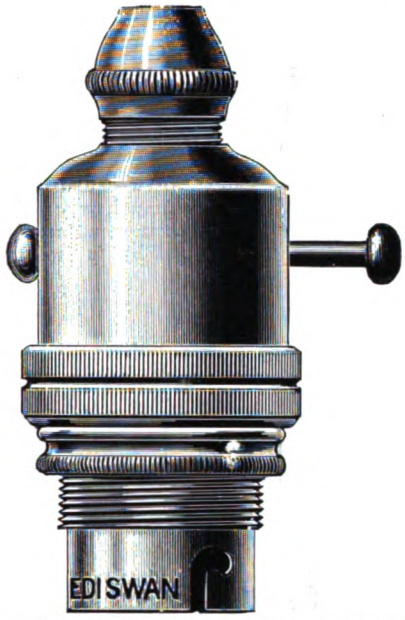
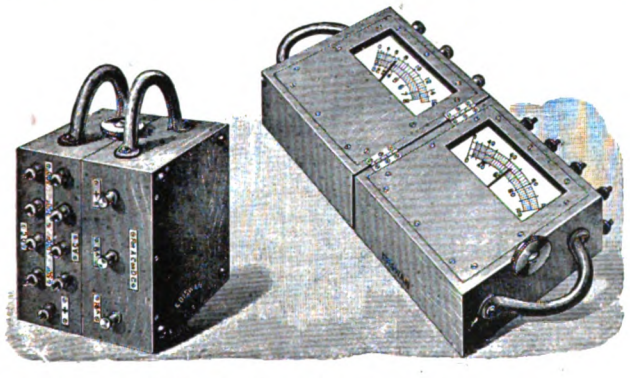
Franco-British Exhibition. In connection with these, the company's small transformers for running low voltage metal filament lamps may be mentioned. A very good display of fitting repre-



New Pattern of Ediswan Switch Holder.

sentative of a variety of styles, including Adams, Louis XIV., XV., and XVI., Renaissance, Georgian, and Flemish, is to be seen. A new design of the light counterweight fitting among these is illustrated herewith. In addition to these counterweight fittings some very neat types of spring extension pendants without weights have been introduced. These spring counterweights are applicable to three-light as well as single-light fittings. Attention should also be drawn to a series of very



Ediswan Portable Testing Set.

artistic table lamps and other fittings in Doulton ware, and some handsome bronze figures.

A number of Ediswan instruments are shown, and among these there is a novelty in the shape of the testing set consisting of a portable ammeter and voltmeter for several ranges in wooden cases hinged together, as shown in the accompanying illustration. Among the switchgear and accessories shown may be mentioned a large knife switch type of cut-out in iron cases designed for use as main fuses on house or power circuits, automatic circuit breakers, and an improved pattern of knife switch of great mechanical strength. Specially noticeable is the recently introduced "Phlatta switch," which is shown in an extremely neat-looking rectangular pattern, as well as the round type. This switch is well known as having an extremely small projection from the wall, while containing a well-made movement on the wedge system. Among the many other accessories may be mentioned the new form of switch-holder illustrated, which is of remarkably simple but substantial construction. Several types of distribution board as shown, including a high class form in asbestos-lined iron case. The numerous other exhibits include fans, flame arc lamps of the yellow and pure white types, and in a prominent position on the stand is an example of the effective "Ediswan Luxol" illuminated sign; in these signs, each letter is made of opal glass with a full rounded surface, and bevelled extremities, so that by daylight it reflects the light at every angle. The under-surface is hollow, and the curves are such that at night a single 5 c.p. lamp is sufficient to illuminate thoroughly every portion of a 6 in. letter.

Bray, Markham & Reiss, Ltd.,

Blackhorse Lane, Walthamstow, N.E. (Stand No. 20.)

Motor Starters.—A considerable number of different types of starter are shown, including a new design of automatic starter for use with float switches or other form of distant control. This is marked by a small motor within the case, which actuates a ratchet device by a crank action and pulls over the starter arm one step at a time against a spring. Releases are fitted to cause the arm to disengage and fly back, and at the same time to heat the circuit of the operating motor in whatever position the starter may be in case of overload or failure of voltage. Examples of the latest standard type of B.M.R. starter, with ratchet motion worked by rocking the handle to and fro, are also shown. Another well-thought-out starter is that of the Admiralty type, in which the starter arm is interlocked with a double-pole main switch by an ingenious toggle arrangement. These starters are largely used on board ship for turret control, and are made with mica insulation throughout, as the use of slate and marble is not permitted under these conditions. A different type on a marble base is made for dockyard use. All the starters described above are fitted with renewable carbon breaking contacts on every step, and are so designed that no current passes through the arm. Another well-designed piece of apparatus is a pillar with combined starter and shunt rheostat for speed regulation, interlocked together. In addition to this continuous-current apparatus a very compact form of anti-transformer starter for squirrel-cage induction motors is also exhibited, and examples are shown of the B.M.R. enclosed double-pole switch. The mechanical design of the switch is of the simplest. Two levers are mounted on one pin, a spring tending to keep them normally together. Two links forming a toggle joint are pulled into line by a sleeve mounted on a sliding rod and force the levers apart, thus pressing the insulated spring brush against the contacts. To switch off, the rod is pushed inwards till the links are above the dead point, when a spring brings them rapidly together, the sleeve sliding up the rod, thus renders the quick break, independent of the operator. In the front of the stand is a showcase demonstrating the construction of the special form of enamelled metal tubes used for the resistances in some of these starters. These are coated first with hard enamel, and then with a coating of softer enamel. The resistance wire is next wound on, and a subsequent firing causes it to embed itself into the soft enamel, but not into the lower layer of hard enamel.

National Gas Engine Co., Ltd.,

Ashton-under-Lyne. (Stand No. 271.)

Gas Engines.—On this stand is shown an example of the latest pattern horizontal single cylinder gas engine of the firm's Y. E. type, designed for an output of 100 b.h.p. with suction gas. The engine is shown running, at a speed of 200 r.p.m., from a suction producer plant. It is of a new design, only three of which have been manufactured, the other two being in the Franco-British and Scottish National (Edinburgh) Exhibitions respectively. The engine is entirely throttle governed, and runs remarkably steadily. Low-tension magneto ignition is fitted, and two separate magnetos are provided, one on each side of the cylinder, as this is not only found to give more rapid combustion, but affords greater security in case of weakness of one of the sparks. A special arrangement for lubricating the exhaust valve guides is adopted, and the main and cam-shaft bearings are all ring lubricated. In addition to this engine, a small 9½ b.h.p. single-cylinder horizontal engine is shown, running on town gas, and driving a dynamo by Messrs. J. Hall & Co., giving an output of 29 amperes at 200 volts, and running at 250 r.p.m.

Crossley Brothers, Ltd.,

Openshaw, Manchester. (Stand No. 269.)

Gas Engines.—The chief object of interest on this stand is an example of the new vertical four-cylinder Crossley gas engine, coupled directly to a generator, which is connected up to the exhibition sub-station, so that it can be used for emergency lighting, or to assist in the general supply to the exhibition. The engine is similar to that shown in the accompanying illustration, and is designed for an output of 110 b.h.p. on suction producer gas, or 125 b.h.p. on town gas. It runs at 250 r.p.m., and is direct coupled by a Raffard flexible coupling to a 75-kw. continuous-current generator of the General Electric Co.'s make. Some of the features of the engine lie in the position of the inlet and exhaust valves, both of which are in the cylinder heads, and are operated by overhead rocking levers from a

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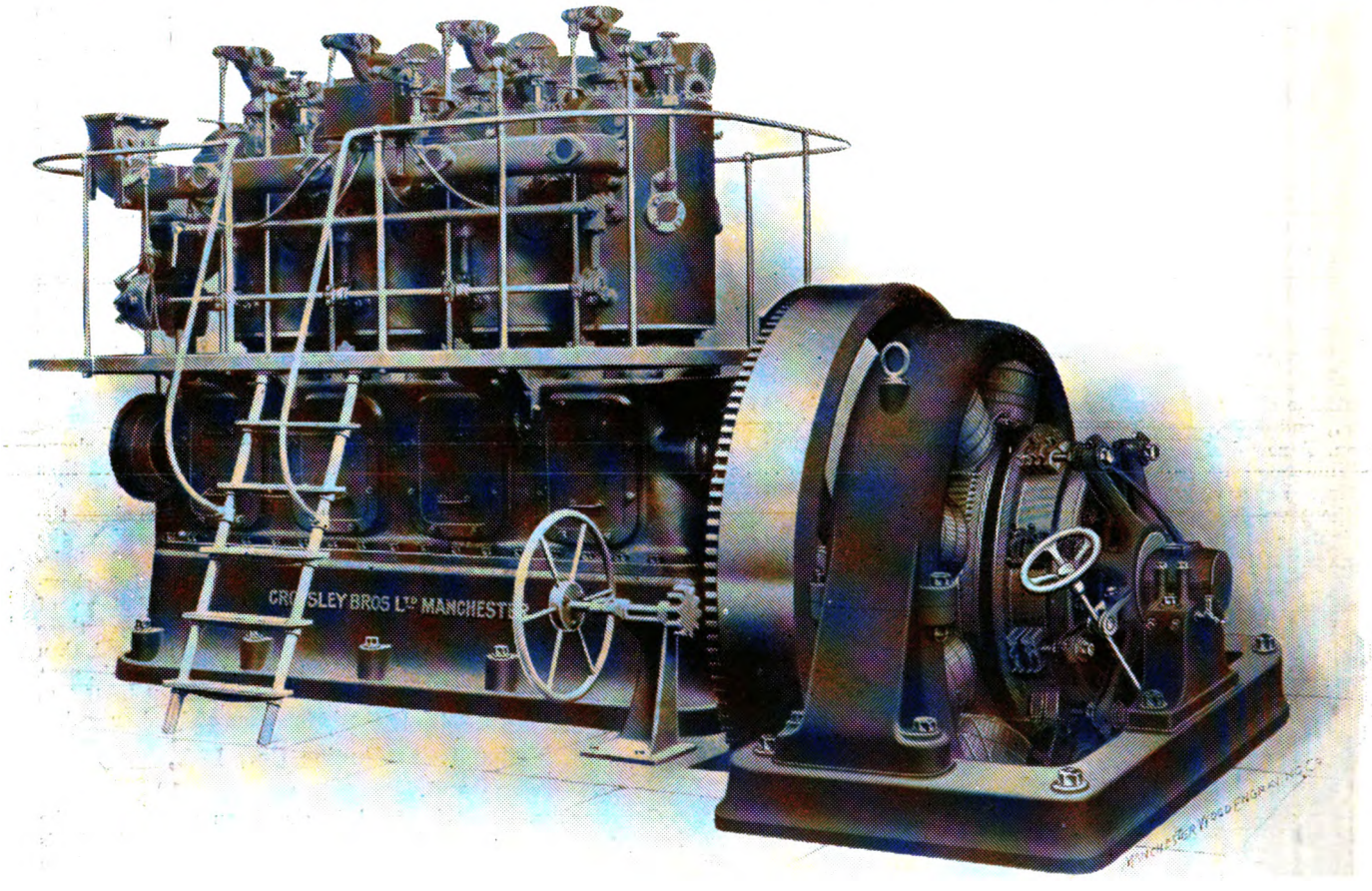
single camshaft. Forced lubrication is used, and the ignition is on the high tension system by battery and coil. In these engines the governing is entirely on the throttle, without any hit and miss arrangement. Their excellent running is largely attributed to the way in which the gas and air are throttled separately, and only mix on entering the cylinder. It should be mentioned that the governing arrangements are so designed that the engine can be changed over from producer gas to town gas, and *vice versa*, without stopping. A similar engine, but of larger size, is running at the Franco-British Exhibition. The set is supplied from one of the firm's No. 6 suction producers on the stand, using anthracite fuel. A smaller engine of 37 b.h.p., of the more familiar horizontal single-cylinder type, with magneto ignition, is also shown running. Compressed air for starting is supplied by a small compressor driven by a single-cylinder petrol engine, which compresses up to 150 lbs. per square inch, but starting can be carried out until the pressure falls to 80 lbs. per square inch. Another set shown is a small two-cylinder vertical engine, running on benzine, coupled to a Mather & Platt 8¼-kw. continuous-current generator, running at 700 r.p.m.



Crossley Four-Cylinder Vertical Gas Engine.

"Electrical Engineering."

203-206 Temple Chambers, London, E.C. (Stand No. 189.)

Electrical Engineering.—This stand is in a very central position in the hall, and the large illuminated sign attracts much attention to it. The sign is 18 ft. long and 6 ft. 6 in. deep, and bears in blue letters on dead white background a facsimile of the title, "Electrical Engineering," on the cover of the paper, with a bold 1d. on either side of it. Forty-eight 25-volt 16 c.p. Osram lamps are arranged in two rows at the top of the sign, and a large reflector casts the light down over it, so that the white surface is very brightly illuminated. A good proportion of the light also falls on the shelves on the front of the stand, upon which copies of Electrical Engineering are displayed. The walls of the stand and two screens provided for the purpose are hung with an interesting collection of pictures cut out from various numbers and framed. In a comfortable office in one corner of the stand the editorial work in connection with the exhibition is conducted, and visitors are always welcome there.

G. M. Boddy & Co., Newington Works, Liverpool. (Stand No. 198.) *Lamps.*—On this stand there has been erected an effective board with various types of lamps upon it, which can be connected up to a wattmeter on to a 200-volt D.C. circuit by means of 12 switches. Thus, for instance, he shows that two Sun tantalum lamps in series take 81 watts, a 200-volt 32-c.p. "Metalik" lamp takes 35 watts, that a 200-volt 100-c.p. "Metalik" lamp takes 98 watts, and a 16-c.p. carbon lamp 66 watts. Another exhibit of which the firm is proud is a 200-volt "Metalik" lamp fixed in a perfectly horizontal position on a bracket, and although it is continuously alight the filament does not sag.

The Bell Rock Belting Co., 24 Gravel Lane, Salford, Manchester. (Stand No. 270.)—This firm show samples of a variety of different kinds of belting of their manufacture, including a special quality of balata belting. This is made entirely from cloth, specially manufactured by the company themselves for the purpose, by which a particularly uniform quality can be obtained. The full amount of stretch of the material is obtained during manufacture, it being kept under tension during the whole process, so that when the belt is taken into use further stretching is impossible. A number of other patterns of belting are shown, including a solid woven cotton belting, and several varieties of leather belting.

J. W. & C. W. Phillips, 23 College Hill, Cannon Street, London, E.C. (Stand No. 3.)—This stand is devoted to examples of the recording instruments of the Bristol Co., for which Messrs. Phillips are agents. The instruments shown comprise recording pressure gauges, voltmeters, and ammeters of a particularly compact form, in which a circular revolving disc carries the card on which the record is made, instead of a continuous strip being used wound on a drum. This has the advantage that the whole record can be seen without removal from the instrument. The instruments are contained in the portion of the case below the dial, so that the pointer is in an almost vertical position.

The exhibits described in these pages represent only a few of those on view at the exhibition, and further articles will appear in following issues of this supplement, which will continue throughout October.

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ELECTRICAL ENGINEERING

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☞ **Manchester Exhibition Supplements.** With this issue, No. 3 of a series of five supplements describing the Manchester Electrical Exhibition is given *Gratis*. All readers should see that this supplement is included in their copy of to-day's "Electrical Engineering."

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PUBLISHERS' ANNOUNCEMENT

The price of "Electrical Engineering" has been reduced to 1d.

The first number of "Electrical Engineering" was published on January 3rd, 1907, and the paper immediately took the leading position among the electrical newspapers. A thoroughly sound and practical technical paper, written and edited by men with long experience on the practical side of the electrical engineering industry, and illustrated with useful drawings to scale and well-printed photographs, was welcomed, and in spite of the comparatively high price of 6d., which it was necessary to charge for it, the paper scored an immediate success. The proprietors were, however, repeatedly urged to reduce the price in order to bring the paper within the reach of a wider circle of readers, and they decided from October 1st last to place "Electrical Engineering" on sale throughout the United Kingdom at the popular price of 1d. weekly (post free 1½d.). The leading features of the Paper remain unaltered. No change has been made in the Editorial Staff, the same high-class printing and illustrations are maintained, and the proprietors rely absolutely on the enormous increase of circulation which is assured, to recompense them for the sacrifice they are making in decreasing the price.

SUMMARY

Our account of the exhibits at the Manchester Electrical Exhibition is continued in the third of our series of special supplements, which accompanies this issue.

A letter from Mr. G. Wilkinson, Borough Electrical Engineer, Harrogate, raises some important points to central station engineers in connection with the increasing adoption of metal filament lamps. Mr. Oswald B. Davis deals with the prevention of breakdowns similar to that which occurred recently at Lots Road. (Page 538.)

Some illustrations are given showing the nature of the apparatus at the Lot's Road generating station of the Underground Electric Railways, the breakdown of which caused the stoppage of four electric railways. (Page 539.)

The first heavy reversing rolling mill in this country to be electrically driven is one in the works of Messrs. Dorman, Long & Co., at Middlesbrough, which

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has been equipped by the Electrical Co. The rolls are directly coupled to a 1,200-h.p. continuous-current motor capable of working up to 3,600 h.p., supplied with current through an Ilgner flywheel set driven by a 950 h.p. three-phase motor. (Page 540.)

The machines manufactured by Messrs. Mawdsley's, Ltd., and known as the "Zone" dynamos and motors, have several unusual features in their design. In order to prevent distortion of the main field and the consequent excessive voltage between commutator segments, the main poles are divided into two halves. The field coils are so arranged as to extend over the whole pole pitch; and the influence of the sides of the coils, which lie parallel and close to the sides of the armature coils undergoing commutation, is said to considerably reduce the value of the current in the short-circuited coil, and further to reduce the reactance voltage. The mechanical construction of these machines is also of interest. (Page 541.)

The International Conference upon Electrical Units and Standards, called together by the British Government, commenced its sittings on Monday in London. Mr. Winston Churchill, M.P., welcomed the delegates, who represent thirteen countries, and Lord Rayleigh was elected President of the Conference. A Technical Committee was subsequently appointed to consider in detail draft specifications of the ohm, the ampere, and the volt. A resolution was passed by the Conference adopting the C.G.S. electro-magnetic system as the basis of measurement. In a discussion upon a further resolution that the international ohm shall be defined as the resistance of a specified column of mercury, Dr. Rosa, of the United States, suggested that the length should be specified as one metre. This point was referred to the Technical Committee on Tuesday, when it was negatived. The adoption of the ampere as the second primary unit was decided upon at the meeting of the Conference yesterday. (Page 543.)

An application has been made to the Burnley Corporation by the London Electrobus Company for permission to run a service of omnibuses in those parts of the borough where there is at present no tramway service.—The Cardiff Corporation contemplate seeking Parliamentary powers next session for wiring consumers' premises, hiring out motors, fittings, &c.—The use of trolley omnibuses is under consideration at Liverpool and Falmouth.—The proceedings in connection with the application of the Hove Corporation for a reduction in the charges made by the local electric supply company have been concluded, and a report will be issued by the Board of Trade shortly.—The National Electric Construction Company propose to introduce a Bill next session for the substitution of the overhead system for the surface contact system in Folkestone, Sandgate, and Hythe.—An offer has been made to the Oxford Corporation by the National Electric Construction Company for the installation of the conduit system in the centre of the town and the overhead system in the other parts, in substitution of the surface contact system originally proposed.—Mr. Arthur Wright has been appointed by the West Ham Corporation to advise in relation to the contracts for power which were the subject of comment at the recent Local Government Board inquiry. (Pages 545-547.)

A loan of £23,823 for electrical purposes has been sanctioned to the Coventry Corporation. A Local Government Board enquiry has been held into an application by the Sheffield Corporation for a loan of £11,000 for electrical purposes. The Dublin Corporation have applied for a loan of £4,000. Tramway material is required by the Leeds Corporation. The Walthamstow Council invite tenders for arc lamp carbons. Three double-truck tramcars are required at Southend. A large number of tenders have been accepted for tramway material by the London County Council during the recess. (Pages 548-549.)

The report of the Victoria Falls Power Company from the Incorporation of the Company in 1906 to December 31st, 1907, states that the surplus of revenue over expenditure, namely, £36,685, has been carried forward. The Power Station at Brakpan is completed and the construction of another steam generating station at Simmer Pan is rapidly progressing. (Page 549.)

Among the specifications published by the Patent Office on Thursday last is one by Mr. H. A. Mavor, describing a modification of his system of electric marine propulsion, and another suggesting a method of diminishing the rolling of ships. Messrs. Siemens Brothers Dynamo Works, Ltd., have patents referring to alternator armature winding and high-speed commutator construction respectively; and the British Thomson Co. protect an improvement in automatic motor starters. The satisfactory running in parallel of motors on petrol—electric, and other vehicles is the subject of a specification by Mr. W. H. Stevens. J. S. Pullan patents a compound tramway rail with renewable tread. The Telegraph and Telephone patents include a system of avoiding interference in wireless telegraph of A. M. Young and the Marconi Co., and a telephone relay of R. A. Fessenden. Short abstracts of these are given in our Patent Record. (Page 551.)

The Paper by Mr. C. Koetgen and C. A. Ablett on Rolling Mills, read before the Middlesbrough meeting of the Iron and Steel Institute, contained a quantity of data drawn from actual results with electrically-driven rolling mills, and considered a number of points in connection with the design and operation of electrically-driven rolling mills in the light of this experience. (Page 553.)

Under Electrometallurgy there appear notes on the electrolytic refining of gold, silver, &c., at the San Francisco Mint, and the preparation of steel for permanent magnets. (Page 553.)

The Board of Trade have issued a revised set of regulations under Section 4 of the Electric Lighting Act, 1888. These deal with the erection of overhead wires, where the owners are not subject to the provisions of a licence, provisional order or Special Act of Parliament. They supersede regulations previously in force, and there has been considerable revision. (Page 554.)

Novelties in the shape of a new ironclad switch and a new design of bell push are described on page 556.

The International Conference on Electrical Units and Standards which is now sitting has been convened by the British Government in response to a request made from America. The chief object may be said to be to extricate those countries which have adopted the Clark cell as a standard from the difficulty which has arisen from the discovery that its value is not 1·434 volts, but about 1·433. We are in no such difficulty, for the Board of Trade standard is an electrostatic volt meter calibrated by reference to the ampere and ohm. The eminence of the respective delegates will ensure thoroughness in the consideration of the questions at issue, but opportunities will no doubt be taken, as is usual in such meetings, for a certain amount of axe-grinding and faddism.

The Board of Trade Regulations, which we print in full on another page, do not apply to electricity undertakings working under Provisional Orders or

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Special Acts, but relate to the smaller number of undertakings, as a rule of comparatively small size, working without Provisional Orders or Special Acts, and therefore exempt from the provisions of the Electric Lighting (Clauses) Act and falling under Section 4 of the Act of 1888. They are in many respects identical with the first part of the 1906 regulations referred to—that is to say, the part which is for the purpose of securing the safety of the public; but the second part, "for ensuring a proper and sufficient supply of electrical energy" and dealing with the obligation to supply current continuously at constant pressure, frequency, &c., is not included, for the so-called "non-statutory" undertakings are not bound by these conditions. The sections of these new regulations to which particular attention may be directed are those relating to earthing and testing, as these represent the requirements of the Board of Trade in all cases, both for statutory and non-statutory undertakings, and are put in a more complete form than in the 1906 code.

THE reason for the adjournment of the debate upon the London Electric Power Bills in the House of Commons on Monday, once more emphasises the difficulties which the electrical engineering industry has to contend with at the hands of the legislature. Politics is again playing the leading part in deciding this question, for the objection of Mr. Lough, the member for West Islington, to the discussion being taken on Monday, the day appointed before the House rose for the recess in August, was suspiciously like the obstruction which was, in reality, the main cause of Mr. Merz's Bill of 1905 failing to become law. So keen is the opposition of the borough councils in London to any definite decision being arrived at, and so great is the pressure which is being brought to bear upon their local members to this end, that it would seem that the latter, in an effort not to irritate their constituents, and at the same time avoid quarrelling with the Government, will elect to adopt what are, in effect, obstructive measures, as the only way out of their difficulty. From the political point of view, the present position is much more complicated that it has been hitherto, for the London County Council are supporting the London and District Electric Power Bill, and the Government has given it a somewhat evasive approval, in face of which the position of the members of Parliament representing those authorities owning electricity works is distinctly an unenviable one. It is the action of these members which the promoters of the Bill have to fear most, in view of the length of time which a Committee must necessarily take to consider the measure and the short autumn session available. The opportunity for preventing Bills being considered upon their merits, which is afforded members, is a serious defect of our Parliamentary system.

THE enormous strides that have been made in the design of motor starters is very evident from even a casual stroll around the Manchester Electrical Exhibition. Before electric driving had assumed the important position it now occupies in engineering works, the man who had to start a motor was more or less of an expert—at any rate, when motor drive was the exception rather than the rule, it was possible to instruct each individual machine hand in his duties. Now, however, the whole conditions are different, and the motor-driven machine tool is the rule rather than the exception. There will, perhaps, be hundreds of motors with their main and starting switches throughout the works, and it is a necessity that the starting and stopping of the motors is a simple matter and leaves no possibility of injuring the motor if done carelessly. The whole design of motor switches has, therefore, undergone a radical change during recent years, and the modern "fool-proof" switch is one of the most perfect products of the electrical manufacturer. It is now made impossible to start the motor too quickly or to hold the starting switch on the starting contacts so as to use it as a regulating switch; in some designs the main switch and fuses are combined so that the case cannot be opened when the switch is on, and so that the main switch is always securely locked in the "off" position when the case is open. Other most ingenious devices have been contrived for special uses, and the whole design of the switches and cases is of a substantial pattern which represents an enormous advance upon the flimsy open types of starter to which one was accustomed in the earlier days of electric driving. The modern motor starter perhaps does as much to recommend electric driving to the average works manager than the most elaborate data with regard to the saving in coal and the speeding up of the machines and consequent increase in the output of the shops. An increased output, decreased coal consumption, and steadier drive would all be neutralised if it involved the frequent repair of motors due to improper starting.

Accident at the County of London Electric Supply Co.'s Station.—On Friday evening a fire broke out at the County of London Electric Supply Co.'s City Road generating station, which caused some damage to the switchboard and a portion of the roof of the power house. It is stated that a workman was slightly burned. The mishap caused a slight interruption to the supply in the district by that station. We have received from the company the following account of the occurrence:—"The operating engineer was in the act of synchronising a 400-kw. motor generator when an arc occurred on the switchboard. Immediately following this a short circuit occurred on the main panel of the 1,500 kw. turbo alternator, resulting in a section of the switchboard being completely burnt out, but the remaining portion of the switchboard was not injured, and we had therefore no difficulty in resuming the supply by at once starting up a reserve turbine set of 2,500 kw."

London Electric Power Bills.—When the second reading of the London Electric Supply Bill and the London (Westminster and Kensington) Electric Supply Bill was called on Monday in the House of Commons, objection was taken, and the consideration of the two Bills has been postponed, it is understood, until Monday next. It will be remembered that when the London and District Electric Power Bill was read a second time in August, the Bill was supported by a large number of Liberal members for the reason that the County Council did not propose to come forward with a scheme. There is a likelihood, however, that during the recess these members have changed their views, and that the Bills will now meet with a good deal of opposition. The President of the Board of Trade is understood to have in view a motion asking the House to confer powers of purchase upon the London County Council when the London and District Bill comes before Committee. In reference to the question of electric supply in London, Mr. C. Newton Russell, the Borough Electrical Engineer, of Shoreditch, and President of the Associated Municipal Electrical Engineers of Greater London, has sent a letter around to the Press, in which he calls attention to the extreme inconvenience and danger of supplying London from one large generating station, and instances the mishap at the Lots Road power station last week. On behalf of the Association he urges the re-introduction of the Supply of Electricity Bill put forward by the late Government in several sessions, which gives power to existing undertakers to associate for the purposes of mutual supply.

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ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, OCTOBER 15TH.

Rugby Engineering Society.

8 p.m. Meeting in the Benn Buildings, High Street, Rugby. Mr. A. F. Bennett, the President, will deliver his address on "Notes on the Progress of Steam Engineering."

FRIDAY, OCTOBER 16TH.

International Congress on Electrical Units and Standards.

Banquet by the Lord Mayor at the Mansion House to the delegates.

Incorporated Municipal Electrical Association.

Official visit to the Manchester Electrical Exhibition.

Electrical Contractors' Association.

Quarterly Business Meeting at the Manchester Electrical Exhibition.

SATURDAY, OCTOBER 17TH.

Incorporated Municipal Electrical Association.

Council Meeting at the Manchester Electrical Exhibition.

Electrical Contractors' Association.

"Propagandist" Meeting at the Manchester Electrical Exhibition.

Rugby Engineering Society.

Visit to the Manchester Electrical Exhibition.

MONDAY, OCTOBER 19TH.

International Electrotechnical Commission.

12 noon. Meeting at the Institution of Electrical Engineers, Victoria Embankment, for the election of a President in succession to the late M. E. Mascart.

"Dynamicables."

7.30 p.m. Dinner at the Franco-British Exhibition, when the delegates to the International Conference on Electrical Units and Standards and the International Electrochemical Commission will be entertained.

THURSDAY, OCTOBER 22ND.

Institution of Electrical Engineers.

7 for 7.30 p.m. Annual dinner at the Hotel Cecil.

International Conference on Electrical Units and Standards.

Meetings of the International Conference on Electrical Units and Standards will be held on Friday, October 16th, and again on Wednesday, October 21st. The Technical Committee meet again this morning, and also on Monday and Tuesday, October 19th and 20th.

CORRESPONDENCE

THE ACCIDENT AT CHELSEA GENERATING STATION.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—The report of the mishap at the Lots Road generating station of the Underground Electric Railways Co. of London, and your leading article thereon, supply food for much consideration as to the efficiency (as regards reliability of supply) of the many large power stations now in use or in course of erection. You give as your opinion that sectionalisation of the system, however complete, never renders a station immune from temporary breakdowns. Whilst not disputing this statement, I would point out that a small alteration in the arrangement of the oil-switches would have certainly prevented such a mishap as occurred on the 3rd inst. It is obvious that, had the oil-switch above the defective transformer not been rendered useless by the short-circuiting of its leads, the sphere of action of the primary accident would have been entirely locally confined. Such a condition would undoubtedly have been realised, had the entering and leaving cables been completely separated by passing into and out of the switch compartments at opposite ends. I would also remark that, in the case of power systems possessing several inter-connected stations running in parallel, sudden transference of load, especially such a load as 25,000 kw. at 11,000 volts, from one station to another is very apt to cause surges throughout the whole system. Some of the American, and, at least, one of the English power companies have suffered severely from surges of this kind, and the remedy to complete "shut-downs" which you suggest may therefore be worse than the disease.

Yours truly,

OSWALD B. DAVIS.

HEATON, NEWCASTLE-ON-TYNE,
Oct. 13th, 1908.

METHODS OF CHARGING FOR LIGHTING CURRENT.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—The advent and rapid introduction of metallic lamps in place of carbon lamps is resulting in greatly reduced consumption of electricity by individual consumers. In those towns where authorities and undertakers are largely dependent on revenue from current supplied for lighting purposes they are face to face with a difficult and somewhat serious problem. Not much has hitherto been said or written upon this subject, and it will be interesting to have information from various authorities as to how far their business has already been influenced and prejudiced by the use of the new lamps, and especially what steps are being taken to meet the temporary loss of profit. The difficulties of the situation are increased by the fact that many meters which have been in use for years registering current to carbon lamps are too large and not sufficiently sensitive to measure the reduced amount of current required for metallic lamps. For this reason there must be many instances where a small number of lamps (which are generally the long hour burning lamps) will not operate the meter at all; especially is this the case on alternating current supply mains where low voltage auto-transformers are used and left on the mains continuously. These transformers, giving, say, 25 volts, can be bought up to ·8 kwt. capacity, taking not more than 10 watts excitation on open circuit, and there must be many thousands of meters in use which are not capable of measuring this small amount of energy, with the result that the supply authorities are presenting the excitation energy to the user free of charge. Again, the revenue from consumers, by the introduction of metallic lamps and low voltage transformers may be reduced to, say, one-third the average amount obtained from carbon lamps; in face of this reduced revenue it will not pay the supply authority to take out the large and obsolete meters and replace them with meters of modern type; nor will new installations (especially in the case of small tenements) warrant any additional expenditure for meters or demand indicators if a profit is to be earned on the transaction. Thus the supply authorities are up against the pressing question as to how consumers who are small users of electricity are to be supplied at a profit, and the only sound business method appears to be to supply such consumers on fixed tariffs, such fixed tariffs to include the quota of standing charges plus the running costs based on an assumed maximum time of use, per day. Such a system secures the supply authorities from loss in every case, while the fact that the consumer has to-

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furnish his own lamps—which are somewhat expensive—is a guarantee that he will not use his electric light wastefully. This system calls for a current limiter of a simple and cheap description, which ought to be purchasable for something less than 10s. each. To secure new consumers rapidly the existing regulations with regard to services, charges, double pole switches, cut-outs, and especially the stringent regulations in force as to wiring will have to be modified and brought into line with present day requirements, and it appears to me it is only upon these lines that the industry can hope to continue to flourish and make headway amongst all classes of consumers.

With a view to inaugurating a system of charging by contract I have instituted careful enquiries for a suitable current limiter and have succeeded in getting propositions from two firm only, both German, and investigations so far have not shown their instruments to be particularly well adapted for the work in view either as regards simplicity or cost. So far as my experience goes I forecast a healthy demand for such instruments in the near future, and shall be glad if this letter will result in manufacturers giving attention to their design and production. I also hope that my communication will elicit the views and experience of my colleagues on the points raised, which I submit are at the present time of vital and pressing importance.

Yours, &c.,

GEO. WILKINSON

Harrogate,
October 9th, 1908.

THE ACCIDENT AT THE GENERATING STATION OF THE LONDON UNDERGROUND RAILWAYS

ON page 524 of our last issue we described the breakdown which occurred on Saturday, October 3rd, at the generating station of the Underground Electric Railways Co., of London, at Lot's Road, Chelsea. The nature of the gear which was affected

FIG. 1.—VIEW SHOWING BRICK CHAMBER CARRYING GENERATOR CABLES TO OIL SWITCH CHAMBER ON FLOOR ABOVE.

will be made clearer by the accompanying illustrations, which are reproduced from photographs kindly sent us by Mr. J. R. Chapman, chief engineer to the company. The relative position of the apparatus in question can be seen from Fig. 1, which is taken from the main engine-room floor, where the turbo-generators are situated. The main 11,000 volts cables from each 5,000 kw. generator pass up from the floor in separate channels in the vertical brick pillar seen in the illustration to the main motor-operated generator oil switches on the first floor of the switchboard galleries. The main bus bars are in chambers on the second floor, not shown, and the feeder oil switches are on the third or top floor. All the feeders are provided with static dischargers of the non-arcing multi-gap type in the compartments shown in Fig 1 on the same floor as the main generator oil switches.

The current transformers, to the breakdown of one of which the accident was primarily due, are fixed to the cables within the pillar already mentioned, and are shown in Fig. 2. The arc and flame from the explosion of one of them drove through the porcelain tube insulators, through which they are taken through the concrete floor to the switch above, and short-circuited the cables leading to and from it. It speaks well for the construction of the switch, which was supplied by the British Thomson-Houston Co., that it was ready for service again the next morning. The resulting heavy surge caused all the feeder static dischargers to come into action, and these amply fulfilled their function of preventing damage to other apparatus on the system, although they were not able to recover after the heavy discharge, as they mostly bridged over and then remained earthed, so that the whole station had to be shut down. One of these static discharger panels is shown in Fig. 3. They are each 5 ft. long and have eight gaps of 0·0047 in. each and a carbon

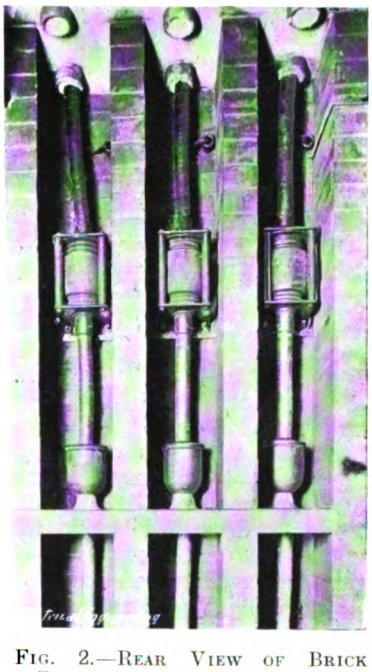

FIG. 2.—REAR VIEW OF BRICK CHAMBER CARRYING GENERATOR CABLES SHOWING SERIES TRANSFORMERS, EARTH STRIPS AND SECONDARY LEADS TO CONTROL BOARD. TRANSFORMER ON RIGHT-HAND PHASE FAILED.

FIG. 3.—STATIC DISCHARGE PANELS ON FEEDER CABLES. ASBESTOS BOARD COVER REMOVED.

resistance rod $\frac{3}{4}$ in. diameter and 33 in. long with a resistance of 0·375 megohm; 186 of these panels were affected and the clearing of the gaps naturally was a work of time.

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AN ELECTRICALLY-DRIVEN REVERSING ROLLING MILL

THE first heavy reversing rolling mill in this country to be electrically driven is that at the works of Messrs. Dorman, Long & Co., at Middlesbrough, which has been equipped by the Electrical Co., Ltd., upon the Ilgner system, and which was inspected by the members of the Iron and Steel Institute during the meeting at Middlesbrough. The general principle of the Ilgner system of load equalisation by means of a flywheel is well known in connection with winding engines for mines, but it is equally suitable for other applications of power where the maximum considerably exceeds the normal load, and the peaks are of short duration. Briefly, the system consists in the employment of a motor generator coupled to a heavy flywheel switchgear. The field of the rolling mill motor is excited from the same exciting set, and remains constant except for the small variation mentioned below.

From the diagram of connections given below, the arrangement of the essential parts of the equipment can be seen. It will be noticed that the exciting set includes an additional generator, the field of which is excited by the main motor current. The object of this is to give a certain amount of compounding effect to both the generator and rolling mill motor fields by means of the auxiliary windings shown, and allows of a decrease of speed on sudden overloads, so as to keep the current within the limits for which the circuit-breakers are set.

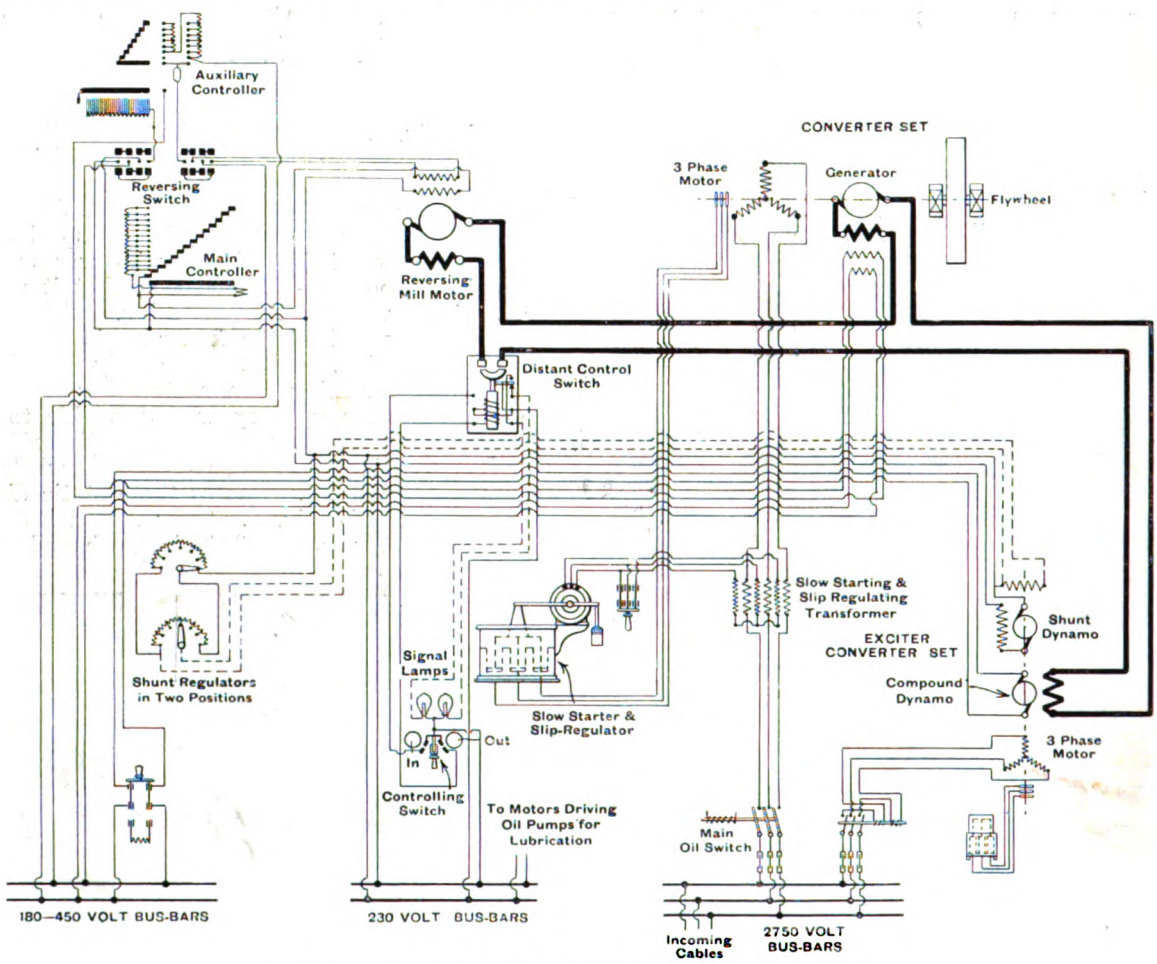

Diagram of Connections of Reversing Rolling Mill.

driven from the usual constant voltage supply, in this case alternating, and delivering continuous current to the rolling mill motor. The speed of the set is controlled by an automatic device described below, which causes it to slow down and give out energy when the load is heavy and regain its speed by absorbing energy when the demand for power is light. In this way, the demand from the power station can be kept steady, although enormous overloads can be negotiated. It is usual in most varieties of the system to control the voltage applied to the brushes of the rolling mill motor, and, therefore, its speed, entirely by varying the field of the generator attached to the flywheel in the way originally suggested by Ward Leonard. This is done in the present case, and the whole of the starting, stopping, and reversal is done by control gear in the generator field circuit, which is supplied from an auxiliary motor generator. The armature circuit of the rolling mill motor is thus practically without

One of the most important parts of the equipment is the "slip regulator," by which the speed of the motor driving the flywheel set is controlled. This consists of a variable resistance in the rotor circuit of the induction motor, which alters the amount of slip between its speed and that of synchronism, according to the speed required. The "slip regulator" consists of a liquid resistance, automatically governed by the "regulating motor." The liquid resistance consists of a tank filled with acidulated water, kept cool through circulation, into which three plates, the electrodes, dip. In their lowest position the electrodes are short-circuited. The electrodes are movable, on a shaft, and their weight is nearly balanced by a counter weight. The armature of the regulating motor, mounted on the same shaft as the electrodes, is movable through a certain number of degrees, and immerses them more or less in the liquid, as required. The rotor circuit of the three-phase motor of the

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Ilgner set is connected to the three electrodes, and thus, through the action of the slip regulator, varying resistances are introduced into the rotor circuit, decreasing or increasing the speed of the motor. As long as the current in the mains remains below a certain value, the torque of the electrodes on the slip regulator shaft is greater than the torques of the counter weights and the regulating motor, but, a heavy load coming on, and the maximum value of the current in the mains being reached, the torque of the regulating motor overcomes the other torques, and the electrodes are slowly lifted, introducing resistance in the rotor circuit, and causing the flywheel to slow down and give up some of its stored energy. Conversely, when the demand is less than the normal for which it is set, resistance is cut out, and the flywheel allowed to regain its normal speed. The current demand from the mains is, therefore, kept practically constant, though the load on the rolling mill varies within very large limits.

The rolling mill motor at the Dorman, Long & Co. wire mills will momentarily develop upwards of 3,600 h.p., but the demand from the mains will be kept constantly at 950 h.p.

It should be pointed out that the actual number of units consumed per ton of rolled material will be slightly more than if the rolling mill motor were connected direct to the mains, but especially in case of a three-phase supply, the advantages of the system, as regards the control system and the equalisation of the demand, more than counterbalance this.

At Messrs. Dorman, Long's works, to which this system has been applied, the rolling mill contains two housings, with 16-in. rolls, and is built for rolling angles and small girders. The mill is directly coupled to the mill motor, a compound-wound continuous-current motor of 1,200 h.p., normal, and 3,600 h.p., maximum output, 600 volts, running at speeds up to 160 revolutions per minute; the maximum torque of the motor is 232,000 foot pounds.

The Ilgner set is situated near by, and consists of one three-phase motor of 950 h.p. continuous output, 2,750 volts, 40 periods, coupled directly to a continuous-current dynamo of 1,250/3,600 h.p. output, 600 volts. The two flywheels, each of 20 tons, are mounted on a separate shaft connected through a coupling to the motor generator shaft. By this arrangement it is possible to disconnect the flywheels in case they are not needed, i.e., if the maximum demand of the rolling mill motor at a certain work does not exceed 950 h.p. The Ilgner set runs at a maximum speed of 400 revolutions per minute, which speed is decreased by the automatic slip regulator to about 350 revolutions per minute.

The current for driving the set is taken from the mains of the Cleveland & Durham Electrical Power Distribution Co., Ltd.

The flywheel dynamo is provided with compensating coils on the Dèri system for the purpose of reducing the armature distortion, and thus securing an absolutely sparkless commutation at all loads with a fixed brush position.

The bearings of the flywheel shaft are water cooled, and the flywheels are housed in a massive sheet-iron case, in order to reduce the air friction, and accordingly the losses of the Ilgner set. All bearings are of the ordinary bush type, lined with white metal, and of very substantial dimensions, reducing the pressure per square inch to a very low figure. The lubrication is supplied by oil under pressure from either motor-driven pumps or a highly placed tank, to which the oil is conveyed by motor-driven pumps. In case of emergency, hand-pumps substitute the motor-driven ones. An electric alarm is provided which calls the attendants' notice should the oil supply fail.

In order to start the Ilgner set with its heavy masses, a special barring gear is provided consisting of a 15-h.p. motor with necessary gear, this being cut off automatically when the Ilgner set reaches a speed of three revolutions per minute. The flywheels, which are each of 14-ft. diameter, are equipped with a powerful water-cooled brake for the quick stopping of the set.

The exciter set consists of one three-phase motor, 80 h.p., 2,750 volts, 40 periods, coupled directly to two continuous-current dynamos, of which one serves to excite the fields of the dynamo and the mill-motor, and the other feeds a special compound winding, as already explained. The elevated operating platform, with the controller, is situated in full view of the mill. The control is effected by a single lever, and a small switchboard contains the necessary instruments.

THE MAWDSLEY ZONE DYNAMOS AND MOTORS

DURING the last few years, the weight and price per horse-power of both dynamos and motors have been considerably reduced, and this without any radical change in design. The reduction in weight has been obtained partly by more careful design, particularly with regard to the better proportioning of parts and windings, partly by improved methods of ventilation, and partly by increasing the permissible temperature rise. This reduction in the weight of the material employed permitted a reduction in price, and this latter no doubt has been furthered by the use of more economical methods of manufacture. In the case of continuous-current machines, the improved methods of ventilation were so effectual that a point was reached where, instead of heating being the limiting factor, it became necessary to adopt some expedient so as to avoid commutation troubles. The result of this was that interpoles were introduced. Interpoles, while considerably improving commutation, have, however, the disadvantage of increasing the number of parts in the machine, and of restricting ventilation. Furthermore, they do not prevent the distortion of the field due to armature reaction, which is accompanied with consequent excessive voltage between adjacent commutator segments and risk of "flashing over."

In the ordinary type of continuous-current machine, successful commutation may be obtained by reducing the self-induction or reactance voltage of the armature coils undergoing commutation.

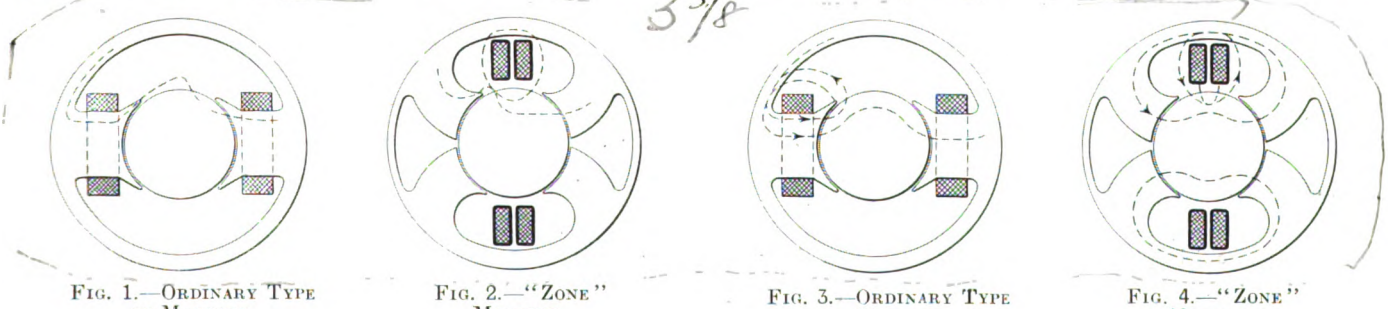

Fig. 1.—Ordinary Type of Machine.

Fig. 2.—"Zone" Machine.

Diagrams Illustrating the Distortion of the Main Field due to Armature Reaction.

Fig. 3.—Ordinary Type of Machine.

Fig. 4.—"Zone" Machine.

Distribution of Leakage Flux.

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or by artificial reversal of the current in these coils either by commutating in the fringe of the main pole or by the use of auxiliary or interpoles. The reactance voltage may be reduced by decreasing the number of turns of armature winding per commutator segment, and by shortening the length of the armature coil, especially that portion which is embedded in the iron of the armature core. As in practice not less than one complete turn per segment can be used and a certain length of core is necessary, it is obvious that a point is soon reached where it is impossible to still further reduce the reactance voltage by these means.

With regard to the second of the above methods, it is stated in most text-books that the brushes of a dynamo must be moved forward so that the magnetic fringe from the trailing pole tip may generate a reversing E.M.F. in the short-circuited armature coil. With carbon brushes, however, the advantage of this brush movement is not so much that the commutating zone is moved into a reversing field as that it is moved away from the flux from the leading pole, which owing to armature reaction is distorted in such a way that it, as it were, invades the commutating zone, which should be kept strictly "neutral." This flux, of course, increases the current in the short-circuited armature coil, with the result that there is sparking at the brushes. If this distortion could be prevented, "brush commutation," or the choking effect of the film between carbon brush and commutator surface would be sufficient in most machines to give sparkless running.

The type of machine manufactured by Messrs. Mawdsley's, Ltd., of Dursley, and known as the "Zone" dynamo, is designed so as to reduce the self-induction of the armature coils undergoing commutation, and also to prevent injurious distortion of the field. The field poles are usually cast solid with the yoke-ring, so as to save machining, laminated poles only being used in certain special cases. As will be seen in Figs. 2 and 5, they are bifurcated. This bifurcation has the effect of greatly throttling the cross flux due to the armature ampere-turns, and incidentally of shortening the path of the main flux, thus reducing the number of ampere-turns required for excitation. The field coils are wound so that the portion between the poles lies close to and parallel to the armature coils undergoing commutation. By this arrangement it is said that the field coil acts in a similar manner to the closed secondary of a transformer, reducing or choking the current flowing in the armature coil during the time it is short-circuited by the brush, or, in other words, reducing the self-induction and reactance voltage. We are informed that it has been found possible in these machines to commutate successfully with (calculated) reactance voltages three to four times higher than those considered permissible in the ordinary type of machine.

A further advantage is claimed in that injurious distortion of the field is prevented owing to the main field or magnetomotive force acting directly in the neutral zone instead of on each side. It is obvious that it is practically immaterial what path the lines of force take outside the neutral zone, whereas in the zone itself it is of the very greatest importance, and the controlling force should undoubtedly be at this point. The flux distortion in the ordinary type of machine is shown in Fig. 1, and in the Zone machine in Fig. 2. It will be seen that in the latter case the invasion, as it were, of the distorted field is repelled by the main field and the neutral zone kept "neutral."

Another advantage is claimed from the fact that in the ordinary machine magnetic leakage from the armature is disadvantageous and detracts from the flux efficiency, as shown in Fig. 3, whereas in the "Zone" system the space between the pole and the coil is practically added to the polar surface, as can be seen from Fig. 4, thus increasing the flux efficiency. In some sizes this increase in efficiency amounts to about 10 per cent., the wasteful magnetic leakage being practically nil. It will be seen that there is a certain flux in the teeth surrounding the short-circuited armature coils, the field coil acting in this respect as an interpole, without the disadvantages associated with an iron interpole, namely, increased magnetic leakage and reactance voltage.

Owing to the greatly increased stability of field and the prevention of distortion, these machines are specially adapted for high speeds, and where it is necessary to run with weak fields, as in the case of variable-speed motors. It is also unnecessary to increase the number of poles in order to reduce the armature ampere-turns per pole. This alone allows of considerable economies in copper and cost of construction. Messrs. Mawdsley's, Ltd., make machines up to 15 h.p. bi-polar, and over that size multi-polar, the 250 h.p. size having six or eight poles, according to voltage. The bi-polar type for small sizes has many advantages over the multi-polar form, not only as regards cost of manufacture and simplicity, but also as regards the brush gear.

It will be seen from the drawings in Fig. 5 that ventilation

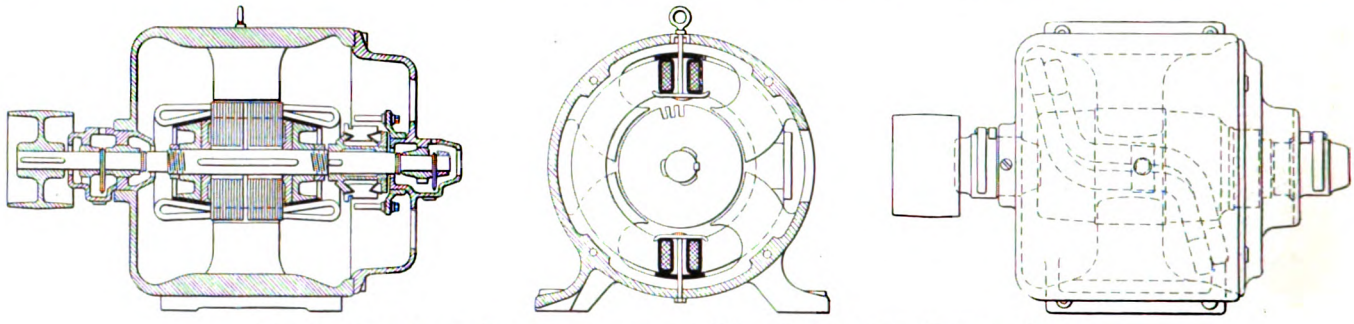

Fig. 5.—Method of Construction of the "Zone" Two-Pole Magnetic System.

Fig. 6.—Totally Enclosed "Zone" Motor.

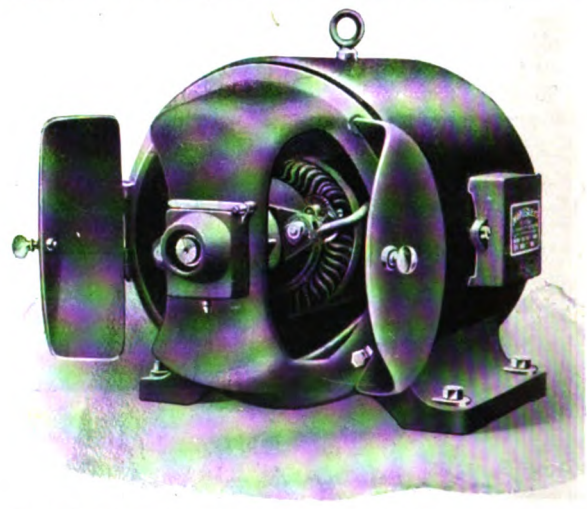

Fig. 7.—Totally Enclosed "Zone" Motor (Covers open.)

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is well provided for, owing to the field coils being surrounded by air and to the large space in the centre of the field pole. It is also possible to use low inductions and large airgaps without unduly increasing the manufacturing cost, this resulting in quiet and cool running machines. Two views of a complete totally enclosed bi-polar motor are given in Figs. 6 and 7. In the latter the covers are shown open. On account of the fixed position of the neutral zone, practically sparkless commutation with fixed brushes at all loads is obtained. Indeed, we are informed that the machines will run sparklessly with a lead of the brushes in the case of motors and a lag in the case of dynamos, thus permitting a 50 per cent. speed variation by merely moving the brushes. We have also been informed that practically sparkless collection has been obtained from this type of machine with a ratio of field to armature ampere-turns of only 0·6, and a calculated reactance voltage of 9·2.

INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS

THE International Conference upon Electrical Units and Standards, which has been called together by the British Government, commenced its sittings on Monday in the rooms of the Royal Society at Burlington House, Piccadilly, London. As stated in our last issue, when the full list of delegates was given, the main object of the Conference is to obtain international agreement on the three electrical units, the ohm, the ampere, and the volt, so that the realisation of these units in all the countries of the world shall be as nearly as possible identical. The Secretaries to the Conference are Mr. W. Duddell, F.R.S., and Mr. M. J. Collins, of the Board of Trade.

The proceedings were opened by an introductory address by Mr. Winston S. Churchill, M.P., the President of the Board of Trade.

Mr. CHURCHILL said that 14 years had passed since the last International Congress, at which definite resolutions were passed as to electric units. The resolutions of Chicago in 1893, based as they were upon the conclusions reached at Edinburgh in the previous year, had formed the starting point of legislation in various countries. The 14 years that had elapsed had seen many changes in the science of electric measurement, and our knowledge had so greatly increased that specifications and definitions which were thought to be accurate 14 years ago, or at any rate sufficiently accurate for practical purposes, had been shown—at least, so far as one of the important units is concerned—to be palpably in error: at the same time, the demand for exact measurement had become more vehement, and the need for uniformity of standard not merely in any one country, but throughout the civilised world, had become clear and urgent. Mr. Churchill then referred to the deaths among leaders in the science of electric measurement which had taken place since the Chicago Congress, and made special mention of Kelvin and Mascart. The present Conference, he continued, owed its inception to the resolution passed at St. Louis in 1904. That resolution not only confirmed the necessity for a more practical and perfect uniformity of electrical standards through the labours of an International Commission, but further expressed the hope that that Commission might ultimately be preserved in a permanent form. His Majesty's Government had responded with precision and cordiality to the proposal to convoke an International Conference in London, and the result of their invitations had been most gratifying, every country of importance in the civilised world having sent its foremost workers in the branches of science concerned. The function of the Conference was to define in clear and accurate expression those scientific quantities in terms of which electric energy was bought and sold, and, if possible, to embody its conclusions in draft articles which might form the basis of legislation and administration so far as electric units and standards are concerned. They must not rest satisfied merely with providing that the electric standards of the world shall be identical in 1908; their steps must be directed towards securing a permanent uniformity. The changes required were, however, small. They had only to make exquisite and harmonious adjustments of an international system of units and standards, which had already almost an international language of its own. The first duty of a Conference of this nature was to determine its rules of procedure. On this point they had the precedent of the recent Conference on Wireless Telegraphy at Berlin to guide them. The draft rules of Procedure which had been circulated among the delegates were based on those accepted at Berlin with merely those changes which were requisite to adapt them to the present Conference.

On the suggestion of Mr. Churchill, these rules were adopted. The principal object of these rules is to regulate the procedure of the meetings and deal with the voting power.

Mr. CHURCHILL, continuing, said that, in accordance with the rules just adopted, and as representing His Majesty's Government which has summoned this Conference, he nominated Lord Rayleigh, President of the Royal Society of London, as President of the Conference.

Lord Rayleigh having taken the chair, the following vice-presidents were elected:—

Dr. W. S. Stratton, Director, Bureau of Standards, Washington; Dr. Viktor Edler von Lang, President of the Commission of Weights and Measures, Vienna; Professor S. A. Arrhenius, Nobel Institute, Stockholm; M. Lippmann, Member of the Institute and Professor at the Sorbonne; Dr. Warburg, President of the Imperial Physico-Technical Institute (Germany); M. Egerow, D.Sc., Director of the General Chamber of Weights and Measures.

The next business was to appoint a Technical Committee, provided for in the rules of procedure. This Committee has the duty of considering in detail draft specifications of the ohm, the ampere, and the volt, after the Conference has accepted the principle of certain resolutions on these measurements. The following is the list of delegates elected to the Committee:—

Dr. S. W. Stratton, Director, Bureau of Standards, Washington; Dr. Henry S. Carhart, Professor of Physics at the University of Michigan; Dr. E. B. Rosa, Bureau of Standards, Washington; Monsieur Gerard, Director of the Montefiore Electro-Technical Institution, and President of the Consultative Commission on Electricity; Prof. S. A. Arrhenius, Nobel Institute, Stockholm; Monsieur Lippmann, Member of the Institute and Professor at the Sorbonne; Dr. Warburg, President of the Imperial Physico-Technical Institute; Dr. Jaeger, Member of the Imperial Physico-Technical Institute; Dr. Lindeck, Member of the Imperial Physico-Technical Institute; the Right Hon. Lord Rayleigh, President of the Royal Society; Dr. R. T. Glazebrook, Director of the National Physical Laboratory; Mr. A. P. Trotter, Electrical Adviser to the Board of Trade; Prof. Antonio Roiti, of Florence; Dr. H. Haga, Professor at the University of Groningen; Dr. Fr. Weber, Professor at the Swiss Polytechnic School at Zurich; Prof. Threlfall, Australia; Major P. Cardew, Electrical Adviser to the Crown Agents for the Colonies; Dr. Nerville; Dr. Benoit; Monsieur Egerow, D.Sc., Director of the General Chamber of Weights and Measures; Dr. Pierre Chappuis, Basle; Dr. Kusminsky, Inspector of Commission of Weights and Measures, Vienna. Subsequently Dr. Osuko Asano, Official Expert of the department of Communication, Tokyo, and M. Clément, Secretary of the Consultative Commission on Electricity, were elected for Japan and Belgium respectively.

The meetings of this Committee may be attended by all the delegates, who may take part in the discussions, but only the members of the Committee have the right to vote.

On Monday, the agenda concluded with the consideration of the principle of certain regulations relating to the first primary standard, the ohm. Before dealing with these, however, we give the text of a specification for the international ohm which has been circulated among the delegates as forming a basis for discussion, and also some historical information on the subject.

SPECIFICATION OF THE INTERNATIONAL OHM.

The International Ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross-sectional area, and 106·300 centimetres in length, arranged in accordance with the following specification.

The column of mercury shall be of circular section, or nearly so, and shall be contained in a tube of suitable glass which has been carefully annealed. The tube shall be straight to the eye, and the maximum variation in its area of cross section shall not

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exceed 2 parts in 100. The tube is to be carefully calibrated and the correction for its conicality determined.

In determining the weight of mercury contained by the tube when filled at the temperature of melting ice, the column of mercury is to be bounded by planes at the terminal cross sections of the tube. The tube should not be unduly heated, and it should be filled with mercury by exhaustion of air.

The axial length of the tube should be measured at 0° C., if possible, otherwise the coefficient of expansion of the glass should be determined and the axial length of the tube at 0° C. calculated from axial measurements made very near to that temperature. To facilitate measurements of the axial length, the ends of the tube should be ground very slightly convex.

For the electrical measurements the ends of the tube are to be connected to spherical bulbs of glass; the slightly convex ends of the tube form approximate portions of the internal spherical surface of the bulbs. Each bulb is to be provided with current and potential leads, the point of entry of the former being at the opposite end of a diameter of the bulb from the end of the tube. The potential lead shall be situated in a plane midway between the point of entry of the current lead and the end of the tube, and at right angles to the line connecting them.

Contact with the mercury shall be made by means of platinum wires.

The diameter of a bulb is to be from 30 to 33 times the diameter of that end of the tube to which it is connected.

If L is the axial length in centimetres of the mercury column contained by the tube at 0° C., W the weight of the column in grammes, and c the conical factor for the tube, the resistance of the column at 0° C. is

$$c\,\frac{L^2}{(106{\cdot}300)^2}\cdot\frac{14{\cdot}4521}{W} = 0{\cdot}001278982\,c\,\frac{L^2}{W}\text{ international ohms.}$$

When the spherical bulbs are fitted to the ends of the tube and the whole filled with mercury, if r is the mean radius of the tube and r_1, r_2 the mean radii in centimetres of the terminal sections, the resistance at 0° C. between the potential leads is

$$0{\cdot}001278982\,\frac{L^2}{W}\left\{c + \frac{0{\cdot}80r^2\left(\frac{r_1+r_2}{r_1r_2}\right)}{L}\right\}\text{ international ohms}$$

correct within one per cent of the added resistance

$$0{\cdot}001278982\,\frac{L}{W}\left\{0{\cdot}80\,r^2\left(\frac{r_1+r_2}{r_1r_2}\right)\right\}$$

The electrical measurements are to be carried at 0° C., the tube and spherical vessels being surrounded by melting ice and about 15 centimetres below the upper surface of the ice. The connecting wires employed for the current and potential leads must be thin, so that the flow of heat through them to the mercury shall be insufficient to warm the mercury so as to produce appreciable error.

The insulation resistance between the mercury column and the ice surrounding the tube must not be less than ten million ohms.

The current employed in comparing the mercury resistance with other resistances shall be limited by the condition that the mercury shall not be warmed sufficiently to produce appreciable error.

The mean of at least five tubes must be taken to determine the value of the mercury unit.

The mean of at least three fillings shall be taken as the value of the resistance of a tube.

The Ohm (10⁹ C.G.S.) and the International Ohm.

At the International Congress of Electricians held in Paris in 1881, the C.G.S. system was first internationally adopted for electrical measurements, and it was resolved that the ohm should be represented by a column of mercury, 1 sq. mm in section at 0° C., the length of the column being left for a Commission to determine.

The next International Conference for the determination of electrical units was held in Paris in 1882, but the Commission was not then able to fix the numerical value of the ohm in terms of the mercury column.

In 1884 the International Conference at Paris resolved that the "legal" ohm is the resistance of a column of mercury of 1 sq. mm. cross section and 106 mm. in length at 0° C. The mean of 15 values for the length of the mercury column was 105·97 cm.

In 1893, at the Chicago Congress, the length for the mercury column was stated as 106·3 cm., and the mass of mercury filling the tube at 0° C. was given as 14·4521 grammes. Within a few parts in 100,000 the cross section at 0° C. of such a tube is certainly 1 sq. mm.

Since the Chicago Congress, Austria, Canada, France, Germany, Great Britain, and the United States have legislated on the ohm. The Austrian and Canadian definitions are practically the same as that at Chicago. In Austria it is stated that the ohm "may be considered equal" to a particular column of mercury.

The first resolution put before the Conference was proposed by Mr. A. P. Trotter, Electrical Adviser to the Board of Trade, and read as follows:—

"The Conference agrees that, as heretofore, the magnitudes of the fundamental electric units shall be determined on the electro-magnetic sytem of measurement with reference to the centimetre as the unit of length, the gramme as the unit of mass, and the second as the unit of time.

"These fundamental units are (1) the Ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the Ampere, the unit of electric current which has the value of one-tenth (0·1) in terms of the centimetre, gramme, and second; (3) the Volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gramme, and the second."

Mr. Trotter, in proposing this resolution, said that the C.G.S. system was so universally accepted in electrical science and in the electrical industry that the ohm, the ampere, and the volt occupied a position of a more fixed and international character than was enjoyed by any other unit of measurement; more fortunate, even, than the metre and the kilogramme, in that they had no rivals. The system was a foundation worthy of supporting the monument which had been raised to the great men whom we honoured by recalling the names of Ohm, Ampere, and Volta.

The resolution was then put to the Conference and carried unanimously.

Mr. Trotter next proposed the following, which was read in conjunction with the previous resolution:—

"As a system of units representing the above, and sufficiently near to them to be adopted for the purpose of Trade and Commerce, the Conference recommends the adoption of the International Ohm, the International Ampere, and the International Volt defined according to the following definitions."

As a decision on this depends upon the result of other resolutions to come, voting upon this resolution was postponed.

Dr. Warburg (Germany) then put the two following resolutions before the Conference:—

"The International Ohm shall be defined as the resistance of a specified column of mercury."

"The International Ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross-sectional area, and of a length of 106·300 centimetres. To determine the resistance of a column of mercury in terms of the International Ohm, the procedure to be followed shall be that set out in Specification A attached to these resolutions." [This latter refers to the specification given above.]

Dr. E. B. Rosa (United States) moved that the length of the mercury column should be 1 metre, and that the amount of mercury employed should be 12·7898 grammes, so that the resistance to the column should be the same as that proposed in Resolution IV. In support of this amendment it was pointed out that this would bring us back to the length of the Siemens unit. It is probable that if Siemens had specified the weight of the mercury instead of the cross section of the tube we should never have changed from 100 cm. to the present 106·3, and, further, that if in the future it should be necessary to alter the international ohm it would only be necessary to change the mass of mercury, and not the length and the mass as is necessary with the present definition. In any case, he suggested that the point should be referred to the Technical Committee. The British and German delegates objected to the change, but, on a vote, the matter was referred to the Technical Committee by 16 votes to 5, Great Britain voting against, two countries not voting.

On Tuesday, the Technical Committee, of which Dr. R. T. Glazebrook has been appointed chairman, met at Burlington House, and considered in detail the specification of the ohm given above. The final result of their deliberations will be presented in the form of a report at the close of the conference. The suggestion by Dr. Rosa that the specified length of the column of mercury should be one metre, as set out above, was considered, but eventually the Committee negatived the proposal.

On Wednesday the meeting of the conference was taken up with a discussion of the following resolution, which was proposed by Dr. Glazebrook, and seconded by Dr. Warburg: "That the ampere is the second primary unit." In proposing this resolution, Dr. Glazebrook emphasised the superiority of the silver voltameter as an instrument for primary determinations over any form of standard cell.

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Professor Lippmann introduced a counter proposal recommending the volt as the second primary unit as determined by the Weston cell in accordance with a detailed specification which he brought forward. The American delegates also spoke in support of this counter-proposal and the discussion was continued at considerable length. Finally, however, Professor Lippmann's proposal was negatived and the motion adopting the ampere as the second primary unit was carried.

Further resolutions regarding the exact definition of the ampere and the use of the Weston cell as a secondary standard were adopted subject to a modification in the latter, to consider which a special meeting of the Technical Committee was held in the afternoon.

On Monday the delegates were entertained at dinner at 6.30 p.m. by the President and Members of the Royal Society Club, and at 8.30 p.m. they attended a reception by the President and Council of the Royal Society. Visits were paid on Tuesday to the National Physical Laboratory and on Wednesday to the Imperial College of Technology, South Kensington. Today the Lots Road Power Station will be visited and in the evening an official banquet will be given on behalf of the Government at the Ritz Hotel, Piccadilly. On Friday, October 16th, the Lord Mayor of London will give a luncheon at the Mansion House; a visit to Cambridge upon the invitation of Trinity College will be paid on Saturday, October 17th; the Central Telephone Exchange, Carter Lane, will be visited at 3.30 p.m. on Monday, October 19th, and in the evening the delegates will dine with the "Dynamicables" at the Franco-British Exhibition; Greenwich Observatory will be visited on Tuesday, October 20th, and an opportunity will be afforded at the same time of viewing the Greenwich L.C.C. power house. On Thursday, October 22nd, the delegates have been invited to the annual dinner of the Institution of Electrical Engineers.

Further meetings of the Technical Committee will be held this morning, and also on the 19th and 20th inst.; the full conference meets again on Friday to receive the interim report of the Technical Committee, after which it will consider the steps necessary to secure uniformity of the standards in the future. The final meeting of the conference is on Wednesday, October 21st, when a final report of the Technical Committee will be received.

LOCAL NOTES

ACTON: *Bulk Supply.*—A conference was held on Friday between representatives of the District Council and the Metropolitan Electric Supply Co. with regard to the terms upon which the Council is supplied with electrical energy in bulk. It is understood that on Friday a propostion was made on behalf of the company, and same will be considered by the Committee of the Council, who are in charge of the electrical undertaking.

BACUP, HASLINGDEN & RAWTENSTALL: *An Ancient Provisional Order*—Bacup is celebrated for being the town which holds the oldest Electric Lighting Provisional Order. They obtained their order in 1890, and have sat upon it ever since. Recently these three authorities, which are not far from one another, have been in treaty with the Lancashire Power Co. to supply them, and the company could only consider it worth while to lay a main to them in the event of all three taking power. Rawtenstall eventually decided, however, to build its own power station. They have now obtained the necessary sanction from the Local Government Board for a loan, and the power-house is in course of erection. Bacup will take power in bulk from Rawtenstall both for lighting and power purposes, and for the tramways in the district, which are to be electrically equipped. The Rawtenstall Corporation are to reconstruct the system of the Rossendale Valley Tramways Co. with both Rawtenstall and Bacup, and will work the steam tramways until the electrification is accomplished, taking all the receipts meanwhile. The sum necessary for the purchase of the tramways in Bacup will be lent by Rawtenstall.

BARKING: *Transfer of Electrical Undertaking.*—The promotors of the London and District Electric Supply Bill have accepted the Council's terms for the transfer of the local electric light undertaking, and a draft agreement has been prepared for inclusion in the Bill now before Parliament.

BENWELL & FENHAM: *Electric Lighting.*—It was stated at the last meeting of the Newcastle Corporation that an arrangement made by the Benwell Council a short time ago with the Newcastle & District Electric Lighting Co. had been declared *ultra vires*, but that as many houses had been wired in the expectation of a supply of electricity being available, the Newcastle Corporation had made arrangements with the District Co. to give a supply. The Corporation will take over the supply arrangements in 1922 at 5 per cent. per annum depreciation.

BOURNEMOUTH: *Tramway Receipts.*—The traffic returns upon the Corporation tramways for the summer season just ended show a marked decrease on the corresponding period of last year, the receipts amounting to £35,849, against £37,749, and the number of passengers carried was 5,895,052, against 6,041,278 last year.

BRADFORD: *New Tramways.*—The Tramways Committee are considering the extension of the tramways in various directions, and it is probable that a Bill will be deposited in Parliament this session.

BRAUNTON (N. DEVON): *Electricity Supply.*—Messrs. Crompton & Co. are interested in a scheme for electric lighting in this district.

BURNLEY: *Proposed Electrical Omnibus Service.*—The London Electrobus Co. have applied to the Burnley Tramway Committee for a licence to open a service of electric omnibuses in the borough, where no electric tramway service is afforded. A recommendation has been made that in the event of the application being acceded to, traffic should be confined to strictly suburban routes, and the Town Clerk has informed the company of the Corporation's powers to run and work motor omnibuses.

BURTON-ON-TRENT: *Football by Electric Light.*—A football match was played at Burton by the aid of electric light on Monday evening. This was accomplished by using ten of the Electrical Co.'s 10-amp. flame arc lamps, four being used on either side of the ground, and one at each end over the goals, the grand stand being illuminated by five 50-c.p. Osram lamps. The arc lamps were run in series directly off the trolley wires at 520 volts. The match in question was an important one in the first division of the English Football League.

CAMBERLEY: *Electric Lighting.*—The Aldershot Gas & Water Co., have asked the Council for its approval to its application for an Electric Lighting Provisional Order for this district.

CARDIFF: *Wiring Consumers' Premises.*—The Town Clerk has reported that the necessary powers to wire consumers' premises, and hire out electric motors can only be obtained by Act of Parliament. The matter has been referred to the Parliamentary Committee with a view to a clause, or clauses, being inserted in the next Bill to be promoted in Parliament empowering the Corporation to undertake the work.

CLECKHEATON: *Spen Valley Tramways.*—A conference has taken place at the Board of Trade Offices in connection with an application of the Yorkshire Woollen Tramways Co. regarding the cessor of its powers in respect of the unconstructed portion of the line, authorised by the Spen Valley Light Railways Extension Order. Mr. G. R. Askwith, Assistant Secretary to the Board of Trade, who heard the inquiry, was informed that a scheme of light railways is under consideration which includes the linking up of Leeds with Halifax, *via* Cleckheaton and Brighouse, and that an application will be made to Parliament for powers in connection with it. In view of these facts the application of the company for cessor of powers was adjourned until January 31st, 1910, to enable the scheme in question to be put before Parliament.

ELLAND: *Tramways.*—The Town Council has received offers from the Huddersfield Corporation and the West Riding Tramways Co. for the construction of tramways in their district. That of the company appears to be the more favourable to the Council.

FALMOUTH: *Trolley Omnibuses.*—A scheme for the provision of trolley omnibuses through the town and along the sea front is being considered.

FARNHAM: *Overhead Wires.*—The Council is still negotiating with the Farnham Electric Light & Power Co. for the erection of overhead wires for lighting purposes. The parties have been unable to come to any agreement upon a general scheme, and it has been decided that the company shall submit to the Council for its approval the position of every standard before its erection.

FELIXSTOWE: *Electricity Works.*—In connection with the Council's purchase of the undertaking of the Suffolk Electric Supply Co., Mr. R. P. Wilson, the Council's consulting engineer, has reported upon the use of Diesel oil engines in connection with the reconstruction of the works, and recommends their adoption.

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FORMBY: *Electric Lighting Provisional Order.*—The Council has agreed to transfer the Electric Lighting Provisional Order to the Formby & Freshfield Electric Lighting Co.

GATESHEAD: *Purchase of Tramways.*—In return for a suggestion by the Council that they should carry out certain extensions, the Gateshead and District Tramways Co. propose that the date of the exercise by the Council of their powers of compulsory purchase should be postponed for ten years. The Town Improvement Committee offered an extension of eight years from August 12th, 1922, as the period before compulsory purchase, and the company has agreed to this.

GLASGOW: *Tramway Finances.*—A recommendation by the Tramways Sub-Committee on Finance that a contribution of £17,500 be made by the Tramway Department to the Common Good has been adopted by the Tramways Committee.

Tramway Brakes.—In consequence of the accident that occurred in the High Street on January 3rd last, and the report by Colonel Yorke, in which he made suggestions with regard to brakes and sandboxes, the Tramways Committee has recommended that all cars be fitted with additional devices for sanding the tramway rails in accordance with a proposal by Mr. J. Dalrymple, the General Manager. An investigation is also to be carried out as to the method of operating the brakes on the cars.

GREENOCK: *New Tramway.*—In connection with a new street, the tramway company will in all probability lay a new tramway in order to provide a much needed additional outlet to the surrounding district.

HAMBURG: *New Telephone Exchange.*—According to a British Consular report, the concentration of the Hamburg telephone system in the newly-erected Telephone Exchange Building has not yet been finally accomplished, and in the meantime complaints as to the unsatisfactory service have rather increased than diminished. It is hoped here that not only the changes still in progress (that is to say the final arrangements of the central office and the complete substitution of underground for overhead wires) will be brought to an end without further delay, but that a well-trained and sufficiently numerous staff of employés will be at the service of the public in order to cope with the continually increasing demands made upon the telephone system.

HANWELL: *Condition of Tramway Track.*—The Commissioner of the Metropolitan Police has forwarded to the District Council the report of the local inspector on the condition of the tram track in Hanwell, in which he states that almost invariably it has been found that the noise was due rather to the condition of the track than the cars. The Commissioner adds that he has no control over the condition of the track. The Council have decided to forward a copy of the report to the Board of Trade, requesting them to take the necessary steps to require the tram company to put the track in proper condition, which, in their opinion, can only be done by relaying the whole of the track in Uxbridge Road.

HASLINGDEN: *Tramways Inspection.*—On Thursday, Major Pringle inspected the one mile of electric tramways in the Haslingden borough from Commercial Hotel to the Rawtenstall boundary. This length completes the reconstruction in the borough.

HEREFORD: *Electricity Tariffs.*—A report by the Electricity Committee for the adoption of the two-rate meter system of charging has been passed.

HOVE: *Electric Light Charges.*—Mr. Sims Williams, the Board of Trade Commissioner, who has for some time past, at long intervals, been hearing evidence in connection with the application of the Corporation, to compel the Hove Electric Light Co. to reduce its charges, has now completed his investigation, and will make his report to the Board of Trade in due course.

HYTHE: *The Tramway Scheme.*—The National Electric Construction Co. has notified the Hythe Council of its intention to apply to Parliament in the ensuing session for a Bill to amend the Folkestone, Sandgate, and Hythe Tramways Bill of 1906, by substituting the overhead system for the surface contact system. In a long communication, the Parliamentary Agents informed the Council that in view of the very onerous obligations put upon the promoters by the local authorities, it was at one time the serious intention to abandon the whole scheme. They are willing, however, to proceed with the Bill referred to, provided the Folkestone, Sandgate, and Hythe Councils are willing to meet them in the matter of terms.

IPSWICH: *Crosthwaite Furnaces.*—On page 500 of our issue for October 1st we mentioned that the Electric Lighting Committee anticipated a saving of £1,200 per annum by the adoption of an offer by the Crosthwaite Fire Bar Syndicate, Ltd., to fit their furnaces to the power station boilers. We are informed that this figure should be £400 per annum.

LEICESTER: *Electricity Accounts.*—At the meeting of the Town Council last week the report of the Electric Light Committee dealing with the past year's working of the electrical undertaking was adopted. The total expenditure amounted to £6,698, and the gross revenue to £15,847. After meeting interest and sinking fund charges, there was a net profit of £1,951, which, added to the balance brought forward, leaves a net profit of £2,739.

LEITH: *Electricity and Tramway Estimates.*—The estimates in connection with electricity department for the year ending May 15th next, show a surplus of £2,955. Upon the tramways undertaking the estimates show a probable deficit of £2,696. From January 1st next, the charge for electricity for lighting purposes will be reduced to 3d. per unit.

LIVERPOOL: *Lister Drive Steam Turbines.*—At the meeting of the Liverpool Council last Thursday, the report of Mr. A. Bromley Holmes, the Consulting Engineer to the Corporation, upon the Westinghouse turbines at the Lister Drive Power Station, was adopted after a lengthy discussion, in which a good many personalities were indulged in.

Trolley Omnibuses.—We understand that the Tramways Committee have under consideration the proposed adoption of trolley omnibuses.

LONDON: *Battersea: London Electric Power Bills.*—Counsel has been briefed in opposition to the London and District Electricity Supply Bill and the London Electric Supply Bill, the costs at present incurred being £250.

St. Pancras: Advantages of Cheap Electric Supply.—Having regard to the obligation imposed by Patents and Designs (Amendment) Act, 1907, with regard to patents being worked in this country, the Borough Council is issuing a circular in English, French, and German, calling attention to the advantages of St. Pancras as a manufacturing centre, especially in regard to the facilities for cheap electric power.

Paddington: Opposition to Power Bills.—The Borough Council, upon the recommendation of the Legal and Parliamentary Committee, has presented petitions against the London & District Electric Power Bill and the London Electric Supply Bill.

Woolwich: Tramways to Eltham.—In regard to a request by the Borough Council that they should include in the programme of works for the coming year the construction of the authorised tramways from Woolwich to Eltham, the Highways Committee of the London County Council state that they are giving careful consideration to the question, but think it advisable to apply for an extension of time for the construction of these lines. The Borough Council have written a letter to the County Council expressing their regret that this should be necessary.

Honor Oak: Proposed Tramways.—A deputation representing the Honor Oak Park and Brockley Tramways Committee waited on Thursday on the Highways Committee of the London County Council to urge the consideration of the tramway authorised from Lewisham High Road through Brockley to Forest Hill. Mr. Whitaker Thompson, the Chairman of the Highways Committee, replied that capital expenditure was the crux of the matter, and if it were possible to reduce this by the construction of a single line with passing places, so as to decrease the cost of street widenings, there would be some likelihood of the tramway being constructed next year.

LOUGHBOROUGH: *Electrical Finances.*—A special sub-committee, which was recently appointed to inquire into the finances of the electrical undertaking, there having been an adverse balance on the last year's working of £2,527, recommends that an independent engineer should be called in to report upon the working of the department.

MANCHESTER: *Mutual Telephone Syndicate.*—The resolution referred to in our last issue, that a special committee be appointed to consider and report on the position of the Mutual Telephone Syndicate, Ltd., and as to whether or not any payment should be made by the Corporation to reimburse to some extent the expenditure incurred by the Syndicate in their efforts to promote a cheaper telephone service for the city, was passed at the meeting of the City Council on Thursday last week.

MIDDLESBROUGH: *Electric Supply.*—Mr. H. M. Taylor, Electrical Engineer, reports that in consequence of the increased demand on their power station this winter, the Council will be compelled to generate to the extent of 900 kilowatts from their own plant, in addition to the power they will take from the power company.

MIRFIELD: *Electric Tramways.*—The Yorkshire (Woollen District) Electric Tramways, Ltd., have communicated with the Local Ratepayers' Association, stating they are unable to entertain a proposal to extend the tramways through Mirfield.

OXFORD: *Tramway Question.*—The National Electric Construction Company have finally decided that the Dolter service contact system will not be suitable for the city of Oxford, in face of the Corporation resolution that they are not satisfied with the working of the system in other towns. A communication has been sent to the Corporation offering to instal the conduit system in the centre of the town, and the overhead system on the outskirts, if the Corporation, on account of the extra cost incurred, can see their way to reduce the rental to £800 per annum.

PENRITH: *Electric Lighting.*—A company has been formed with a capital of £7,000 to acquire the Council's Electric Light Provisional Orders of 1900 and 1907.

PRESTON: *Tramway Undertaking.*—In their annual review of the Corporation accounts, the borough elective auditors point out that, after charging interest and sinking fund, the net revenue amounts to £3,194 for the past year, against £5,568 of the previous year. They mention, however, that a sum of £1,200 has been charged to revenue for the conversion of 10 open top-deck cars to covered top-deck cars. The total receipts show an increase of £816, whilst the working expenses have

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increased by no less than £2,177, and the auditors express the opinion that, judging from the accounts for the two past years, the income would appear to have reached its maximum with the present system, but there is little doubt that there will be further increases in the working expenses. The reserve fund of the undertaking now stands at £13,102. The total expenditure to date amounts to £187,269.

ROCHDALE: *Electrical Charges.*—Although the electricity charges have just undergone special consideration by the Electricity Committee, an effort was made at the last meeting to secure a still further reduction. A resolution to this effect, however, resulted in five voting for it and 35 against it.

SALFORD: *Electricity Contracts.*—At the meeting of the Corporation on Thursday, a request was made by one of the Councillors for particulars of all special agreements entered into by the Electricity Committee, in which prices were charged less than the ordinary scale. It was stated in reply that the provision of such information rested with the Committee, and no definite decision was come to.

SALONICA (TURKEY): *Electric Tramway.*- A British Consular report states that the widening of the quay by 26 ft., which began in 1903, is at last finished; and though the diminutive parapet aligning the sea-side pavement fails in its object, the road is now broad enough for all kinds of traffic, including the newly-established electric tramway. The rolling-stock, imported from the United States, consists of 25 cars, which have cost £720 each. They accommodate 36 persons, including those standing on the platforms outside. A large generating station has also been built containing two 200 h.p. gas-driven dynamos and one 800 horse-power oil engine. The electric tramway service of Salonica, as well as that of the horse-drawn tramway which preceded it, is due to Belgian enterprise. It remains to be seen whether electric light will be installed by the municipality or by private persons, who seem to be deterred by fear of the heavy initial expenditure.

SOUTH AFRICA: *New Rand Power Scheme.*—A scheme is under consideration for the erection of a generating station to supply all the mines in the Rand district. It is probable that a company will shortly be registered with a capital of £1,750,000 in £1 shares, including £500,000 deferred shares. The name of Mr. W. A. Harper is mentioned in connection with the scheme as consulting engineer.

STRETFORD: *Electricity Accounts.*—In a statement of assets and liabilities lately presented to the Council, it is shown that the total amount expended upon the electricity undertaking now amounts to £63,818, whilst the amount sanctioned by the Local Government Board is £93,969.

TURTON: *Electric Lighting.*—An application is to be made to the Board of Trade for an Electric Lighting Provisional Order for the Urban District Council.

WALSALL: *Anti-Vibration Foundations.*—The electrical engineer having reported that the trial set of anti-vibration foundations on Prache's patent system had been perfectly satisfactory, the Electricity Committee has given instructions to have the second transformer equipped with a similar foundation at a cost not exceeding £50.

WEST HAM: *Electricity Accounts.*—As compared with the year ended March 31st, 1907, which resulted in a deficit of £1,829, the revenue of the West Ham electricity department for the year ended March 31st, 1908, amounted to £63,069, against £53,324—an increase of £9,745. Working expenses amounted to £39,326, an increase of £7,372, and capital charges to £28,044, an increase of £4,470, to which has to be added the cost of changing a single-phase generator to two-phase, making a total increased expenditure of £12,586. Adding last year's deficiency of £1,829, there is a deficit for the year ended March, 1908, of £4,670. As an explanation of, at any rate, a portion of this deficit, it is pointed out that the cost of changing over the single-phase generator to two-phase has been charged in the one year, although the benefit of the change will be felt for many years to come, whilst in addition there is a sum of £185 paid for water rights in connection with Abbey Mills Generating Station, which was scrapped in 1904. Other items which do not ordinarily occur as charges upon revenue are as follow :—Deductions from sanction of loan made by the Local Government Board in connection with installation of chain-grate stokers (£200); cost of public arc lighting in Hermit Road, &c., not covered by loan (£181); stores buildings, 84 Romford Road, charged against the year's revenue account (£250); increasing capacity of battery booster and coal storage (£180); breakdown of machinery at a large consumer's premises (£500). These special items total £2,240 out of the deficit of £4,670. The remainder is partly due to capital charges upon works which are not yet fully remunerative, and to the cost of internal reorganisation of the various departments. The cost of generation (£23,454) is an increase of £3,659, and of this coal represents £2,145, due to the increased output from the station and partly to increased coal prices. The coal cost per unit generated was 0·271d. against 0·345d. for the previous year, and compares with 0·218d. for April–August of the current year. So complete has been the reorganisation of the undertaking since Mr. Seabrook took charge of it two years ago, necessitating such heavy capital expenditure, that he considers a start was only made on a completely reorganised basis from March 31st, 1908. There appears, however, to be very little exceptional expenditure on revenue account ahead now. Only a small capital expenditure on mains is necessary for the current year, all the power districts now being supplied with two-phase current; the main increase is in normal connecting-up of consumers. Another main feeder for Silvertown and Stratford may be required next year, for which excavation and ducts were provided for in the last extension. At the generating station additional plant will be required to be put in from time to time, for which buildings and foundations already exist, the expenditure for the current year amounting to about £10,000 (payments due at March, 1909) for 3,000 kilowatts increase in capacity. For the first five months of the current year there has been an increased income for the whole undertaking of £6,052 over the corresponding period of the previous year at an increased total cost, including capital charges, of £1,731. The number of units sold during the year was 11,299,783, made up as follows :—Private lighting, 2,123,336; private power and heating, 4,161,156; public lighting, 790,180; tramways, 4,225,111. The maximum demand was 5,500 kw.

Appointment of Electrical Expert.—As the outcome of the recent Local Government Board inquiry, which was adjourned by the inspector on the representatives of West Ham refusing to disclose the prices at which they supplied certain power-consumers with current, the Town Clerk and Electrical Engineer reported to the Electric Lighting and Tramways Committee that they approached Mr. Merz, electrical expert, with a view of securing his services, but being connected with the London Power Promotions in opposition to the Corporation he was unable to accept. Mr. Arthur Wright, consulting engineer to the Corporation of Brighton, Marylebone, &c., has been appointed. Mr. Wright, who has already commenced his investigations, is to receive a fee of 100 guineas, *plus* 25 guineas for each day's attendance at the adjourned inquiry.

WORCESTER: *Powick Generating Station.*—The old plant at the Powick generating station has been sold to Messrs. Thomas Ward & Co., of Sheffield, for £850. This is less than the Electricity Committee originally hoped to get, but the price has been largely influenced by the drop in the price of copper. The deficiency upon the plant amounts to £800, but it will be met out of revenue during the next three years.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRAZIL.—The *Diario Official* of September 11th contains a copy of a Decree approving plants presented by Messrs. Guinle & Co. for a hydro-electric power transmission line for the purpose of conveying energy from the hydro-electric works in the river Itapahau at Santos, State of Sao Paulo.

COVENTRY.—The Local Government Board's sanction has been received to the borrowing of the following sums :—Mains, £23,823, repayable in 25 years; transformers and services, £8,600, repayable in 50 years; meters, £500, repayable in 5 years; motors, £2,000, repayable in 10 years.

PENDLETON.—We announced in our issue for September 24th that Messrs. A. Knowles & Son, Ltd., were contemplating putting down electrical machinery at certain of their collieries. Messrs. Knowles ask us to state that this information is not quite correct, as no immediate steps of this character are contemplated.

PORTSMOUTH.- Tenders are invited for the reconstruction of a turbo-generator. Particulars from the Engineer, and tenders by October 21st.

PORTUGAL.—The *Diario do Governo* of October 1st contains a copy of a Decree authorising the Sociedad Armazeno das Beiras of Gouveia, concessionaires for the supply of electric light in the town of Ceia, to appropriate water from the river Alva for the production of electric power. The *Diario*, which contains information as to the terms under which the concession is granted, may be seen at the Commercial Intelligence Branch of the Board of Trade.

SHEFFIELD.—Mr. H. Shelford Bidwell held a Local Government Board inquiry last week into an application by the Council for sanction to borrow £120,000 for the purpose of public improvements. Of this £11,000 is required for electrical purposes, but no formal opposition was offered to this by the ratepayers. Questions were asked, however, on behalf of the local electrical contractors, of Mr. S. E. Fedden, the City Electrical Engineer, with regard to the Corporation selling fittings and undertaking wiring work. A case is pending challenging the legality of this procedure on the part of the Corporation, but as it was not relevant to the present loan in any way, the Inspector listened to the arguments, and the matter dropped.

SALFORD.—Tenders are invited for cooling-towers, tanks, pumps, and pipe-work. (See an advertisement this week.)

STRAITS SETTLEMENTS.—The *Straits Budget* states that the Government have sanctioned the proposal of the Penang

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Municipal Commissioners to raise a loan of 100,000 dollars for the extension of the electric lighting and the duplication of the electric generating plant in the Northern Settlement.

Miscellaneous

BRADLEY FOLD.—The Brynn Hall Colliery Co., a well-known Wigan colliery firm, will, it is understood, adopt electrical working in connection with the new collieries they propose sinking at Bradley Fold between Bolton and Radcliffe on the Earl of Wilton's estates.

CUBA.—According to the *Bulletin Commercial* (Brussels), the Belgian Legation at Havana has reported that the Havana Electric Railway Co. have recently been authorised to carry out a considerable extension of their lines in that town. Work, it is stated, will very shortly be commenced.

DUBLIN.—An application is to be made to the Local Government Board for sanction to a loan of £4,000, in connection with street lighting.

LEEDS.—The Street Lighting Committee invite tenders for the purchase of scrap copper and brass. Offers to the Town Clerk by 20th inst.

Tenders are invited for the erection of a transformer chamber in East Street, Leeds, for the electric light department. Particulars of Mr. H. Dickinson, manager, 1 Whitehall Road, Leeds, and tenders to the Town Clerk by the 17th inst.

LINCOLN.—A proposal is under consideration for the extension of the tramways to the east and western portions of the city, at an estimated cost of £24,000.

LONDON: *Hammersmith.*—The Electrical Engineer of the Borough Council, in accordance with a scheme previously approved by the Council, has suggested the conversion from gas to electricity of 100 lamps in 15 streets at a cost of £602, and the Electricity and Lighting Committee have agreed to same. The Electricity and Lighting Committee have also had under consideration the lighting of Fulham Palace Road, in view of the erection of standards to carry the overhead wires in connection with the Putney to Hammersmith tramways now being constructed.

SOUTHEND.—The Corporation invite tenders for the supply and delivery of three bogie tramcars. Particulars from the Electrical Engineer (fee, one guinea, returnable), and tenders to the Clerk by October 17th.

SPAIN.—The *Gacetas de Madrid* announces calls for tenders for working the telephone systems (*a*) of the town of Murcia, (*b*) of the town of San Sebastian, (*c*) of the town of Pontevedra, and (*d*) of the town of Sabadell.

WALTHAMSTOW.—Tenders are invited for the sole right of advertising upon the Council's tramways for alternative periods of three or five years. Particulars from the Tramway Manager (fee, one guinea, returnable), and tenders to the Clerk by the 23rd inst.

Tenders are invited for the supply of arc lamp carbons during the period ended March 31st, 1910. Particulars from the Electrical Engineer, and tenders to the Town Clerk by October 23rd.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Alterations and additions, Mansfield House Men's Club, Barking Road, E. Builder, Frank Hamlett Cotswold, Barking Road, E.

Match factory, Stratford. Architect, F. G. Forge, 28 Martin's Lane, E.C.

New offices and store at Canning Town for City Glass Bottle Co., Ltd., St. John's Road.

Store at H. Tate & Sons' sugar refinery, Silvertown. Store and machine workshop at R. Moreland & Son's premises, Bradfield Road.

S.E.—Charlton Congregational Church, Bramshott Avenue, Greenwich. Builder, George Parker, 124 Sumner Road, Peckham.

S.W.—Seventy houses, Mandrake Road and Glenburnie Road, Wandsworth. Architect, W. C. Poole, 62 Belleville Road, Wandsworth Common, S.W.

Building on site of 7 Princes Street, Westminster. Architect, H. C. Clarke, 63 Bishopsgate Street Within, E.C.

Workshop for electrical engineer's works, at Ingate Place, Queen's Road, Battersea. Builders, Macey & Sons, Ltd., 24 Essex Street, Strand, W.C.

W.—Rebuilding of mansion in Tilney Street and Deanery Street (Park Lane). Builders, T. Rider & Son, 181 Union Street, Southwark, S.E.

Alteration of Shaftesbury Theatre, Shaftesbury Avenue, into music hall. Walter Gibbons, Adelphi Terrace House, W.C.

Formation of new street on the Old Oak Lodge Estate, Hammersmith. Contractor, Mr. J. Allen, 111 Adelaide Road, Shepherd's Bush.

W.C.—Alterations to 448 Strand (late post office) for branch of London & South-Western Bank, 170 Fenchurch Street, E.C.

Re-erection of 5, 6, and 7 Spur Street, Leicester Square. Surveyors, Taperell & Haase, 9 John Street, Adelphi, W.C.

PROVINCES.

BELFAST.—New abattoir (£32,118). H. A. Cutler, Engineer and Surveyor, City Council.

BRISTOL.—Alterations and additions to brewery, Bath Street and Tucker Street. Architects, G. Adlam & Sons, Elbroad Street, Bristol.

BURTON-UPON-TRENT.—New police station, superintendent's house, and court-house. Builder, Richard Kershaw, Princess Street.

BURY.—Elementary school at Elton. A. W. Bradley, Surveyor and Engineer, Town Council, Bury.

CARDIFF.—Congregational Church, Penwain Road. Architects, Habershon, Fawckner & Co., 14 Pearl Street, Roath.

Alterations to Cardiff Exchange, Mount Stuart Square.

CHESTER.—Council school (£9,356). I. Matthews Jones, Surveyor, Town Council, Chester.

DEVONPORT.—School. Architects, Thornley & Rooke, 29 St. Aubyn Street, Devonport.

ELLAND (Halifax).—Secondary school. Architect, Henry Thompson, Southgate.

GOSPORT (Hants).—Portion of new school (accommodation for 440 scholars). H. Frost, Surveyor, Gosport and Alverstoke Urban District Council.

LEEDS.—Alterations to Millgarth Street Police Station. R. E. Fox, Town Clerk, Leeds.

Proposed extension of library accommodation at Woodhouse. W. T. Lancashire, City Engineer and Surveyor.

PETERBOROUGH.—School at West Town (£2,400). John William Walshaw, Surveyor, City Corporation.

SEAHAM (Durham).—Seamen's Mission, Seaham Harbour (£1,300). W. Cordner Scott, hon. sec.

SHANKLIN (I. of W.).—Proposed Kursaal (8,000). Architects, F. Matcham & Co., 9 Warwick Court, Holborn, W.C.

SHREWSBURY.—Elementary schools at Coleham. Architects, A. B. & W. Scott Deakin, 12A Pride Hill, Shrewsbury.

SUNDERLAND.—Children's Hospital, Durham Road. Ald. S. Richardson, J.P., Chairman of Infirmary Committee.

WALSALL.—Adaptation of Bloxwich Music Hall, for accommodation for Corporation administrative work. John Taylor, Borough Surveyor.

Cloak room, &c., Grand Theatre, Park Street, for the Walsall Theatres Co., Ltd.

WATFORD.—Manual instruction centre and cycle-shed at Victoria School (£764). County Surveyor, Herts County Council.

Drill Hall for Herts Territorial Force. Colonel C. E. Longmore.

WOLVERHAMPTON.—Factory and out-buildings in Penn Street for Southen Bros.

TENDERS RECEIVED AND ACCEPTED

ARGENTINE.—Nine tenders were received in connection with the erection of a generating station by the Cordoba Municipality. The power-house will contain two 500 kw. sets. The tenders were:—Ludke, Sajoux & Cia., $102,650; Hopkins & Cardom, $96,690; Cia Industrial de Electricidad del Rio de la Plata, $93,360; Agar, Cross, & Cia., $86,600; Colson, Brookhouse & Pyne, $82,541; G. Scherb & Cia., $81,470; Lindenberg, Nellen & Cia., $79,560; Parcus & Cia., $79,400; Bianchetti Hnos, $77,000.

BATH.—The tenders of Messrs. Babcock & Wilcox, Ltd., for a boiler at £2,150, and of Messrs. Stothert & Pitt for a water-tank at £145 for the electricity works, have been accepted.

BELFAST.—The tender of Messrs. Gregg, Son & Phœnix, Ltd., for the supply of cast-iron frames and covers for the electricity department has been accepted.

BOLTON.—The tender of the British Insulated & Helsby Cables, Ltd., for the purchase of scrap copper has been accepted by the Electricity Committee.

BRADFORD.—The tender of Messrs. J. W. Singer & Sons, Ltd., for special electric light fittings for the Town Hall has been accepted at £1,749.

DAWLEY.—Kynoch, Ltd., have secured a contract for the supply of a pumping plant to the Dawley District Council. The plant consists of two sets of Kynoch gas engines and suction gas plants, and Mather & Platt turbine pumps. The consulting engineers for the work are Messrs. Willcox & Raikes, of Birmingham and London.

GLOUCESTER.—The tender of Messrs. Moy, Ltd., for slack coal at 11s. 9d. per ton has been accepted in connection with the electrical undertaking.

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The following tenders have been accepted for the supply of coal:—Mr. Alexander Crane, Princess Royal steam, 11s. 6d.; Lydbrook, 10s. 9d.; and Speech House, 9s. 9d. per ton; the New Bowson Coal Co., Lightmoor Colliery rough small, 7s. 8d. per ton.

INDIA.—The Empire Roller Bearings Company, Ltd., have received an order for 1,216 wheels and roller bearings complete for India, and amongst other contracts they have recently secured orders for roller bearings for the Ordnance Department and the Admiralty.

LONDON: *London County Council.*—The following tenders have been received:—

Slot rails and conductor rails.

P. & W. MacLellan, Ltd. (made by the North-Eastern Steel Co., Middlesbrough) (recommended), £15,193; Frodingham Iron & Steel Co., Ltd., £15,611; Walter Scott, Ltd., £16,559; Edward Le Bas (made by Ougrée Marihaye Steel Co., Belgium) (for short rails only), £12,197; Société Anonyme des Aciéries d'Angleur (for short rails only), £12,300.

Track rails and fastenings.

Société Anonyme des Aciéries d'Angleur, £21,439; Edward Le Bas, London (made by Ougrée Marihaye Steel Co., Belgium), £22,080; Walter Scott, Ltd., Leeds, £24,263; Bolckow, Vaughan & Co., Ltd. (recommended), £24,453. The chief engineer's estimates, comparable with the above tenders, are £15,857 and £24,773 respectively.

For the supply and erection of overhead travelling hand crane for the Camden Town tramways sub-station, the following tenders have been received:—John Smith (Keighley), Ltd. (accepted), £190; James Spencer & Co., £190; Alexander Jack & Co., £199; James Carrick & Sons, Ltd., £208; Marshall, Fleming & Co., £219; Applebys, Ltd., £264; John Williams & Sons (Cardiff), Ltd., £270; Rowland Priest, £275; Willcocks & Son, £295.

London County Council.—The tender of Elliott's Moulding & Joinery Co. for a tramway shelter at the Blackfriars terminus of the Embankment tramway, in oak, at £185, has been accepted.

The following tenders have been received for six electric stores transport vehicles, for use on the Council's tramways:—Mountain & Gibson, Ltd., £3,230 (accepted); Dick, Kerr & Co., Ltd., £3,230; United Electric Car Co., Ltd., £3,414; Hurst, Nelson & Co., Ltd., £3,439; Gloucester Railway Carriage & Wagon Co., Ltd., £3,774.

The following tenders have been received for three lifts at the central car repair depôt, two electrical, and one to be worked by hand: Medways Safety Lift & Elevator Co. (accepted), £603; Eastern Lift Co., Westminster, £882; Messrs. Archibald Smith and Stevens, Battersea, £920; E. Waygood & Co., Ltd., London, £923; A. W. Penrose & Co., Farringdon Road, £1,084.

For the supply of indicator box fittings for electric cars, the following tenders have been received: Hurst, Nelson & Co., Ltd., Birmingham (accepted), £150; Hoskins & Sewell, Ltd., Birmingham, £157 10s., less 2½ per cent.; Player & Mitchell, Birmingham, £160 8s. 8d., less 2½ per cent.; United Electric Car Co., Ltd., Preston, £567 11s. 4d.; Howarth & Houson, Birmingham (tender not to specification), £70. less 5 per cent.

London County Council.—Tenders have been invited from selected firms, for the work of substituting electric arc lamps for the existing gas lamps on Westminster Bridge—G. E. Taylor and Co. (accepted), £331; Foote & Milne, Ltd., 362; W. T. Henley's Telegraph Works Company, Ltd., £535; W. T. Glover & Co., Ltd., £587; Callender's Cable & Construction Co., Ltd., £591.

Chelsea.—The Borough Council has accepted the quotation of Wright Bros. & Co., for the supply and fixing of 87 electric light fittings for the Town Hall extension at £124. The acceptance is subject to the approval of the L.C.C. as regards the manner of suspending the fittings in the licensed portion of the building.

NELSON.—The tender of Messrs. L. Fryar & Co., of Nelson, for supplying and fixing screens for electric fans in the market hall has been accepted.

Manchester Engineers' Association.—The opening meeting for the session of this Association took place on Saturday, at the Grand Hotel, Manchester, when Mr. G. Hughes, of the Lancashire & Yorkshire Railway Co., took the chair. A discussion took place on the various engineering and electrical exhibits at the Manchester Electrical Exhibition, among the speakers being Mr. S. L. Pearce, the Manchester City Electrical Engineer.

Telegraph Traffic.—This week there are only two repairs of submarine cables to notify—namely, those between Sitia and Rhodes, and between Cape Haiti and Mole St. Nicholas on the north coast of the island of Haiti in the West Indies. The first repair was made on the 6th inst., while the other cable was put through on the 8th inst., having been down since September 13th last. Telegraph communication between Saigon and Pattambourg was interrupted on the 13th inst., and traffic is being forwarded "via Obone." There is still no alteration in the telegraphic situation at Venezuela. British Honduras is negotiating with Mexico for a telegraph line to connect it to the Mexican system.

COMPANIES' MEETINGS AND REPORTS

DEVONPORT & DISTRICT TRAMWAYS CO.—The accounts for the year to June 30th show a surplus of £580 after deducting debenture and other interest. The total amount available, including the sum brought forward, is £736, which the directors propose to carry forward. It is also recommended that £5,000 from the depreciation reserve fund be transferred to permanent-way renewals.

ROSARIO ELECTRIC CO.—The report for the year to June 30th shows a profit of £23,000, after meeting depreciation and expenses of issuing new capital, in addition to £4,600 brought forward. A dividend of 5s. per share is recommended upon the ordinary shares, making 8 per cent. for the year; a dividend of 8 per cent. on the second preference shares which have been converted into ordinary shares, and an additional dividend on other second preference shares which have been converted into ordinary shares. It is further proposed to allocate £600 as additional remuneration to the directors, and to add £5,000 to the reserve, carrying forward £6,549.

THE VICTORIA FALLS POWER CO., LTD.—The report of the directors from the incorporation of the company (October 17th, 1906), to December 31st, 1907, states that a profit and loss account has not been included because the year 1907, and also the current year, are, and will be, occupied by the work of construction, during which interest on the preference shares issued in December, 1906, is paid by the British South Africa Company. A revenue and expenditure account is included in the balance sheet, and £56,685, being the surplus of revenue over expenditure, is carried forward to the current year. The issued share capital of the company is £1,808,000, divided into 1,000,000 ordinary shares of £1 each, which have been issued fully paid, and 808,000 fully paid preference shares of £1 each. £800,000 debentures have also been issued. The assets acquired by the purchase of the Rand Central Electric Works included a 3,550 h.p. steam-driven station situated at Brakpan, which was in good working order, has run satisfactorily, and has earned good profits. It is intended, when the new stations now being erected by the company have been completed, to utilise this plant as a reserve. The assets of the Rand Central Electric Works, Ltd., also included the concession from the Government to supply electric power to the mines along the Witwatersrand. The president, vice-president, Sir Charles Metcalfe, and Mr. Henry Birchenough, directors of the company, visited the Rand during the summer of 1907, accompanied by Mr. Ralph D. Mershon and Mr. Arthur Wright, the Electrical Engineers of the company, and Mr. Bertram Fox on behalf of the Engineers-in-Chief. The directors and engineers also visited the Victoria Falls, and inspected the sites for the future water power stations and canal. The supply of the Witwatersrand market continues to be the first object of the company. The selection of the best positions for the erection of the company's new works on the Witwatersrand has therefore been a question of very great importance, and was one of the principal matters dealt with during the visit of the directors and engineers to South Africa. After full investigation of the local conditions, and having in view the above-mentioned facilities at Brakpan, it was decided to erect a new 8,000 h.p. station at Brakpan, and a second station of 16,000 h.p. capacity at the Simmer Pan, near Germiston, where an excellent freehold site has been purchased, and the required facilities have been granted by the Government. The power station at Brakpan is completed and the machinery is now running. The construction of the power-house building at Simmer Pan is rapidly progressing, and some of the machinery has been delivered. This station will be complete during the early part of next year. The new transmission lines along the reef are complete, and an extension to the west of Johannesburg is in hand. The company has entered into a number of important contracts for the supply of power to mines. The Germiston and Boksburg municipalities take the whole of their requirements from this company. Major the Hon. Walter L. Bagot, D.S.O., has been appointed General Manager of the Company in South Africa. Mr. Arthur E. Hadley, who has throughout been the alternate director for Herr Geheimrath Rathenau, has been elected a director. Mr. Hadley retires in accordance with the provisions of the Articles of Association, and, being eligible, offers himself for re-election. The meeting is on the 23rd inst. at Salisbury House, London Wall.

Electrical Standardising, Testing, and Training Institution.—The following arrangements for special lectures to be delivered during the Michaelmas Term have been made by the Governors of Faraday House:—"Generator Design," by Mr. H. M. Hobart; "Electrical Measurements," by Mr. J. Rennie, of the Board of Trade Electrical Standards Laboratory; "Fuel Economy," by Mr. J. B. C. Kershaw.

Rugby Engineering Society.—The first meeting of the Rugby Engineering Society for this session will be held in the large assembly room at the Penn Buildings to-night at 8 p.m., when the Presidential Address will be delivered by Mr. A. F. Bennett. The programme for the 1908-9 session includes the following Papers:—"Incandescent Electric Lamps," by F. Findlay; "The Exhaust Steam Turbine," by R. F. Halliwell; "Electric Railways," by F. W. Carter; "The Propulsion of Ships," by G. M. Brown.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., quoted on Tuesday night, was £62 to £62 10s. per ton (last week, £61 15s. to £62 5s.).

GENERAL ELECTRIC BIRMINGHAM BRANCH.—The Birmingham house of the General Electric Co. is now situate at 42 High Street, and extensive showrooms, containing all the latest designs in electrical fittings, heating and cooking apparatus, fans, plain and fancy lamps, glass and silk shades, &c., have been opened.

HUDSON & BOWRING LIFEGUARDS.—In connection with the tramcar fender and wheel-guard tests inaugurated by the Public Service Commission of the first district, New York, a representative of the firm of Messrs. Hudson & Bowring, Ltd., of Manchester, paid a special visit to the United States, and submitted a guard. The tests, which took place at Schenectady, resulted in a very high percentage of marks being awarded to this guard, in one case 3·75 out of a possible 4.

SCHIFF & CO.—This firm will in future be known as "Ship Carbons, Ltd." 67 Aldersgate Street, London, E.C.

TANTALUM LAMPS.—Messrs. Siemens Brothers Dynamo Works, Ltd., of 6 Bath Street, City Road, E.C., express their regret at any slight delay which may occur in the delivery of their new "Tantalum" lamp showcards. Although a very large number of these were printed, the demand has far exceeded all expectations. A reprint is now in active course of preparation, and all applications for showcards will be filled at the earliest possible date.

VISIT TO MANCHESTER EXHIBITION.—On Saturday a party of upwards of 50 foremen of Messrs. Siemens Bros. Dynamo Works, Ltd., Stafford, accompanied by some of the officials, made an excursion to Manchester to visit the Electrical Exhibition. The members of Siemens' Stafford Engineering Society will visit the Exhibition on October 17th.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The public examination took place last week at Bradford County Court of Mr. W. T. Garnett, of Bradford, formerly carrying on the business of electric cable and wiring manufacturer, at Barker End Mills, Bradford, as W. T. Garnett's Cable Co. The debtor estimated his gross liabilities at £94.942, of which £31,329 was expected to rank for dividend. His assets, less preferential claims of £257, he estimated, would produce £8.129, leaving a deficiency of £23.200. The debtor attributed his failure largely to the fall in the price of copper during the past twelve months. The examination was closed.

A meeting of the Singapore Tramways, Ltd., will be held at 19 St. Swithin's Lane, London, on November 10th, at 12 noon, for the purpose of hearing the liquidator's account of the winding up.

MISCELLANEOUS CITY NOTES

CALCUTTA TRAMWAYS CO.—An interim dividend is announced upon the ordinary shares at the rate of 4 per cent. per annum for the half-year to June 30th.

CALLENDERS CABLE & CONSTRUCTION CO.—An interim dividend of 5s. per share (10 per cent. per annum) has been declared.

DIRECT UNITED STATES CABLE CO.—An interim dividend of 4s. per share, free of tax, has been declared for the quarter ended September 30th.

INDO-EUROPEAN TELEGRAPH CO.—An interim dividend for the half-year ended June 30th, at the rate of 5 per cent. per annum, has been declared.

MELBOURNE TRAMWAY & OMNIBUS CO.—The report for the year to June 30th shows a balance of £51.507, including £25.991 brought forward, after paying £72.C00 in dividend for the year in question. From the balance, it is proposed to pay a bonus of 6d. per share, and to give a bonus of 10 per cent. on their salaries to the staff, carrying forward £25.079. The number of passengers carried was 5.000,000 more than in the previous year.

MEXICAN LIGHT & POWER CO.—A dividend of 3½ per cent. has been declared upon the preference shares.

PRIMITIVA GAS & ELECTRIC LIGHT CO. OF BUENOS AIRES.—An interim dividend at the rate of 2s. 6d. per share is announced upon the ordinary shares.

STOTHERT & PITT.—A dividend of 10 per cent. free of income tax is recommended upon the ordinary shares for the past year, carrying £5.C01 to reserve, and £1.022 forward.

Glasgow Local Section I.E.E.—The meetings of the Glasgow Local Section of the Institution of Electrical Engineers, of which Mr. W. W. Lackie is chairman for the ensuing session, will again be held in the Lecture Hall, 207 Path Street. The opening meeting is on November 10th, and several important and interesting papers have been promised during the session. The seventh annual dinner will be held at the Grosvenor on November 17th, and the annual smoking concert at the same place on February 6th.

APPOINTMENTS AND PERSONAL NOTES

In accordance with the expressed desire of the Barking Electricity Committee, Mr. H. L. Howard, the Electrical Engineer, has withdrawn his resignation.

At the meeting of the Coventry City Council last week, the resignation of Mr. J. A. Jeckell, Electrical Engineer and Manager, was accepted, and the appointment of a successor at a salary of £450 per annum was recommended. A letter from Mr. Jeckell asking for his resignation to be withdrawn, and inviting a full investigation into certain coal contracts, was read, and an amendment that the matter should be referred back was defeated.

Mr. W. R. Poole has been appointed to the position of assistant to the Derby Electric Lighting Committee in place of Mr. C. A. H. Hughes, who has resigned .

Mr. H. Bell, one of the engineers-in-charge at the Hammersmith electricity works, has resigned.

Two hundred and seventy-five applications were received by Hammersmith Borough Council in connection with the appointment of two junior engineers. The commencing salary is £135, rising £5 annually to £150, and the positions have been secured by Mr. W. A. Kitchen, Hatch End, and Mr. C. H. Thorpe, Hither Green.

Mr. W. G. Tillott, mains superintendent at Hammersmith, has resigned his position on account of ill-health, and is going to New Zealand. Mr. Tillott was in the service of the Hammersmith Electricity Department for eleven years. Mr. H. S. Taylor, mains assistant, has been appointed to the vacancy at a salary of £140, rising by £5 per annum to a maximum of £150 per annum.

By a printer's error in our last issue, the name of Mr. Neachell, who has been appointed General Manager of the Liverpool Overhead Railway, in succession to Mr. S. B. Cottrell, was given as "Meachell."

Mr. M. P. Ford has resigned his position as Managing Director of the Brooke Tool Manufacturing Co., and is now with Mr. S. N. Brayshaw, of Manchester.

NEW COMPANIES

PENRITH ELECTRIC SUPPLY CO.—This company was registered on October 5th with a capital of £7,000 in £1 shares (3,500 5½ per cent. cumulative preference), to acquire the benefit of the Penrith Electric Lighting Order, 1900, to adopt an agreement with the Penrith Urban District Council, and to carry on the business of an electric light and power supply company. The subscribers are:—W. P. Theermann, 263 Oxford Road, Manchester, electrical engineer; H. Fox, 44 Windsor Road, Doncaster, electrical engineer; J. W. Speight, The Elms, St. Anne's-on-the-Sea, consulting engineer; P. H. Whitaker, 46 Abingdon Street, Blackpool, engineer; H. L. J. Butler, 2 Castlegate, Penrith, electrical engineer; W. A. Turner, 2 Castlegate, Penrith; P. Fox, 12 Wrayfield Avenue, Shipley. Minimum cash subscription, 25 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than seven; the first are W. P. Theermann, H. Fox, and J. W. Speight. Qualification, 200 ordinary shares. Registered office, 3 Castlegate, Penrith, Cumberland.

PRIVATE TELEPHONE CO.—This company was registered on October 8th with a capital of £1.000 in £1 shares, to acquire the business of a company of the same name (incorporated in April, 1908, and now in voluntary liquidation), and to carry on the business of electricians, electrical engineers, manufacturers of and dealers in electrical apparatus, &c. The subscribers are:—M. Atkinson, Oakfield, Highgate Avenue, N., engineer; Miss F. E. Pittard, 148 St. John's Road, S.E., secretary. Private company. The number of directors is not to be more than three. M. Atkinson is the first director, and may retain office while holding 100 shares. Registered office, 27 Chancery Lane, W.C.

SHIP CARBONS.—This company was registered on October 7th with a capital of £1,000 in £1 shares, to sell in the United Kingdom (and not elsewhere) carbons, incandescent lamps, and other electro-technical articles, &c. The subscribers are:—M. P. Schiff, partner of Schiff & Co., Schechat, Austria; J. P. Schiff, 200 Alleegasse, Vienna; E. Ornstein, Schwechat, Austria; A. Merle, Schwechat, Austria; Dr. O. Thorsch, Vienna, Imperial Councillor; R. Guth, Hybernergasse 20, Prague; Dr. H. Singer, Vienna. The number of directors is not to be more than three. The directors are given the customary powers of borrowing on debentures or other security, or without security. Registered office, 67 Aldersgate Street, E.C.

Manchester Local Section, I.E.E.—The opening meeting of the Manchester Section of Electrical Engineers takes place on Friday, October 23rd, at the Midland Hotel, Manchester, at 7.30 p.m., when the chairman, Mr. Miles Walker, will deliver his address. The remaining meetings of the session will be held in the Physical Laboratory of the Manchester University. The opening meeting of the Manchester Students' Section will take place at the Grand Hotel at 7.30 p.m., on Tuesday, October 27th, with a supper and smoking concert.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Oct. 8th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

1907 Patents

13,724. **Electric Power Transmission Gear for Ship Propulsion, &c.** H. A. Mavor and Mavor & Coulson, Ltd. This apparatus is virtually an electrical variable-speed gear, as is suitable for the propulsion of ships by high-speed steam turbines and low-speed propellers, and similar purposes. The shaft to be driven is connected to an element common to a multiphase generator, the field magnet of which is driven by the prime mover, and a multiphase induction motor, the stator of which surrounds the combination. Arrangements are made that this member can be subjected to the reaction torque of the generator, either alone or augmented, diminished or overcome by the torque due to the motor as required, by varying the slip between the stator and rotor field of the motor, the direction of the current and the number of effective poles. The arrangement can be adopted to produce current for external purposes also. (Two claims, one figure.)

21,073. **Alternator Armature Windings.** Siemens Brothers' Dynamo Works, Ltd. and M. Kloss. In a spiral winding for alternator armatures the necessity for open slots is avoided, and the use of semi-closed slots rendered possible by arranging the former wound coils in such a way that each coil limb fills only half a slot, and that the pitch of two adjacent coils belonging to the same group or pole differs by the tooth pitch only. (One claim, two figures.)

21,651. **Avoidance of Interference in Wireless Telegraphy.** Marconi's Wireless Telegraph Co., Ltd. and A. M. Young. Extraneous signals which cannot be tuned out by ordinary methods, are eliminated by the employment of two receiving transformers. The primary of one is in a circuit in resonance with the wave length of the desired signals, and the primary of the other is in a circuit in resonance with the wave length of the objectionable signal. The secondaries are connected to a telephone or other receiving instrument in such a manner that the difference between the strength of the signals from them actuates the instrument. Means of adjusting are provided for equalising the strength of the objectionable signals, and thus eliminating them. (Two claims, two figures.)

23,915. **Automatic Motor Starters.** British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*). This improved automatic motor-starting system, of the class in which the resistance steps are controlled by contactors operating successively as the counter electromotive force of the motor rises, is made more particularly suitable for circuits where there are large variations of voltage, which might result in an excessive use of pressure being applied to the motor on the last step by the addition of a relay only allowing the contactors to operate when the drop of pressure across the whole resistance, or the last section thereof does not exceed a predetermined value. (Two claims, two figures.)

25,772. **Control of Traction Motors.** W. A. Stevens. In order to ensure that two motors in petrol-electric, or electric cars shall take approximately the same current when in parallel, and to prevent one machine running as a dynamo and the other as a motor, an additional field coil is added in series with each motor armature, which tends to strengthen the main field, when the armature is running as a motor, but acts differentially when the armature tends to run as a generator, weakening the field, and thus creating a balance so that the two run in parallel as motors, taking the same amount of current. (Two claims, one figure.)

26,399. **Compound Tramway Rail.** J. S. Pullan. The girder portion and the flange form one piece. The replaceable tread is dove-tailed into an undercut longitudinal groove, and secured by taper keys for the insertion of which suitable spaces are left at intervals. (Two claims, one figure.)

1908 Patents

2,046. **Prevention of Rolling of Ships.** H. A. Mavor and Mavor & Coulson, Ltd. In this method of damping the rolling of ships a movable weight is employed, which tends to remain stationary as the ship rolls, and offers resistance to the rolling movement. The weight can be in the form of a carriage on a track transverse to the ship, the motion of which is damped by an electro-magnetic brake. (Three claims, two figures.)

7,493. **Telephones.** R. A. Tessenden. In these telephone transmitters and relays the varying microphone resistance is produced by the displacement of a floating electrode, supported to dip into a quantity of granules of carbon instead of the latter being enclosed in a chamber with yielding walls. The connections can be made so that the two sections of granules on both sides of the floating electrode are included in the two arms of a differential circuit. In the relay the floating electrode is attached to the armature of a differential relay. (Seven claims, five figures.)

8,133. **Commutators for High Speed Machines.** Siemens Brothers' Dynamo Works, Ltd. and E. O. Kieffer. In the type of high-speed commutator built with external steel rings, the segments are secured by conical end rings, provided with slots so arranged as to provide a certain amount of spring. By this means they are enabled to take up slackness of segments produced subsequently to building up by unequal expansion or vibration, and prevent the commutator becoming loose. (Two claims, three figures.)

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

16,780, Metallurgiska Patent Aktiebolaget. Apparatus for magnetic separation of ore.
21,106, Eisenstein. System of multiplex telegraphy.
21,212, McKee. Meter connections.
21,271, Evershed & Vignoles, Ltd., & Evershed. Apparatus for measuring electrical resistance.
21,460, Siemens Bros. Dynamo Works, Ltd., Altmann, & Lau. Armature windings.
21,588, Von Zweigbergk. Electric controllers for railways.
22,700, Hirst & Maurice. Means for supporting electric lamps.
23,780, Lindsay & Lindsay. Reversible and collapsible trolley pole for electric vehicles.
23,816, Cummins. Means of controlling brake power on electrical tramway and railway vehicles.
23,857, Chapman. Means for attachment to the trolley boom of an electric tram for the purpose of guiding the trolley wheel to the live overhead wire.
25,355, Capitaine. Electric arc lamps.
25,841, Crosta & Dilley. Brakes for road and tramway vehicles.
27,681, Jones. Electric resistances.
28,137, British Thomson-Houston Co. (*General Electric Co.*). Alternating-current induction motors.

1908 Patents

1,420, Chloride Electrical Storage Co. & Heap. Treatment of wood for use in batteries and electrolytic cells.
1,984, Electric Ignition Co. & Hall. Electric-ignition apparatus for internal-combustion engines.
2,480, Fried. Krupp Akt.-Ges. Electrically-driven elevating gear for ordnance.
3,634, Fried. Krupp Akt.-Ges. Electrically-driven elevating gear for barrel recoil ordnance.
5,160, Pieper. Electro-mechanical transmission systems for automobiles and the like.
6,149, Sykes. Electric switches.
6,412, Löwendahl. Electric sliding or other contacts.
7,747, Chambers Motors, Ltd., & Patton. High-tension magneto ignition apparatus for internal-combustion engines.
7,750, Ketchum. Electric locomotives.
9,697, Thames Iron Works Shipbuilding and Engineering Co., & Flood. Electric switches.
10,156, Erdmann. Apparatus for preventing collision between ships by means of electric waves.
10,172, Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*). Construction of telephone jacks.
12,050, Siemens Bros. Dynamo Works, Ltd. (*Siemens Schuckert-werke Ges.*). Electric fuses fitted with indicators.
12,927, Kavanagh. Tramcars or the like.
13,451, Siemens-Schuckertwerke Ges. Repulsion motors.
14,697, Siemens Bros. & Co. & Ferreira. Devices for indicating the position of railway points and the trains.
16,496, Fiddes & Seifke. Electric water-heaters.
16,900, Tayoux, Chauchy, & Fraysse. Magneto-electric machines.
18,222. Siemens Bros. Dynamo Works, Ltd. (*Siemens Schuckert-werke Ges.*). Fixing and supporting overhead electric traction conductors in tunnels and the like.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

18,372, Allgemeine Elektricitäts-Ges. Alternating-current dynamo-electric machines of the commutator type.
19,265, Marsh. Electric furnaces.
19,574, Felten & Guilleaume-Lahmeyerwerke Akt.-Ges. Manufacture of insulating-tubes.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	5⅞*	10—10¼	
Do. 4½% Cum. Pref.	10	4½	4½	9½—10	
Do. 6% Cum. Second Pref.	10	6	6	10⅜—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	4½*	4⅜—4⅝ xd	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	96—100	
Brompton & Kensington E. S. Co., Ld.	5	10	5%*	7—8	
Do. 7% Cum. Pref.	5	7	7	7—8	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½%*	3⅜—3⅞	-⅛
Do. 4½% Cum. Pref.	5	4½	4½	3⅝—4⅜	-⅛
Do. 4% Deb. Red	Stock	4	4%	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3½—4	
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	2⅛—3⅜	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10¼	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3⅜—4⅛ xd	
County of London Elect. Sup. Co. Ltd.	10	5	—	7—8	-½
Do. 6% Cum. Pref.	10	6	6%	10⅝—10⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4⅜—5⅛ xd	
Do. 5% Cum. Pref.	5	5	5%	5—5½ xd	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	—	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7⅞—8⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N'Ting Hill E.L. Cos. Db. Rd.	Stock	4	4%	96—100 xd	
London Electric Supply Corporation	3	2½	—	⅞—1⅜	
Do. 6% Pref.	5	6	6%	4⅝—4⅞	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¼—4½	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—4⅝	-⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E.Corp. for P. Dist. 1st Mt. D	100 & 500	4½	5⅜%	94—97	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	5⅛—5⅜	
Do. (fully paid)	4	8	2½%	4⅛—4⅜	+⅞
Do. 5% Pref. Do.	5	5	2½%	5⅛—5⅜	
Do. Do.	4	5	2½%	4—4⅛	+¾
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅝—6⅛	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	7½—8¼	
Do. 7% Non-Cum. Pref.	5	7	7%	6½—7½	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	½—¾	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2½—2¾	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	98 –101 xd	
Urban Elec. Supply Co., Ltd.	5	5	5%	½—1 xd	
Do. 5% Cum. Pref.	5	5	5%	1⅞—2⅜ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83 xd	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8—9	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	-1
Central London	Stock	3	3%*	69—71	-2
Do. 4% Preferred	Stock	4	4%	86—88	
Do. Deferred	Stock	2	—	49—52	-2
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	85—87	
City and South London Cons.	Stock	4½	1½%	32½—33½	-1½
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	7¾—8¼	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	½	1½%	39—40	-½
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	75—78	
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—78	
Metropolitan District	Stock	—	—	13—14	-½
Do. 6% Perp. Deb.	Stock	6	6%	124—127	-1
Do. 4% Deb.	Stock	4	4%	82—86	
Do. Perp. Extension Pref. (5%)	Stock	—	—	24—29	-1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	50—55	
Underground Elec. Railways Co. of London 5% Profit Sha. Sec. Notes	Various	5	5%	43—47	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	—	½—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	83—88 xd	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93 96	
British Electric Traction Co., Ltd.	10	—	—	¾—1½	-⅛
Do. 6% Cum. Pref.	10	6	6%	3⅝—4⅛	
Do. 5% Perp. Deb.	Stock	5	5%	91—92 xd	-2
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	—	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	98—102	

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation.	Rise o Fall since Last Week.
	£	%	%		
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5½	-½
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	73—78	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	92—95	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	78—82	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	3—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	58—61	
Do. 6% Pref. Ord.	Stock	6	6%*	103½—104½	
Do. Def. Ord.	Stock	1	—	16⅝—17½	-¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	88—90 xd	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½ xd	
Do. 10% Cum. Pref.	5	10	10%	8—9 xd	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½	13½—13¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—101½	
Do. do. (Mauritius Sub.)	25	4	—	101½—105½	
Eastern Ext. Australasia & China	10	7	6%	12½—13½	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	1½%*	136—139	
Do. 3½% Pref.	Stock	3½	3½%	85—87	
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅝—¾	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	118—120	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5½—5¾	
Do 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red.	Stock	4	4%	102—104	
Western Telegraph Co., Ltd.	10	7	6%*	13⅝—14½	
Do. 4% Deb.	Stock	4	4%	102—104	+½
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	7%	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	10%*	3⅜—3⅝ xd	-⅛
Do. 6% Pref.	1	6	6%	1½—1⅝ xd	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¼—6½	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—¾	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10¼	-¼
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅝—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅝ xd	
Do. 6% Cum. Pref.	1	6	6%	1—1¼ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A." £3 paid	5	2/6	—	⅛—⅜	
Do. do. (fully paid)	5	4/2	—	1½—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87 xd	+1
Electric Construction Co., Ltd.	2	—	—	⅞—1⅛	-⅛
Do. 7% Cum. Pref.	2	7	—	1¼—1⅜	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7⅛—8	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	84—88 xd	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16½—17⅝	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red.	100	4	4%	101—103	
Willans & Robinson, Ord. Shres.	1	5	—	¾—1⅛	
Do. 6% Cum. Pref.	5	6	6%	2½—3½	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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EXPERIENCE WITH ELECTRICALLY-DRIVEN ROLLING MILLS

NOT the least interesting of the Papers read at the Middlesbrough meeting of the Iron and Steel Institute was that by Mr. C. Koettgen, Managing Director, Siemens Brothers Dynamo Works, and Mr. C. A. Ablett, of the same firm. The authors at the outset emphasised the great facilities which the employment of electric power for rolling-mill driving offers for the exact measurement of the power required for different classes of work, and for accurate determinations to be made regarding the variation of the power required with different sections, temperatures, and materials. The Paper was accompanied by valuable tables giving results of this nature obtained in German practice. For example, bars 1·4 in. square can be rolled with an expenditure of energy of only 28·8 kw.-hours per ton, whereas tees 1·2 in. by 0·16 in. require as much as 136 kw.-hours per ton. From results such as these the average power required for a mill to perform given work can be estimated, and by making due allowance for the intermittent nature of the working. The rolling-mill motor, however, must be designed also with a view to the maximum power required, the proportion of which to the mean power will vary according to circumstances. In a three high mill, for instance, the motor must be so proportioned to meet the case of the heaviest passes occurring in each housing simultaneously. Again, the presence of a flywheel will reduce the maximum demand on the motor. A collection of curves are reproduced in the Paper to the magnitude of the variations in the load in a number of actual cases.

In order that the flywheel may equalise the fluctuations in the power, the motor and flywheel must fall in speed as the maximum power is required, to enable the flywheel to give up its stored energy, and the flywheel regains its stored energy again as it is speeded up in the interval between the passes. With a direct-current motor the necessary fall in speed can be obtained by using a compound-winding, but with a three-phase motor a resistance must be inserted in the rotor circuit, which increases the slip of the motor.

Curves are shown and explained for a case where the use of a flywheel reduced the maximum power which the motors were required to give from 1,980 h.p. to 1,200 h.p., while the maximum variation in speed was from about 7 per cent. There are cases, however, where heavy passes follow each other in too rapid succession for the flywheel to have time to recover its speed.

Where a three-phase motor is used, and the fall in speed is obtained by placing a slip resistance in the rotor circuit, a loss of power takes place in the slip resistance which is proportional to the slip required and to the power which the motor is giving. No such loss of power takes place in the case of a direct-current motor where the fall in speed is obtained by using a compound winding. In consequence of this, with a three-phase motor, a less fall in speed is usually allowable than is the case with a direct-current motor, and consequently a heavier flywheel has to be used to give out the same amount of energy.

An automatically-controlled slip resistance is sometimes used, arranged to be only fully in circuit when the motor current exceeds a certain predetermined limit, and is switched out again at lighter loads. There is not, however, the saving in efficiency which would appear at first sight, as the slip resistance remains connected in circuit during the periods of maximum load (when the power lost is also maximum), whether it is provided with an automatic arrangement or not, and it is only switched out of circuit during the periods of minimum load when the loss of power is comparatively small. There are, however, some cases where it is an advantage.

The replacement of steam by electrical driving has almost invariably been found to increase the output of the mill, and sometimes by as much as 50 per cent., mainly owing to the steadiness of the speed, which greatly facilitates handling of the material and the less reduction of speed on overloads, owing to the greater overload capacity of electric motors, and their power of responding more quickly than steam engines to sudden demands for power.

In dealing with matters of detail, the authors emphasised the desirability of using flexible couplings between the motor and the rolls, and described one or two suitable forms.

In the latter portion of the Paper figures and curves are given relating to power taken at each successive pass in reversing cogging mills, which are usually equipped on the Ilgner system. It is pointed out that the electrical equipment is working economically in the sense that the greatest output is obtained for a given capital outlay, if the draughts are taken so that the motor is giving constant torque at each pass, this torque being the maximum working torque of the motor. It must be remembered, however, that if the mill motor is giving constant torque during each pass, it will require much more energy during the last passes than during the earlier ones, as the ingot is becoming longer, and so takes longer to go through the rolls. It is therefore advisable to reduce the draught in the last few passes, the torque which the motor is required to give for these reduced draughts being correspondingly reduced, as otherwise the flywheel set will have to be unduly large.

ELECTROMETALLURGY

IN *Electrochemical and Metallurgical Industry* of October, Mr. L. Robert Whitehead concludes his description of the electrolytic refining of gold, silver, and copper at the United States works at San Francisco. An illustration is given of the melting room, which contains four melting furnaces holding from 80 to 100 graphite crucibles. The furnaces are heated by means of oil fuel, and differ from those of the Denver equipment in that they contain an open top with the circular combination chamber, the consumption of oil in this furnace being very low. With seven furnaces in operation working seven hours per day the total cost per month does not exceed 60 dollars, and this is remarkably low considering about 600,000 ounces are melted each month. He then gives a comparison of the methods used by the different mints. In San Francisco the Thum process with certain modifications is employed, for example, particularly in respect to the circulation of the electrolyte necessitating the employment of a larger quantity of solution, but it is more readily purified than in other processes. Other mints employ the Tuttle process, and in this process it is necessary to have a rolling mill for making the silver cathodes, which, in the bath are placed about three inches apart from the anode, each anode, however, being individually bagged. The anodes consist about one-third part of gold, and as the silver dissolves from them the gold remains intact, and therefore does not crumble away and press down in the bags.

In dealing with an outside plant it would probably be different, because very few plants employ metal containing as much as 50 parts per one thousand in gold. The gold would, therefore, fall off as slime and work through the bags, and another point is that the propeller system of circulation causes too much agitation in the baths. The deposited silver, however, is not actually coherent, because it trees very considerably, and therefore it is necessary to take out the cathodes and scrape them every day in order to prevent short circuiting. Another disadvantage is that about 10 per cent. of the deposit falls to the bottom of the tank. The chief drawback of the process from a commercial standpoint is the low current density required if a coherent deposit is to be obtained (7-8 amperes per square foot of cathode surface at the commencement, but later from 4-5 amperes). There is one advantage over the Thum process in that an E.M.F. of 1 volt is sufficient with this process, whereas the other requires 3½ volts. The addition of small quantities of gelatine improves the coherency of the deposit. In one of the mints the powdered silver which falls to the bottom of the bath is melted and refined by means of the Thum process, while in another it is used together with the daily scrappings from the cathode to make silver nitrate for replenishing the electrolyte. The anode residue of gold, which is, as already mentioned, solid, is of a chocolate colour, and generally has a silver core running through it, so that it has first to be parted in nitric acid, and finally in sulphuric acid. By this treatment it is got sufficiently low in silver to be refined by the Wohlwill process.

The author says that he is not surprised that the Wohlwill process has not been taken up commercially outside the mints because anyone going through the Government plants and seeing the large amount of gold which is tied up in the process concludes naturally that this is necessary. For example, the electrode bars are covered with strips of fine gold as also are the hangers. Large stocks of gold chloride are always kept on hand, and big reserves of anodes and cathodes. It would not pay industrially to keep such a large quantity of valuable material in stock, but the author says that the electrodes can be made of the same material. Cathodes of fine rolled silver can be used upon which to deposit the gold, which can afterwards be stripped off, which can easily be done, as the author has made experiments with proof gold, and found, after stripping, that the gold assayed 998·5, and the hangers and straps may be of fine silver.

By using a cathode with only one side exposed for deposition, 85 per cent. of the gold can be removed in 24 hours, and the remaining 15 per cent. in 48 hours. Consequently the gold con-

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stantly tied up would be the amount in the electrolyte. When one considers that the Government refiners are saving yearly about 50,000 dollars' worth of platinum with very little expense, and for which nothing is paid, it would seem to be about time that industrial plants commenced to test this process commercially.

In *Stahl und Eisen*, 1908, Vol. 28, p. 1237, G. Hannack describes the best class of steel for magnets. In order to prepare steel for permanent magnets it is necessary that it should be hard, as it is found that with increase in hardness the adhesive power increases. After a certain grade of hardness, however, a maximum is reached; then further hardening causes it to decrease. According to Madame Sklodowska-Curie, the maximum carbon content of the steel must not be beyond 1·2 per cent. It is also necessary for the magnet steel to be fine grained, and this is caused by the addition of tungsten. If, however, too large a quantity of tungsten is added, the steel becomes less valuable for magnetic purposes. Manganese is said to be harmful, but the author finds that manganese does not particularly affect the power of being magnetised, but it decreases the permanency. For example, magnet steel with from 0·2 to 0·3 of manganese readily magnetises, but rapidly loses its magnetism. Small quantities of silicon are not objectionable. A specially good steel was found to consist of carbon 0·597 per cent., tungsten 5·369 per cent., manganese 0·176, phosphorus 0·018, sulphur 0·038, silicon 0·255, and copper 0·004. Any considerable quantity of sulphur, phosphorus, copper, or nickel, is objectionable. Molybdenum can be used, but it is expensive; also chromium behaves very much like tungsten, but titanium must not be employed.

NEW BOARD OF TRADE REGULATIONS FOR PRIVATE TRANSMISSION LINES

The Board of Trade have issued a revised set of regulations under section 4 of the Electric Lighting Act of 1888, which relates to the erection of overhead wires, &c., where the owners are not subject to the provisions of a licence, provisional order or special Act of Parliament. These regulations, of course, only apply in those cases where the safety of the public is involved, and have also been drafted to safeguard the telegraph and telephone systems of the country. In comparison with the old edition the scheme of the new regulations has been considerably altered both in the matter of arrangement and subject matter. For instance, a pressure exceeding 500 volts continuous, or 250 volts alternating, was formerly regarded as high pressure. It will also be seen that special sections are now devoted to "Sub-stations and Transformers," "Compulsory Connection of a three-wire System with Earth," and "Optional Connection of other Circuits with Earth," while sections on "Street Boxes" and "Arc Lamps" which appeared in the old regulations have been deleted.

We give the new regulations in full below:—

Definitions.

In the following regulations:—The expression "Energy" means electrical energy, and for the purpose of the Electric Lighting Act, 1888, and these regulations, electrical energy shall be deemed to be an agency within the meaning of the word "electricity" as defined in the Electric Lighting Act, 1882. The expression "Owner" means any body or person owning or using or entitled to use any electric lines or works, upon whom notice has been served by the Board of Trade requiring that such electric lines or works shall be continued and used only in accordance with these regulations. The expression "Consumer" means any body or person supplied with energy by the Owner. The expression "sub-station" means any premises in which energy is transformed or converted for the purpose of supply to consumers, and which are large enough to admit the entrance of a person after the transforming or converting apparatus is in position, provided that for the purpose of these Regulations any place within any such premises which is used solely for some purpose other than such transformation or conversion shall not be deemed to form part of a sub-station. The expression "Overhead line" means any electric line which is placed above ground and in the open air. The expression "Service line" means an electric line through which energy may be supplied or intended to be supplied by the Owner to any premises other than the premises where the energy is generated. The expression "Pressure" means the difference of electrical potential between any two conductors through which a supply of energy is given, or between any part of either conductor and the earth; and (*a*) Where the conditions of the supply are such that the pressure at any pair of consumer's terminals does not exceed 250 volts, the supply shall be deemed a low pressure supply. (*b*) Where the conditions of the supply are such that the pressure exceeds 250 volts but does not exceed 650 volts, the supply shall be deemed a medium pressure supply. Other expressions to which meanings are assigned in the Electric Lighting Acts, 1882 and 1888, have the same respective meanings in these regulations.

General.

1. Nothing in these regulations shall be deemed to authorise the owner to break up or interfere with any street.

2. When the pressure of the supply exceeds 250 volts, all wires, switches, and metal work in connection with the supply shall be so enclosed or shall be fixed in such a manner that there shall be no risk of any shock being obtained by inadvertence or in the ordinary handling thereof.

3. Where the pressure of the supply exceeds 650 volts, the supply shall be subject to such further regulations as the Board of Trade may make, or shall be given on such conditions as they may prescribe.

4. The insulation of every electric circuit (whether connected with earth in accordance with these regulations or not) including all machinery and apparatus, forming part of the maxinection with that circuit, shall be so maintained that the leakage current shall not exceed one-thousandth part of the maximum current; and suitable means shall be provided for the indication and localisation of leakage. Every leakage shall be remedied without delay. Every such circuit shall be periodically tested for insulation.

5. In the use or delivery of energy, the owner shall exercise all due precautions so as to avoid the risk of causing electric shock or fire, and shall be responsible for all electric lines, fittings, and apparatus belonging to him, or under his control, being maintained in a safe condition.

6. Any electric line or any support therefor exposed to liability to injury from lightning, shall be efficiently protected against such liability.

7. All mains below ground shall be so laid and protected as to avoid risk of damage by accumulation of gas or leakage of electric current.

8. Where any accident by explosion or fire, or any other accident of such kind as to have caused or to be likely to have caused loss of life or personal injury has occurred at any part of any electric line or other works, the owner shall give immediate notice thereof to the Board of Trade.

9. Every reasonable means shall be employed in the placing and use of electric lines to prevent injurious affection, whether by induction or otherwise, to any electric lines or other works of the Postmaster-General or the telegraphic communication through any such lines.

10. (*a*) The owner on receipt of these regulations shall forthwith serve upon the Postmaster-General a notice describing every electric line used for the supply of energy, together with a plan showing the mode and position in which such electric line is laid. (*b*) The Postmaster-General, upon consideration of such notice and plan, may require such alteration in the position and mode of laying, or mode of use of such electric line, or compliance with such other conditions as he may think necessary for the due protection of his electric lines or other works, and any failure on the part of the owner to comply with such requirements shall be deemed to be a non-compliance with these regulations. (*c*) Any notice required to be served upon the Postmaster-General under these regulations may be served by being addressed to him, and left at, or transmitted through the post to the General Post Office, London, and any notice required to be served on the owner may be served by being addressed to him and left at, or transmitted through the post to, his office or last known place or address.

Overhead Lines for Low-Pressure and Medium Pressure Continuous-Current Supply and for Low-Pressure Alternating-Current Supply.

11. All overhead lines shall be attached to insulators, and shall be so guarded that they cannot fall away from the support.

12. An overhead line shall not in any part thereof be at less height from the ground than 22 ft., except with the consent of the Board of Trade, and shall not be accessible to any person without the use of a ladder or other mechanical means.

13. Where an overhead line crosses a street, the angle between the line and the direction of the street at the place of crossing shall, where practicable, be 60° at least, and the spans shall be as short as possible.

14. Where an overhead line crosses, or is in proximity to, any wire or metal, precautions shall be taken by the owner against the possibility of the line coming into contact with the wire or

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metal, or of the wire or metal coming into contact with the line by breakage or otherwise.

15. Every support for an overhead line shall be of a durable material, and shall be properly stayed against forces due to wind pressure, change of direction of the line, or unequal lengths of span.

16. The interval between any two wooden poles used singly as supports for an overhead line shall not exceed 200 ft. In the case of supports other than single wooden poles the intervals between the supports shall be such as may be prescribed by the Board of Trade.

17. The factor of safety shall be for overhead lines at least five, and for wooden poles at least 10, and for iron or steel structures at least six, taking the maximum possible wind pressure at 30 lb. per square foot. No addition need be made for a possible accumulation of snow.

18. Service lines from overhead lines shall be led as directly as possible to insulators firmly attached to some portion of the consumer's premises which is not accessible to any person without the use of a ladder or other special appliance. Every portion of any service line which is outside a building, and is within 7 ft. from the building, shall be efficiently protected by insulating material.

19. Every overhead line, including its supports and all the structural parts and electrical appliances and devices belonging to or connected with the line, shall be duly and efficiently supervised and maintained as regards both electrical and mechanical conditions.

20. Where a supply is given by overhead lines from a two-wire system, with the negative conductor connected with earth, the positive conductor shall be placed above the negative conductor in such a manner that in the event of breakage it must fall on the negative conductor.

21. Where a supply is given by overhead lines on the three-wire system, the positive and negative conductors shall be placed side by side above the intermediate conductor. The intermediate conductor shall consist of two wires placed side by side at a distance apart greater than that between the positive and negative conductors, and connected in each span by two cross wires, placed in such a manner that in the event of either the positive or negative conductor breaking it shall fall on one at least of the cross wires.

22. The owner shall remove any overhead line upon ceasing to use it for the supply of energy, unless upon so ceasing he satisfies the Board of Trade that he intends to bring it into use again within a reasonable time.

23. Overhead lines for pressures exceeding medium pressure continuous current or low pressure alternating current shall be subject to such futher regulations as the Board of Trade may make or such conditions as they may prescribe.

Sub-stations and Transformers.

24. Sub-stations shall be established in suitable places, and shall be in the sole occupation and charge of the owner, and subject to any requirements of the Home Office. Where transformers are used in any other premises (not being sub-stations as defined for the purposes of these regulations) they shall be so guarded and protected as to avoid the risk of causing electric shock.

Compulsory connection of a Three-wire System with Earth.

25. Where the pressure of a supply between the adjacent conductors of a three-wire system of mains exceeds 125 volts, the intermediate conductor shall be connected with earth, in accordance with the following conditions:—(*a*) The connection with earth of the intermediate conductor shall be made at one point only on each distinct circuit, namely, at the generating station, sub-station, or transformer, and the insulation of the circuit shall be efficiently maintained at all other parts. (*b*) The current from the intermediate conductor to earth shall be continuously recorded, and if it at any time exceed one-thousandth part of the maximum supply current, steps shall be immediately taken to improve the insulation of the system.

Optional connection of other Circuits with Earth.

26. The owner may, with the approval of the Board of Trade given with the concurrence of the Postmaster-General (but not otherwise), connect any other circuit with earth, provided the following conditions are complied with (namely):—

General.—The connection with earth shall be made only where energy is delivered to each circuit, that is to say, at a generating station, sub-station, or transformer, and shall be made at a neutral point in the circuit and in such a manner as will ensure at all times an immediate and safe discharge of energy. The connection with earth shall be efficiently maintained, except when it is interrupted by means of a switch or link for the purpose of periodical tests for ascertaining whether any current is passing by means of the connection to earth. The insulation of the mains shall be efficiently maintained at all other parts. Tests shall be periodically made to ascertain whether any current is passing by means of the connection to earth, and if at any time the current so passing exceeds one-thousandth part of the maximum supply current of the circuit, steps shall be immediately taken to improve the insulation.

Special.—1. Separate or three- or four-core mains used for alternating current where a low pressure supply is given between a phase and the neutral point, or where the pressure between any two conductors exceeds 250 volts. The connection with earth shall be made in the case of (*a*) a single-phase supply, at the neutral point on the winding of the transformer; (*b*) a two-phase three-wire supply, by means of the third wire; (*c*) a two-phase four-wire supply, at the neutral point on the winding; (*d*) a three-phase three-wire or four-wire supply, at the neutral point on the star winding. 2. Concentric mains used either for continuous or for alternating current. The connection with earth shall be made by means of the external conductor.

CATALOGUES AND PAMPHLETS RECEIVED

ADVERTISING SIGNS.—The General Electric Sign and Engineering Co., Ltd., of Cambridge Circus, W.C., have sent us a circular describing a neat form of thermal flasher for electric signs and convenient portable single light show card flasher for connecting by an adapter and flexible cord to an ordinary lamp-holder.

ALUMINIUM WIRE.—New leaflets recently issued by British Insulated & Helsby Cables, Ltd., give prices and particulars of aluminium wire and strip from their own rolling mills and wire drawing plant. Annealed aluminium wire has an electrical conductivity 60 per cent. of annealed copper (100 per cent. Matthison standard), and for the same resistance as copper the diameter is 1·29 times greater. The ultimate tensile strength varies from 10·8 to 15·2 tons per square inch, and the elastic limit is approximately three-quarters of this. Sizes are listed from Nos. 40 to 0000 S.W.G., and a list of some of the most important aluminium transmission lines is given. The firm have patented a special method for making welded aluminium joints. The principal feature in this method is a sleeve or trough made of a metal having a higher melting point than aluminium, preferably brass or copper. This sleeve is fixed over the butted ends of the wires or strips to be jointed, and acts both as a mould for the molten metal and as a centreing device for the two ends. Heat is applied to the outside of the sleeve until the wires inside become molten at their adjacent ends when longitudinal pressure is applied to the wires. By this means the oxidised metal is forced outwards, enabling clean metal to come in contact and form the joint. They have also designed and patented a hand welding tool for welding wires by the method described above. The tool is composed of two jaws or clamps to hold the wires, the jaws sliding on a central bar to which is attached a handle. Longitudinal pressure is automatically applied to one jaw by means of a compression spring. By means of this apparatus and one spirit blow lamp, aluminium wires from 0·250 in. diameter down to 0·020 in., or even smaller, can be readily welded.

CONTINUOUS CURRENT MOTORS.—A list is to hand from Messrs. Johnson & Phillips, giving prices for protected ventilated and enclosed type motors, either series, shunt, or compound wound, for 110, 220, and 440 volts, and also prices for the spare parts and armatures and shipping specification of each size of motor. Another list deals with the various materials required by electrical contractors and engineers who have to handle cables. Both lists are coded for the convenience of foreign firms.

DEMAND INDICATORS.—A leaflet from British Insulated & Helsby Cables, Ltd., describes the Fricker patent maximum demand indicator which they now manufacture. This instrument consists of a new and extremely simple form of recording differential thermometer, one bulb of which is heated by a resistance coil or strip carrying the current whose maximum is to be recorded. The thermometer contains a single drop of mercury, which serves the double purpose of a gas valve and a recording index. The expansion of gas in the heated cylindrical bulb causes a definite transference of gas past the mercury valve into the spherical bulb, corresponding to any given current, and on removing the thermometer from the heating coil, or switching off the current, the contraction of the gas in the cylindrical bulb, on cooling, causes the mercury to travel along the stem to a point determined by the total volume of gas originally transferred during the heating process. A special form of the instrument combined with an ordinary porcelain tube switch fuse is made for use in feeder pillars, &c.

DYNAMOS AND MOTORS.—Two recent lists from Messrs. Johnson & Phillips, Ltd., of Charlton, are to hand. One of these deals with continuous current dynamos, and gives prices for shunt and compound-wound machines for open, protected, and totally enclosed types, both for 110, 220, and 440 volts. The

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other gives prices for alternating current motor and starters. The A.C. Motors lists are for two- or three-phase, and the prices cover for machines with wound rotors, and also short circuited rotors for pressures up to 500 volts. Protected, ventilated, enclosed, and totally enclosed type machines are dealt with. We are asked to state that copies will be sent to anyone interested.

FUSE BOXES.—New leaflets have been issued by British Insulated & Helsby Cables, Ltd., of special transformer fuse boxes for enclosed cartridge fuses with fittings mounted on corrugated porcelain insulators, and with separate disconnecting chambers lined with fireproof insulation; trifurcating boxes cut in halves, and provided with a brass gland for connecting a lead-covered three-core cable and porcelain terminal sleeves; and tramway section boxes with switch fuses.

GAS PRODUCER PLANT.—An attractively printed catalogue from Messrs. Joseph Baker & Sons, Ltd., gives particulars of the new Pearson Automatic Gas Producer, which can be seen in operation at pavilion No. 136 of the Franco-British Exhibition. One of the features of this plant is the use of a large charging hopper holding enough fuel for a 10- or 12-hour run, avoiding the necessity for disturbing the action of the producer by the opening of the charging door during a day's run. The arrangement of vaporiser forming a jacket round the hottest part of the fire, and therefore automatically governed by its heat, is also novel. A specially efficient scrubber is used, and also a chemical purifier. In this apparatus much cheaper qualities of fuel than suited to the ordinary suction producer can be used.

HOUSE FUSE BOXES.—A new catalogue from British Insulated and Helsby Cables, Ltd., deals with "Prescot" house fuse boxes of the separate pole, and multiple way types with asbestos-covered fuses.

INDESTRUCTIBLE CABLES.—A booklet from the Indestructible Cable Co. calls attention to the special cables made by this company to resist acid fumes, damp, and other atmospheric influences, and points out the various uses for which they present particular advantages. The insulation consists of a jute covering, impregnated with a mixture of red lead, linseed oil, and other patent ingredients, which become harder and of higher insulating property with time and exposure, and are said to form so hard a crust round the copper that it is practically impossible to cut through the coating with a knife.

METAL FILAMENT LAMPS.—An effective show-card has been issued by Simplex Conduits, Ltd., relating to Simplex metal filament lamps. Father Time is shown holding one of the lamps, which are described as being the light for all time.

PATENT LITERATURE.—Messrs. Browne & Co., of 9 Warwick Court, Grays Inn, patent agents, have just published a new edition of their chart giving information in a convenient form as to the conditions and procedure regarding British and foreign patents, designs, trade marks, and copyrights. This has been revised to include the provisions of the new Patent Act, and gives a great deal of useful information in a convenient form.

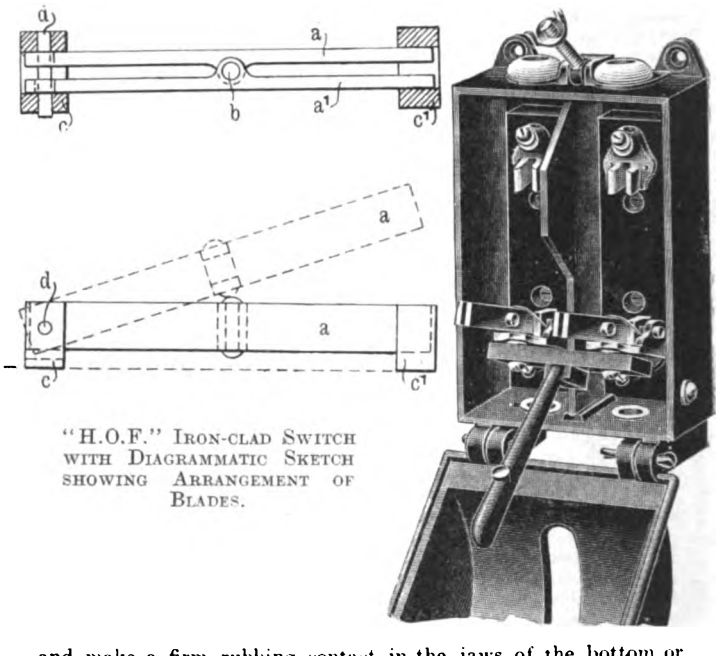
SHIP AND FACTORY FITTINGS, &c.—One of the latest catalogue sections to be issued by the Edison & Swan United Electric Light Co., Ltd., is a new edition of that devoted to ship, factory, colliery, street, and traction fittings. In addition to a variety of fittings of simple and substantial nature for the purposes named, including a series of all porcelain, non-corrodible fittings, particulars are given of special watertight and insulated nipple patterns of holder, and a dust- and damp-proof protector for ordinary lamp-holders.

SHOP WINDOW FITTINGS, SHADES, &c.—A leaflet from the Sun Electrical Co. gives particulars of the Adjusto patent window fitting, in which tubular lamps provided with reflectors are used, carried in holders, mounted on bail and socket fittings on T pieces at intervals along a tube. The whole is a self-contained fitting, easy to fix and very flexible in its applications, as the lamps can be burned individually in any direction and to any angle. A further list deals with special designs of glass shades for tantalum and Osram lamps.

The Marseilles Congress.—The Congress on the applications of electricity held in connection with the Marseilles Exhibition appears to have been attended by a considerable number of members, although the proportion in which different nationalities were represented were hardly such as to render it very international in character. The proceedings commenced on Monday morning, September 13th, when the Congress was opened by Prof. Maurice Levy in the absence of M. Berthou (Minister of Public Works). In the afternoon Prof. C. Fabry, of Marseilles, read a Paper on the electrical features of the exhibition, and the sittings of the nine sections into which the Congress was divided commenced the following day, and continued until the Thursday. As a general rule, however, only a few of the sections held meetings each day. Many of the discussions—and these covered a range of subjects too long to particularise—were long and vigorous, but a number of Papers announced appear not to have been read. In connection with the Congress, several visits were paid to generating stations and other electrical installations in the district. No official British delegate was present, and it is reported that Great Britain was only represented by two visitors.

A NEW IRON-CLAD SWITCH

THE accompanying illustrations represent a new iron-clad switch recently put on the market by Messrs. H. O. Farrell & Co., which presents some interesting features. As will be seen from the diagram, each blade is made in two portions hinged together at their centres, and so arranged that when the tip of the blade is compressed in entering the jaws of the top contact block, the other ends of the contact bars are forced apart

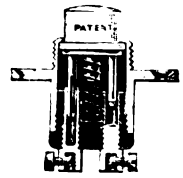


"H.O.F." Iron-clad Switch with Diagrammatic Sketch showing Arrangement of Blades.

and make a firm rubbing contact in the jaws of the bottom or pivot contact block. The contact pressure is thus equal at both ends of blade. In opening the switch, immediately the blade leaves the jaws of the top contact block, the pressure at the pivot end is relieved, and blade is free to move rapidly to the off position. Any wear at pivot end is taken up automatically and a good contact maintained indefinitely.

A NEW BELL-PUSH MOVEMENT

AMONG several novelties for the coming season which have been brought out by Messrs. A. P. Lundberg & Sons, is an entirely new pattern of bell-push movement, which has been particularly designed for combined outfits for shipboard and similar purposes, consisting of switch wall plug and bell-push all on one base, and combined to form a shallow surface or flush fitting, but equally applicable to ordinary purposes. The construction of the bell-push is seen from the accompanying section, which is self-explanatory. The action is easy and agreeable, and the outer shell is effectively insulated from current-carrying parts. The actual contacts are of platinum.



"Pixy" Bell Push.

"The Electron."—The third number of this magazine, which is conducted by the staff of the Siemens Stafford Works, maintains the good qualities shown in its predecessors. The frontispiece is a portrait of the late Sir William Siemens, an account of whose earlier work is also included. The two main features of the number are reprints of Papers on "The Plastic Deformation of Solids," and "Notes on Life of an Incandescent Lamp," read before the Siemens Stafford Engineering Society. Both of these are highly mathematical, but lighter literature is also present in the shape of a sensational tramway story, entitled, "The Last Car," and the chronicles of the doings of the various Siemens literary, athletic, and other societies.

Proposed London Electric Railway.—A meeting was held at the Westminster Palace Hotel on Wednesday last week to consider the scheme referred to in our last issue for the construction of a new railway 4¾ miles in length, linking up the London & South Western and the Metropolitan District Railway systems at Wimbledon with Sutton and the intermediate districts. It is estimated that the necessary land could be purchased, and the line constructed for £250,000. A resolution was passed in favour of the proposal, and a committee was formed to consider, and, if thought fit, to carry forward the scheme. The proposal is to be the subject of a separate Bill in Parliament.

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ELECTRICAL ENGINEERING

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☞ **Manchester Exhibition Supplements.** With this issue, No. 4 of a series of five supplements describing the Manchester Electrical Exhibition is given *Gratis.* All readers should see that this supplement is included in their copy of to-day's "Electrical Engineering."

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SUMMARY

Descriptions of the exhibits at the Manchester Exhibition are contained in the fourth of our series of supplements which accompanies the present issue.

Mr. A. du Pasquier suggests in our correspondence columns that the recent accident at the Underground Railways generating station might have been avoided if certain precautions had been taken—for instance, the use of bare copper from the generator cable trifurcating-box to the trifurcating-boxes for the feeders, or the employment of oil switches with top connections. Messrs. Handcock & Dykes and Messrs. Nalder Bros. & Thompson, writing with reference to Mr. G. Wilkinson's letter in our last issue, call his attention to the latter firm's limit switch. (Page 560.)

An electric mineral railway 2¼ miles in length is in use in connection with the Consett Iron Company's Chopwell Colliery. The line is worked by a Siemens' 14-ton electric locomotive equipped with two 56 h.p. continuous-current motors, taking current from a 500-volt overhead line. One motor is carried on each of the two bogies, and the wheels of each bogie are coupled. The latest form of bow contact is used. A telephone line runs along the same posts as the trolley wire, and special precautions are taken to prevent damage should the wires come into contact. (Page 561.)

A list of the awards for electrical exhibits at the Franco-British Exhibition is given on page 563.

At the quarterly meeting of the Northern Section of the Electrical Contractors' Association, which was held at Manchester on Saturday last, the question of the prejudiced interference of Corporation officials, and more especially fire insurance inspectors, with the work of electrical contractors was brought up. After a discussion on the subject, the matter was referred to headquarters for consideration. At the "Propagandist" meeting held in connection with the Electrical Exhibition, Mr. L. G. Tate, the Secretary, gave a lucid account of the origin, aims, and successes of the Association. (Page 564.)

The sittings of the International Conference on Electrical Units and Standards have been continued during the week, and agreement has been arrived at regarding the ohm and ampere as primary units as represented by a column of mercury and the indications of the silver voltameter respectively. Other matters discussed have included specifications for standard cells for use as practical standards of voltage, and a scheme for the establishment of a permanent international authority to deal with such matters in future. (Page 564.)

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An instruction to the Committee which will consider the London and District Electricity Supply Bill was passed in the House of Commons on Monday to the effect that the London County Council should be named in the Bill as the purchasing authority. There was considerable opposition on the part of members representing constituencies in the area scheduled in the Bill, but outside the London County area, on the ground that the purchasing authority should be composed of representatives of all authorities owning electrical undertakings. Another section of the opposition desired the House to deal with the details of the purchase clause, but Mr. Churchill, on behalf of the Government, explained that it was the desire to have the Bill thoroughly examined by a Committee, and if some of the clauses did not meet with approval when the Bill was returned to the House, members would be free to vote as they wished. (Page 566.)

In answer to a number of questions in the House of Commons on Monday, the Postmaster-General stated that the National Telephone Co. were not suspending their construction work, but had stated that it would not be to their interests to undertake the construction of new plant which would not be brought into use before the end of their licence. In this way a certain number of employees were being discharged, but the Post Office was doing its best to find employment for these men. A circular issued by the National Telephone Staff Transfer Association suggests a joint purse arrangement between the Post Office and the company, to enable further construction work to be carried out. (Page 566.)

On Saturday last 25,000 people visited the Electrical Exhibition at Manchester. The rumour that has been circulated that the Exhibition will be kept open until November 14th instead of being closed on October 31st is without foundation. (Page 567.)

In the report of the Bradford Technical College for the session 1907-8 regret is again expressed at the absence of an adequate equipment in the electrical engineering section.—A return recently issued shows that the Edinburgh street lighting includes 1,193 arc lamps. —In dealing with the work of the electrical undertaking of the Liverpool Corporation for the past year, Sir Charles Petrie, the Chairman of the Electricity Committee, states that a sum of £27,500 has been contributed to the relief of rates.—Mr. W. M. Mordey is to receive a fee of 250 guineas for his report upon the working of the G.B. surface contact system in London. —The L.C.C. has decided to put in hand new tramway works at an estimated cost of £281,265.—In the elective auditor's report to the St. Helens Corporation it is suggested that the only alternative to meeting the continued loss upon the tramways, which are leased to a company, is for the Council to work the lines themselves.—The Southampton Corporation is recommended not to assent to the proposal of a London company to run a service of electrical omnibuses.— The sale of the Swansea municipal telephone service resulted in a profit to the Corporation of £927. In their report upon the electricity undertaking at Swansea the elective auditors call attention to the absence of provision for depreciation. (Pages 567-569.)

The Manchester Corporation require high-pressure steam and feed pipes, &c., at the Stuart Street power station. A storage battery is required at Epsom, stores by the London County Council, and a wheel-turning lathe by the Salford Tramways Committee. The Local Government Board has sanctioned loans of £10,500 for electrical purposes at Stockport and £18,400 at Maidstone. (Pages 569-570.)

The report of Messrs. Ferranti, Ltd., for the year to June 30th shows a net balance of £3,275, after deducting all expenses and charges including allowance for depreciation, debenture interest, &c. Prior lien debentures for £20,000 have been issued during the year. After payment of all charges there is a net profit of £7,577 shown in the accounts of Messrs. Drake & Gorham for the year ended June 30th. A dividend of 5 per cent. is declared, carrying forward £1,327. The Electric Supply Corporation's accounts show profits amounting to £5,456, an increase of nearly 100 per cent. over the previous year. The debenture interest, and interest on temporary loans, has been paid, in addition to 5 per cent. on the share capital from the sum received from the guarantors. At the meeting of the Cleveland & Durham Electric Power Company last week, reference was made to the serious effect which the engineering strike, coupled with general trade depression, has had upon the Company's business during the past year. (Page 571.)

In a paper read before the Verband Deutscher Elektrotechniker by Mr. H. Remané, of the Auergesellschaft of Berlin, the relative running costs of small open and enclosed arc lamps and high candle-power metal filament lamps are compared. On the basis of average figures for candle-powers and current consumptions in both cases curves are deduced, which point to the conclusion that for light units of between 100 and 500 mean hemispherical candle-power the Osram lamp is both more efficient as regards current consumption, and more economical even when the costs of renewals are included. (Page 573.)

The first meeting of the Council of the Electrotechnical Commission was held at the new home of the Institution of Electrical Engineers, Victoria Embankment, on Monday, when the Rt. Hon. A. J. Balfour gave an address of welcome. Owing to the lamented death of Lord Kelvin, the chair was taken by Sir John Gavey. Prof. Elihu Thomson was unanimously elected President of the Commission for the coming year, and Col. Crompton hon. secretary. In his report, the hon. secretary detailed the work that has been done up to date, and stated that in ten countries, electrotechnical committees had been officially constituted and were in full working order; in six countries committees will be formed shortly, and in six countries the matter had been considered with a view to forming such committees. A vote of thanks was passed to the Institution of Electrical Engineers for the part they had taken in the formation of the Commission. (Page 575.)

A new bedside switch and a new pattern of distribution board are described in short articles on page 574.

Among the patent specifications published by the Patent Office on Thursday last is one by Eversheds & Vignoles, Ltd., and S. Eversheds, describing a direct-reading potentiometer for measuring low resistances; the indicating instrument is provided with differentially acting, moving coils. Another by M. Cummins provides for interlocking arrangements to prevent a tramway driver from trying to use a magnetic brake with the wheels skidding. The application of centrifugally-operated switches for bridging over cuts in the rotor rings of a squirrel-cage induction motor when the motor speeds up is patented by the British Thomson-Houston Co. The preparation of wood for use as separators or supports in accumulator cells is described in a specification by the Chloride Electric Storage Co., Ltd., and B. Heap, and a form of tumbler switch for heavy work is patented by W. H. Flood. A patent for a particular form of electrolytic apparatus, granted to C. Kellner, and two others granted to H. J. Creffield, and W. Alexander and W. E. Thompson, for an arc lamp cut-out and a prepayment meter respectively, expire during the current week. Short abstracts of these are given in our Patent Record. (Page 578.)

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Mr. George Wilkinson, in a letter which we published last week, referring generally to some of the problems introduced by the extended use of metal filament lamps, mentioned, among other things, the desirability of a change in the methods of charging small consumers for current. There are now a large number of consumers, or potential consumers, whose demand is so small that, even if it starts the meter, it represents a yearly bill not very much greater than the meter rental that should be charged; and it is almost self-evident that such consumers must be put on a contract system of charging instead of on meters. In small districts we favour the use of locked lamp-holders and free lamp renewals as a part of the contract; some supply station engineers, however, are searching for a limit switch to use in such cases, which dims the lamps or causes them to flicker when the consumer's demand exceeds that which he has contracted for. The limit switch has also been proposed by Messrs. Handcock & Dykes, in conjunction with a meter for their "contract demand" system of charging, but it is to the smaller consumers, whose demand does not justify the provision of a meter, that Mr. Wilkinson particularly refers. He asks for a suitable limit switch, and one firm has already replied that they have one on the market; by a coincidence this very switch was described in our columns in the same issue as Mr. Wilkinson's letter was published. We described two other devices for this purpose a few weeks ago, both of German manufacture, but apparently Mr. Wilkinson desires a greater variety to choose from, and something cheaper. Perhaps other makers can offer alternative designs, or possibly Mr. Wilkinson has an idea of his own "up his sleeve." In the meantime we trust that the perennial subject of systems of charging will be allowed to rest for the present. We were fed to repletion with the subject during the last session of the Institution of Electrical Engineers, and we regret to hear a well-authenticated rumour that the first Paper to be read at a London meeting in the coming session will deal with the same question. We trust that we have been misinformed, and that the debates at the Institution will be inaugurated with a discussion of a more attractive topic, and one with a closer application to electrical engineering problems. There will always be full scope for discussions on systems of charging at Board meetings of Companies, in Committee and Council Chambers of Local Authorities, and at the Incorporated Municipal Electrical Association; the Institution of Electrical Engineers has a wide field of engineering subjects to choose from, and need not allocate a large proportion of its time to the same commercial problem for two sessions in succession.

On Monday the London and District Electricity Supply Bill was sent to committee with an instruction that the London County Council is to be named in the Bill as the purchasing authority. This, in itself, is a comparatively small point, at any rate from the promoters point of view, having in mind the larger issues which several opponents of the Bill wished to have settled during the second reading debate. Thanks to the Government supporting the principle of the Bill, however, any such action was prevented, and the Bill will now come before Mr. Luke White's Committee unfettered save by the proviso that the name of the London County Council must be inserted as the purchasing authority. On all other points the Committee will have the fullest freedom of action, and, in the absence of an undue prolongation of the proceedings by the proposition of superfluous amendments on clauses on the part of opponents, which Mr. Luke White's long experience as a Chairman of Committees should enable him to prevent—there is good prospect of the Bill passing, after a certain amount of modification. As we have already pointed out, the purchasing authority has been definitely settled, but we are inclined to agree with the decision of Lord Cromer's Committee that there was no urgency for this, and that it would have been best to leave the matter open for the future. Political opinions change with such startling rapidity nowadays that it appears unwise to legislate for posterity in this manner. Further, the extension of the London county boundary to include, at any rate, a large proportion of the outer districts scheduled in the Bill, is a dream of many interested in London government, so that a postponement of the question would have been in the best interests, and would have reconciled at least one conflicting interest at the present time. However, the prospects are all in favour of the promoters of the Bill,—if they meet the Government on some matters of detail, to the modification of which, it appears, the Board of Trade attach considerable importance.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, OCTOBER 22ND.

Institution of Electrical Engineers.

7 for 7.30 p.m. Annual dinner at the Hotel Cecil.

FRIDAY, OCTOBER 23RD.

Physical Society.

3.30 p.m. Meeting at the National Physical Laboratory, Teddington. A council meeting will be held at 3.30 p.m., and it is proposed to show a series of demonstrations of work in progress in the laboratory, which will be on view from 3.30 p.m. onwards.

Institution of Electrical Engineers, Manchester Local Section.

7.30 p.m. Opening meeting of the session at the Midland Hotel, Manchester, when the Chairman, Mr. Miles Walker, will deliver his address. A smoking concert will follow the address, and visitors attending the exhibition are cordially invited.

Electro-Harmonic Society.

8 p.m. First smoking concert of the season in the King's Hall, Holborn Restaurant, London, Sir John Gavey, C.B., in the Chair. The members of the International Conference on Electrical Units and Standards, and of the International Electrotechnical Commission have been invited.

TUESDAY, OCTOBER 27TH.

Institution of Electrical Engineers, Manchester Students' Section.

7.30 p.m. Supper and Smoking Concert at the Grand Hotel, Aytoun Street.

WEDNESDAY, OCTOBER 28TH.

Institution of Electrical Engineers, Leeds Local Section.

7 p.m. First meeting of the session at the University, when the Chairman, Mr. H. E. Yerbury, will deliver his address, which will be followed by a Paper on "Electric Signalling on Railways," by Captain Gardner, R.E.

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CORRESPONDENCE

ACCIDENT AT CHELSEA GENERATING STATION.

To the Editor of Electrical Engineering.

Sir,—Mr. Oswald B. Davis's letter in your last issue hardly suggests the best methods to be adopted to prevent such an accident in the future. Had any of the following precautions been taken the complete shut-down would probably have been avoided, and if all of these had been adopted, as is the practice of at least one of the largest manufacturers in England, it is practically certain that only the one unit would have been effected:—

1. Systematic use of bare copper from generator cable trifurcating box to the trifurcating boxes for the feeders.
2. All tubes or ducts through floors efficiently closed.
3. Oil switches with top connections, not at opposite ends, as Mr. Oswald Davis suggests; there are always objections to bottom contacts, and this type is rapidly being discarded.
4. Some form of static discharger, and there are several, which has more arc suppressing property than the straight series gaps employed in this instance.

Yours truly,
A. du Pasquier.

Copenhagen, October 19th, 1908.
11, Vestervoldgade.

SYSTEMS OF CHARGING AND LIMIT INDICATORS.

To the Editor of Electrical Engineering.

Sir,—We have read with interest Mr. Wilkinson's letter in your issue of October 15th, calling attention to the necessity of charging for lighting current on a different basis from that generally in vogue. The fact that the introduction of the metallic filament lamps would seriously affect the great majority of the purely lighting stations, and also the remedy, was pointed out in the Paper on the subject read by us before the Institution of Electrical Engineers in London, Glasgow, and Dublin at the beginning of the year.

We then stated that most of the systems of charging in use at the present time tend directly to discourage the profitable long-hour consumer, and suggested a method of charging which we called the "contract demand system," in which the consumer could himself fix what was the maximum demand he would make on the station, and would be charged a rental accordingly, sufficient to cover the standing charges thus entailed, all current consumed being supplied at a low price per unit, sufficient to just give a reasonable profit on top of the running costs.

In order that the agreed contract demand should not be exceeded, we proposed a limit indicator presenting a number of novel features. If Mr. Wilkinson will make inquiry at Messrs. Nalder Bros. and Thompson's stall at the Manchester Exhibition we feel sure that their representative will be only too glad to show him a limit indicator, designed and made in England, which will meet all his requirements, except possibly the one that it can be bought for 10s.

Since our Paper was written, reports from stations all over the country have only too clearly confirmed our expectation of a large falling off in revenue with no corresponding diminution in expenditure. Further experience with the contract demand system has amply justified its use and shown that it can be introduced in a most simple manner.

Whilst in the case of new consumers the price per kilowatt of demand can be fixed simply with regard to the standing and running charges of the station, it has been objected that it is difficult to change over to the new system old consumers who have been paying a flat rate. Suppose such a consumer has 100 lamps connected and uses 50 at once with a consumption of 1,000 units per annum for which he has been paying a flat rate of 4d. per unit; his account has thus been £16 13s. 4d. per annum. Would it not appeal to him if he were asked to pay a fixed rental of £12 10s. per annum as long as his maximum current did not exceed the equivalent of 50 lamps on at once, and one penny per unit for all current consumed? If his consumption were the same, his bill would be no greater, whilst if he used more, the extra current would only cost him a very small sum—1d. per unit instead of 4d.—and he could use fans, heating, and other appliances without needing to go to the expense of separate wiring.

At the same time, the station would be receiving £8 6s. 8d. per kilowatt (contract demand, 50 lamps at 30 watts = 1·5 kw.) as rental, and would almost certainly secure a long-hour consumer, for actual experience has now proved that, under these circumstances, consumers do burn their lamps longer hours, and also put them in places where previously they had used gas.

We are, Sir,
Yours truly,
Handcock & Dykes.

1 Victoria Street, London, S.W.,
October 19th, 1908.

To the Editor of Electrical Engineering.

Dear Sir,—In your issue of October 15th you publish a letter from Mr. Wilkinson, of Harrogate, on the subject of limit indicators, for use with the system of charging advocated by Messrs. Handcock & Dykes in their recent Paper read before the Institution of Electrical Engineers, and in that letter he points out that he is only aware of the limit indicators made by German manufacturers. We trust we shall not be damaging our character for modesty in drawing attention to the limit indicator which you were good enough to describe in the same number, and which we are exhibiting at the Manchester Exhibition.

We shall be glad to furnish full particulars to any station engineer who is interested in this matter, and in particular those who are face to face with the problem of making both ends meet.

As we are loth to follow the example set by some firms of instrument makers in using the columns of the technical press to obtain gratuitious advertisements, we will not touch upon the question of price.

Faithfully yours,
Nalder Bros. & Thompson, Ltd.,
Fras. H. Nalder,
Managing Director.

34 Queen Street, London, E.C.,
October 20th, 1908.

Committee on Tramway Brakes.—The report of the committee appointed some time ago by the Tramway & Light Railways Association to go into the matter of braking arrangements and sanding gear on tramcars has now been completed, and is ready in print. In deference to the wishes of the Board of Trade, however, a conference will be convened between representatives of the Tramway and Light Railways Association and the Municipal Tramways Association, presided over by a representative of the Board, in order to prevent any inconvenience by the publication of recommendations upon which the two associations are not unanimous. This conference will be held on Friday, October 30th, at the Board of Trade, and meanwhile the official circular of the Tramway & Light Railways Association for September, which consists of a special number containing the verbatim report of the Brake Committee, is being withheld.

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AN ELECTRIC COLLIERY RAILWAY

THE electric railway at the Consett Iron Co.'s Chopwell Colliery possesses several points of interest both for traction engineers and for colliery owners and managers. It is chiefly interesting as being the first installation of the kind in the North of England, and the innovation reflects great credit on this company's Mining Engineer, Mr. F. O. Kirkup, to whose initiative the construction and electrical equipment of the line are due. The line connects the Chopwell Colliery with a new winning at Whittonstall about two and a quarter miles distant. The coal at Whittonstall is loaded into tubs which are made up into a train of 36, and hauled by means of an electric locomotive to the screening plant at the Chopwell Colliery. In this way the installation of a large amount of new and expensive stationary plant is avoided, and it is possible to work new isolated seams economically, which would otherwise be a doubtful commercial undertaking.

The most interesting feature of the installation is the electric locomotive. The difficulty of constructing a suitable locomotive may be appreciated from the following conditions:—

Length of line	About 2¼ miles
Maximum gradient against the load	1 in 24
Length of maximum gradient	About 720 yards
Average gradient against the load	About 1 in 47
Gauge of the track	26 inches
Load to be hauled (exclusive of loco)... ..	25 tons
Time allowed for each journey of two miles...	10¾ minutes
Frequency of service	2 double journeys per hour

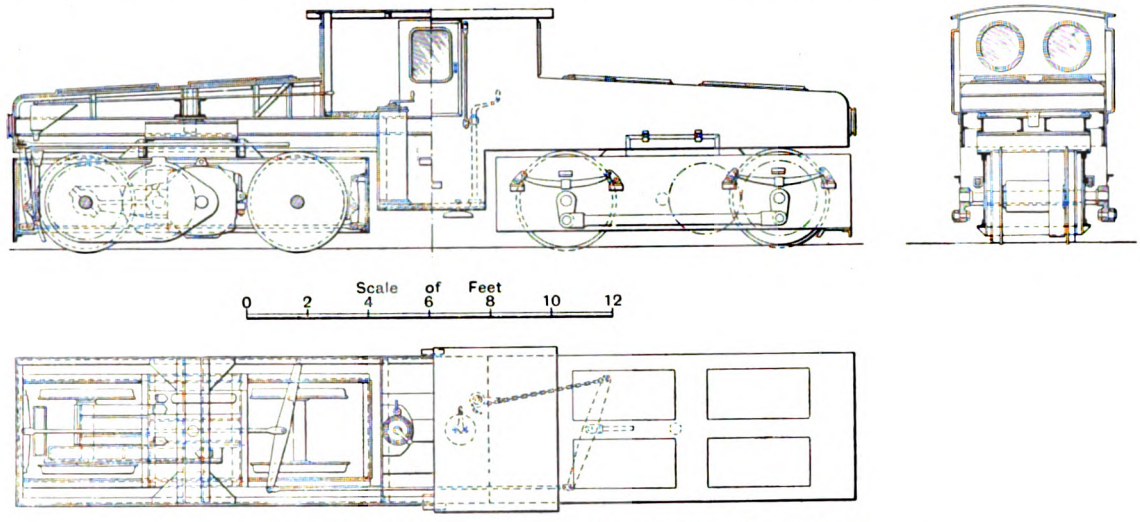

FIG. 1.—PLAN AND SECTIONAL ELEVATION OF LOCOMOTIVE.

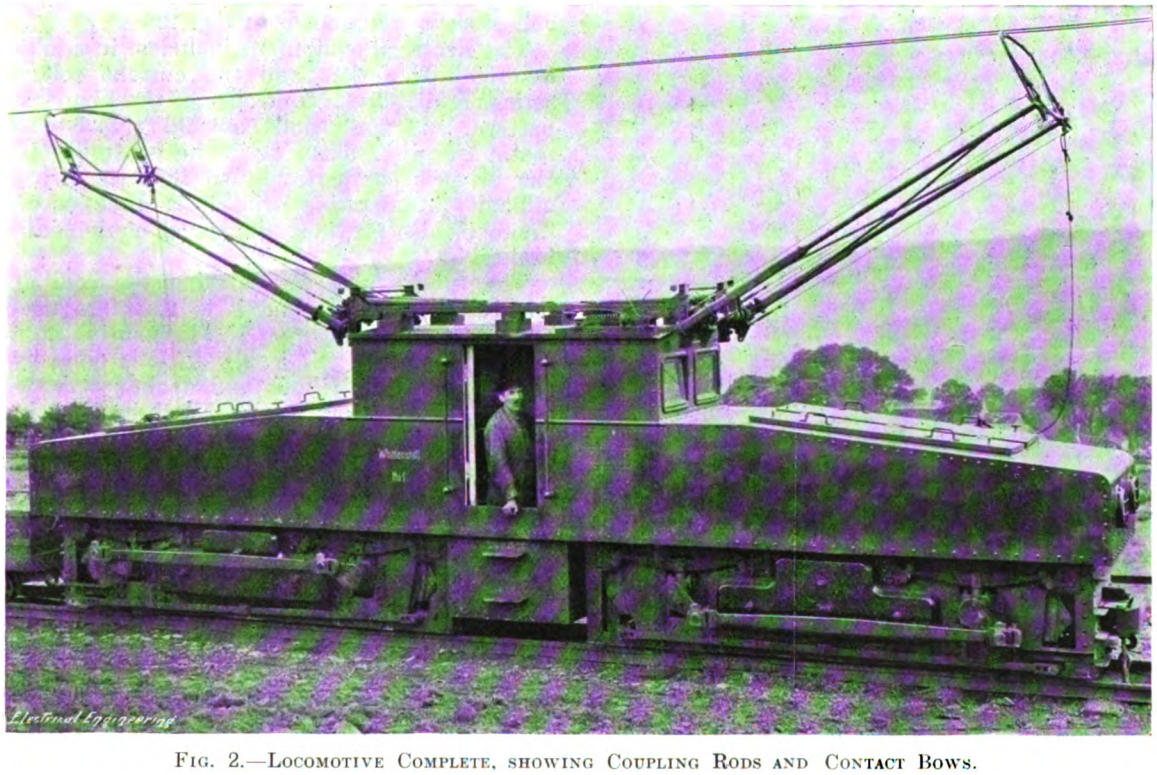

FIG. 2.—LOCOMOTIVE COMPLETE, SHOWING COUPLING RODS AND CONTACT BOWS.

From these conditions it will be obvious at once that a powerful locomotive is necessary, and at the same time that the narrowness of the gauge imposes severe

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restrictions on the motors if suspended on the bogies in the usual way. Under the conditions stated above, the largest motors that could be got in between the wheels would have a capacity of about 20 h.p. for one hour. A locomotive with four such motors would not perform the required service, and it was necessary to adopt some different arrangement by which larger motors could be employed.

The design of the locomotive actually supplied is shown in the accompanying drawing (Fig. 1). The body is supported on two bogie trucks, each of which is equipped with a single 56-h.p. 500-volt Siemens railway motor, the aggregate capacity being, therefore, 112 h.p. The two axles of each bogie are connected together by side rods, in order to utilise the whole weight of the locomotive for adhesion (see photograph, Fig. 2), and one of the axles is driven through spur gearing by the motor. This gearing consists of two equal gear wheels and one pinion, the pinion being fixed on the motor axle, one gear wheel on an intermediate shaft, and one on the driving axle. In this way the motor is not restricted axially by the narrowness of the gauge, but only by the distance between the side frames of the bogie. As the motor occupies the space in the centre of the bogie, the usual arrangement of centre pin and bolster is in this case impossible. The centre is mounted on an arch built of steel plates and beams which rests on the top of the side frames, and the centre pin is carried by cross-beams rigidly fixed to the locomotive body. There are also fixed to the body side rubbing blocks which bear upon similar blocks supported on the bogie by means of helical springs, not shown in the illustration. There is thus as much flexibility in this construction as in the standard bogie with bolster and bolster springs. The centre pins are spherical in shape, and work in cup-shaped centres, so that ample bearing surface is provided for transmitting the tractive force from the bogie to the frame of the locomotive body.

The locomotive body is built up on two main longitudinal steel girders, which are themselves supported

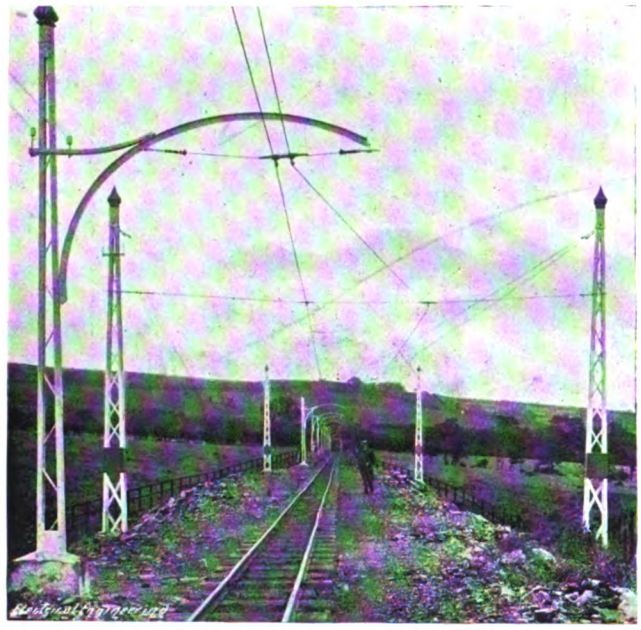

Fig. 3.—Arrangement of Overhead Equipment at Turn-out (for which Track Rails are not yet Laid).

by cross-beams from the bogie centres. The space between the bogies is utilised for the lower part of the driver's compartment. In this way the height of the locomotive is reduced so that the line can be taken under a roadway without excessive excavation. On the roof of this compartment is fixed a frame, forming the base of two current collectors of the Siemens bow type, which are of such a length as to allow of a considerable range in the height of the trolley wires. The movable portion of the collector is made in two parts, viz., the main frame of light steel tubes hinged at the

Fig. 4.—Track and Overhead Equipment at Junction near Chopwell.

bottom to the fixed base, and the small bow carried by this frame. The action of the various springs tends to raise the main frame and to keep the small bow in a vertical position. The pressure of the trolley wire balances this spring action in such a way that both the small bows are always trailing at a small angle in whichever direction the locomotive may be running. The general arrangement and the construction of these collectors is well shown in Fig. 2.

The electrical equipment includes, in addition to the two 56-h.p. motors and the current collectors, one series-parallel-brake controller of the Siemens standard pattern, and the usual controlling resistances, automatic circuit-breaker, &c. The controller is fixed in the driver's compartment so that the driver has no difficulty in operating it in either direction of running. There is also provided the usual equipment of hand-brakes.

The tubs hauled for carrying the coal are of the usual colliery type, and it is therefore necessary to arrange the drawgear on the locomotive at a suitable height above the rail level. This is done by fixing a central buffer with hook and chain on the end frame of the bogie, the outer ends of both bogies being utilised for this purpose, so that the locomotive is double-ended. With this arrangement the tractive force transmitted by the frame of the locomotive body is only that due to one motor.

The following are the particulars and leading dimensions of the locomotive:—

Total weight, including about 4 tons of ballast	14 tons
Gauge	660 mm. (26″)
Overall length	8·46 metres (27′9″)
Overall width	1·5 metres (4′11″)
Height to top of driver's compartment ...	2 25 metres (7′4½″)
Minimum height of trolley wire	2·44 metres (8′0″)
Maximum height of trolley wire	4·42 metres (14′6″)
Distance between bogie centres...	4·5 metres (14′9″)
Wheel base	2 metres (9′7″)
Diameter of wheels	900 mm. (2′11½″)
Motor equipment	Two 56 h.p. motors
Height of drawgear above rail level	267 mm. (10½″)
Height of buffer above rail level	380 mm. (15″)

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Some interesting trials have been made to ascertain the tractive resistance of the locomotive and of the tubs. The tests were made by allowing a train to start from rest on a down grade, and measuring the distance passed over before coming to rest again on the next ascending grade. The following results were obtained: For a train of 10 tubs alone at an average speed of 5·8 miles per hour, the tractive resistance was 36 lb. per ton. For the locomotive alone at an average speed of 9 miles per hour, the tractive resistance was 15·5 lb. per ton.

The track consists of Vignole rails weighing 50 lb. per yard, the gauge being 26 inches. The rails are each 30 ft. long, and are bonded by means of a single bond at each joint, having a cross-section of about 70 sq. mm. The bonds are of the " protected " type, placed under the fish-plates.

The line is a single track for most of the distance, expanding into three tracks at the Chopwell end, and

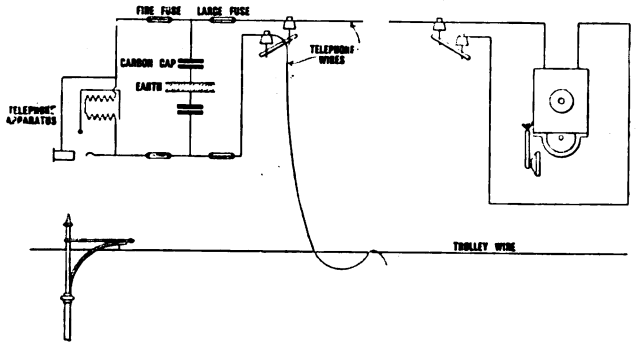

Fig. 5.—Diagram of Protective Device for Telephone Circuits.

into two tracks at Whittonstall, being laid out at this end in the form of a triangle in order to facilitate turning the tubs end for end. There is also a short branch near Whittonstall to a fresh working at Hollin's Drift, and a turn-out about the middle of the line allowing up and down trains to pass. A general view of the track is shown in Fig. 3, which also shows the arrangement of the overhead line for a turn-out, the rails for the second track being not yet in place. The overhead line consists of two trolley wires of hard-drawn figure 8 copper wire of 80 sq. mm. cross-section. These wires are supported by means of side brackets bolted to lattice poles, which are set in concrete foundations beside the track. The construction is well shown in Figs. 3 and 4, the latter giving a view of the divergence of the single track at the Chopwell end into three tracks. The overhead line at this point requires special construction, as the tracks are not at the same level. As will be seen, one of the poles carries two brackets, one considerably higher than the other. The third track is only equipped for a short distance from its divergence, the tubs running down the other part under gravity.

A telephone line is installed by means of two wires supported by insulators on the tail ends of the brackets. This line is tapped at six points between Chopwell and Whittonstall, and the driver of the locomotive carries with him a portable telephone with which he can make connection through plug boxes fixed on the poles.

At each of these points at which the line is tapped a protection device is inserted to guard against the danger of shock if either of the telephone wires has come into contact with the overhead wires supplying the locomotive. This device consists of two large fuses, two carbon gaps, and two fine fuses arranged as shown in the diagram, Fig. 5. The large fuse melts with a current of three amperes, and the fine fuse with 0·3 ampere. In the event of either wire being subjected to any voltage greater than 350 volts, the corresponding carbon gap arcs across to earth and the current immediately blows the large fuse; in case the gap does not discharge, and there should be any leakage to earth in the telephone apparatus, the fine fuse will melt and cut off the connection with the overhead wire. These devices, which are made by Messrs. Siemens and Halske, of Berlin, are used in large quantities on the Continent.

Power is supplied to the locomotive from a 200-kw. direct-current compound Siemens generator, giving 500 volts on no load, and 550 volts at 120 kw., coupled direct to a Belliss engine running at 375 revolutions per minute. The power-house is situated about 600 yards from the railway near the Chopwell end, and is connected to the overhead line by means of two positive and one negative insulated feeder run through earthenware pipes in a trench.

The whole of the electrical installation, including the locomotive, the overhead equipment, and bonding of the line, and the 200-kw. generator, with its accessories, has been supplied to the Consett Iron Co. by Messrs. Siemens Brothers Dynamo Works, Ltd. On the successful setting to work of the installation, a second locomotive was ordered from the same firm in order to deal with the increasing output of coal.

FRANCO-BRITISH EXHIBITION

Awards for Electrical Exhibits

We give below the list of awards for the purely electrical engineering exhibits at the Franco-British Exhibition. Several of the firms mentioned below were also awarded diplomas in other sections:—

Mechanical Production and Utilisation of Electricity.—*Diploma for Grand Prize.*—C. A. Parsons & Co., Ltd.; Mather & Platt, Ltd. *Diploma of Honour.*—W. H. Allen, Son & Co., Ltd.; Reyrolle & Co., Ltd.; Lancashire Dynamo & Motor Co., Ltd. *Diploma for Gold Medal.*—Adams Manufacturing Co., Ltd.; Electromotors, Ltd.; Simplex Conduits, Ltd.; United Asbestos, Ltd.; Watson, Laidlaw & Co.

Electrochemistry.—*Diploma for Grand Prize.*—Sherard, Cowper-Coles & Co, Ltd. *Diploma for Gold Medal.*—Berry, Skinner & Co.; Ozonair, Ltd.; Dr. Henry F. S. Sand.

Electric Lighting, Lamps, Switches, and Accessories.—*Diploma for Grand Prize.*—C. A. Parsons & Co., Ltd.; W. H. Allen, Son, & Co., Ltd.; Ediswan & Swan; United Electric Light Co., Ltd.; Reason Manufacturing Co., Ltd.; Davis & Timmins; Simplex Conduits, Ltd.; the London Decorative Metal Works, Ltd. *Diploma of Honour.*—Linolite Co.; Wm. Geipel & Co.; Sunbeam Lamp Co., Ltd.; A. P. Lundberg & Son; Humbert & How; United Asbestos Co., Ltd.; Reyrolle & Co., Ltd.; British Westinghouse Electric & Manufacturing Co., Ltd.; Stearn Electric Lamp Co.; Berry, Skinner & Co., Ltd.; Louis Hervé. *Diploma for Gold Medal.*—Wellman, Seaver & Head, Ltd.; Westminster Engineering Co.; Birmingham Guild of Handicraft. *Diploma for Silver Medal.*—Galsworthy, Ltd.; Imperial Lighting Co. *Diploma for Bronze Medal.*—John Dugdill & Co.; Duncan, Watson & Co.

Telegraphy and Telephony.—*Diploma for Grand Prize.*—Dr. J. A. Fleming, F.R.S.; Marconi's Wireless Telegraph Co. *Diploma for Gold Medal.*—C. E. Heinke & Co. *Diploma for Silver Medal.*—Cable Code Condenser.

Various Appliances of Electricity.—*Diploma for Grand Prize.*—Dowsing Radiant Heat Co., Ltd.; Cambridge Scientific Instrument Co., Ltd. *Diploma of Honour.*—Bastian Meter Co., Ltd.; Reason Manufacturing Co.; Alfred Apps. *Diploma for Gold Medal.*—Rashleigh, Phipps & Co., Ltd.; Bergtheil & Young, Ltd.; Kinetic Swanton Co., Ltd.; Professor Townsend; Dr. F. Mollwo Perkin; Marryat & Place; Dr. P. E. Shaw. *Diploma for Silver Medal.*—Rochdale Electric Co., Ltd.; Purcell & Nobbs; Reynolds & Branson.

Incandescent Lamp Research.—According to the *Electrical Review* (New York), the engineering department of the National Electric Lamp Association, Cleveland, Ohio, announces that Dr. Edward P. Hyde, now the U.S. Bureau of Standards, Washington, after October 1st will organise and direct a department of physical research under the auspices of, and at the expense of, the association. Dr. Hyde will operate his department with entire freedom from commercial suggestion, and with the same frank publicity which has characterised his work at the Bureau of Standards.

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ELECTRICAL CONTRACTORS' GRIEVANCES

THERE was a very fair attendance of members of the Electrical Contractors' Association at the quarterly meeting of the Northern Section, which was held on Saturday last in some school buildings near the Electrical Exhibition at Manchester. Few visitors were present, however, and this was particularly unfortunate, as it had been arranged to hold a "Propagandist" meeting after the general business had been dealt with.

One of the items of the agenda was the consideration of a letter received from a member of the Association, complaining of interference by fire insurance inspectors with the work of electrical contractors. The writer of the letter said that cases had come under his notice where fire insurance inspectors had practically acted as consulting engineers; they had raised questions with regard to the quality of the contractors' work and the methods adopted; had pointed out insignificant defects in the work, often quite temporary defects due to the presence of moisture, as, for example, in freshly constructed buildings; and had generally shaken the confidence of the consumer in the contractor. Several members supported the view of the writer, that measures should be taken to stop such interference; some suggested, however, that even more harm was being done by Corporation central station officials acting as consulting engineers, sometimes not without prejudice to the contractor concerned.

The chairman of the meeting, Mr. Andrews, of Newcastle, pointed out that the interference of the Corporation officials had in certain cases been amply justified, but that it was very necessary to prevent abuse or prejudiced interference. It was then proposed to submit the matter to consideration at headquarters, with the suggestion that a circular letter should be sent to insurance companies and corporations with reference to the matter. Mr. Cross, a late chairman of the Northern Section, proposed that the two questions should be considered separately, as the fire insurance inspector was in quite a different position with relation to the contractor than that of the Corporation official.

Another member suggested that the prejudiced interference of the Corporation officers could be prevented more effectively by arranging for a personal interview between the local secretary of the Association and the chief engineer of the Corporation concerned than by writing letters; a circular letter also would be offensive, as the number of cases in which such interference had been noticed were not many. Finally, it was decided to adopt this suggestion, and to forward the letter, referring to the fire insurance inspectors, to be dealt with by the Central Board, without any mention of the similar question relating to Corporation officials.

The "Propagandist" work was then proceeded with, the chairman calling upon Mr. L. G. Tate, the Hon. Secretary of the Association, to explain to the visitors present the origin and objects of the Association.

Mr. Tate pointed out the Association had its origin in Glasgow in 1901, when the contractors joined forces to combat the growing danger of branches of municipal trading prejudicial to their interests. Newcastle, Leeds, Manchester, and London soon took the matter up, and in 1902 the National Electrical Contractors' Association was formed. The two great objects before the Association were opposition to municipal trading, and the settling of disputes between contractors and manufacturers, especially with regard to the question of manufacturers supplying goods to consumers at trade prices. In 1904 an agreement was entered into with the National Electrical Manufacturers' Association, and the term "trade buyer" was rigorously defined. A joint committee of four manufacturers and four contractors was formed at the same time to deal with such questions. In September, 1904, the Association became incorporated, and the name was changed to "The Electrical Contractors' Association." Mr. Tate said that considerable help had been given to contractors in defending them against Corporation "fads," such as the enforced use of stranded wire, and also that, as the result of contractors meeting frequently in a friendly spirit, much suicidal competition had been stopped and co-operation substituted, with great benefits to the contractors concerned. An agreement with the Cable Makers' Association as to trade terms had had very beneficial results, and many individual cases could be stated in which members had been materially assisted by the financial, legal, and moral support of the Association.

THE INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS

THE first few days' meetings of the International Conference, which has been sitting at Burlington House, in the rooms of the Royal Society, to arrive at international agreement as to the three electrical units, the ohm, the ampere, and the volt, were reported in our last issue. The proceedings opened on October 12th with an address by Mr. Winston Churchill (President of the Board of Trade), after which the conference settled down to business under the presidency of Lord Rayleigh. At the same meeting the unit of resistance was dealt with, and the following resolutions were passed:—

The Conference agrees that, as hertofore, the magnitudes of the fundamental electric units shall be determined on the electro-magnetic system of measurement, with reference to the centimetre as the unit of length, the gramme as the unit of mass, and the second as the unit of time.

These fundamental units are (1) the Ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the Ampere, the unit of electric current, which has the value of one-tenth (0·1) in terms of the centimetre, gramme, and second; (3) the Volt, the unit of electromotive force, which has the value 100,000,000 in terms of the centimetre, the gramme, and the second.

The International Ohm shall be defined as the resistance of a specified column of mercury.

The International Ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross-sectional area, and of a length of 106·300 centimetres. To determine the resistance of a column of mercury in terms of the International Ohm, the procedure to be followed shall be that set out in Specification A attached to these resolutions. [This latter specification was given in full in our last issue.]

The specification of the mercury standard ohm was further discussed by the Technical Committee on Tuesday, October 13th.

The second meeting of the Conference, on Wednesday, October 14th, was devoted to the question whether the ampere or the volt is to be the second primary unit. The motion:—

That the ampere is the second primary unit

was eventually carried, after an amendment of M. Lippmann (France) to the effect that the volt should be the second primary unit had been discussed at some length. M. Lippmann considered that the volt was independent, and could be measured absolutely by means of a disc rotating in the earth's magnetic field. This amendment was supported by Dr. Cahart (America). This discussion centred largely on the relative merits of the silver voltameter and various standard cells which would be used as practical standards. The following resolution was then moved:—

The International Ampere is the unvarying electric current which when passed through a solution of nitrate of silver in water, in accordance with the specification attached to these resolutions, deposits silver at the rate of 0·00111800 of a gramme per second.

M. Lippmann again dissented, and moved that the international ampere should be defined as 1/10 of the electromagnetic unit on the C.G.S. system. This amendment was also supported by Dr. Cahart, and was eventually lost. The original motion was then carried subject to the exact figure for the electrochemical equivalent of silver being referred to the Committee. The final resolution:—

The International Volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one Inter-

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national Ohm, will produce a current of one International Ampere,

was then carried unanimously, but a note on the Weston cell was referred to the Committee.

The Technical Committee met on Wednesday afternoon and discussed the exact figure to be taken for the electrochemical equivalent of silver at some length, but no decision was arrived at, and the matter was referred to a sub-committee. The next day's meeting of the committee (Thursday morning) was devoted to the consideration of matters of detail regarding the methods to be adopted in standardising laboratories to realise the International ohm and ampere, and to set up the Weston normal cell. A lively discussion ensued as to the last two figures for the electrochemical equivalent of silver.

On Thursday evening the delegates were entertained by the Government at a dinner at the Ritz Hotel, Piccadilly. The chair was occupied by Mr. Winston Churchill, and the company, numbering about 120, included a number of distinguished visitors.

Mr. WINSTON CHURCHILL, in proposing the toast of the delegates, remarked on the practical nature of the object which had brought them together, and urged the importance of unity in matters relating to electrical standards. Of all the sciences that minister to the practical needs of mankind, none, he thought, had more gifts to bestow than the science of electricity. In conclusion, he expressed in the name of his Majesty's Government the heartiest welcome to the delegates, and trusted that their work would be crowned with success, and would not only help to ensure unity in the sphere of electrical standards, but also amongst the nations of the world.

Prof. LIPPMANN, responding on behalf of the delegates, said that Great Britain had been the first country to establish a complete and coherent system of electrical measurement, and paid high tribute to the work of Lord Rayleigh, the British Association, and the Board of Trade. The question of the unity in the electrical standards was a most pressing one; he was glad that an opportunity had been given for settling the matter, and trusted that the labours of the Congress would be fruitful in that direction.

Dr. WARBURG (President of the Reichsanstalt), in responding, said that although at one time the difference between the English and the German ohm amounted to as much as 6 per cent., the differences were now very small indeed. The results of the Congress would, he hoped, eliminate even these small differences, and also enable countries which had no national laboratory to acquire standards for their own use. In conclusion, he expressed the gratitude of the delegates for the assistance given them by the British Government.

Dr. STRATTON (Director of the American Bureau of Standards) remarked that it was most encouraging to see the splendid work that was being done at the National Physical Laboratory, and expressed the opinion that the benefits derived from that and similar institutions fully warranted the expenditure on them. It was, he said, a pleasing sign of the times, that the Governments of the different nations were taking an increasing interest in scientific work.

Lord RAYLEIGH (President of the Royal Society) proposed the health of the Chairman, and spoke of the value of such congresses as the present one. He remarked that controversies as to methods in scientific work seldom arose, and that it was not often that the glow of fight illumined the spirits of scientific workers.

Mr. WINSTON CHURCHILL, in responding, said that he felt it a great honour to address such a company on behalf of the Government, and trusted that their labours would be fruitful and permanent.

On Friday morning the Technical Committee issued the following interim report:—

That the Technical Committee be authorised to issue as an appendix to the report notes detailing the methods which have been adopted in the standardising laboratories of the various countries to realise the International Ohm and the International Ampere and to set up the Weston Normal Cell. The Technical Committee recommend the Conference *not* to alter the length of the Mercury Column in the definition of the International Ohm from 106·300 cm. to one metre. The Technical Committee recommend that the wording of Resolution VI. be altered to read:—The International Ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the specification attached to these resolutions, deposits silver at the rate of 0·001118 of a gramme per second. The Technical Committee recommend that there be added to the specification for the silver voltameter the following paragraph:—"That for purposes in which it is desired to use the International Ampere to a higher degree of precision than that given in the definition; the figures which follow the '8' in 0·001118 shall be considered as . . ." On a vote being taken as to the figures left blank above, the votes were: Eight delegates in favour of "20," five delegates in favour of "00," and one abstention (the chairman not voting).

The third meeting of the full Conference was held on Friday. The interim report of the committee given above was considered, and, on the motion of Dr. Glazebrook, it was resolved:—

"That the Technical Committee be authorised to issue as an appendix to the report notes detailing the methods which have been adopted in the standardising laboratories of the various countries to realise the international ohm, and the international ampere, and to set up the Weston normal cell."

The recommendation of the Technical Committee regarding the length of the mercury column in the standard ohm was then confirmed, and the conference proceeded to discuss the vexed question of the last two significant figures in the electrochemical equivalent of silver, and eventually it was decided by 21 votes to three to confirm the resolution with the figure 0·00111800, for the amount of silver deposited by one ampere in one second. Some suggested modifications in the wording of other resolutions were then dealt with, and the addition of the following words to the second paragraph of the resolution given on p. 564:—

"As a system of units representing the above, and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the Conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions."

The additional resolution:—

"That the ohm is the first primary unit,"

was then passed, and the conference proceeded to consider the steps necessary to secure uniformity of the standards in future.

With regard to the proposed appointment of a permanent Commission the following resolution, moved by Dr. Warburg, was carried:—

"That the Conference approves generally the draft scheme to establish a permanent Commission to secure uniformity of administration in relation to electrical units and standards in the future. The Conference refers the draft scheme to the Technical Committee to consider details and to nominate the first members of the Commission."

The main questions at issue were whether, in view of the existence of the International Electrotechnical Commission (which met in London on Monday, see page 575), a separate permanent body was needed, and whether it was practicable to extend the functions of the Bureau International des Pois et Mésures to include electrical standards. These points were discussed at the meeting of the Technical Committee on Monday, and a draft scheme was prepared to be submitted to the final meeting of the Conference yesterday. A further meeting of the Technical Committee was held on Tuesday, at which a resolution was passed defining the watt, the unit of power, as having the value 10,000,000, in terms of the centimetre, the gramme, and the second.

The final report of the committee, which was discussed at yesterday's meeting of the Conference, will be given in our next issue.

The programme of visits and entertainments attended by the delegates was given in our last issue. On the occasion of the visit to Cambridge on Saturday, the degree of Doctor of Science *honoris causa* was conferred at a special congregation upon Dr. S. A. Arrhenius, Prof. G. Lippmann, Mr. S. W. Stratton, and Prof. E. Warburg.

NEW PUBLICATIONS

"Fowler's Mechanics' and Machinists' Pocket Book and Diary, 1909." Edited by William H. Fowler. (Manchester: Scientific Publishing Co.) Price 6d. net.

"Proceedings of the American Institute of Electrical Engineers," October, 1908. (New York: The Institute.) Price 50 cents.

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LONDON ELECTRIC POWER BILLS

IN the House of Commons on Monday night, the London and District Electricity Supply Bill was considered in relation to a motion by Mr. Winston Churchill, the President of the Board of Trade, "That it be an instruction to the Committee to insert in the Bill a provision conferring purchasing powers on the London County Council." The Bill, it will be remembered, was read a second time in July.

Mr. Hudson Kearley, Parliamentary Under-Secretary to the Board of Trade, who moved the instruction, said that although the promoters had successfully resisted the insertion of such a provision in the House of Lords, they had now accepted it, knowing that it was on no other terms that the Government would support the Bill.

Mr. J. Rowland (Dartford) moved an amendment striking out the words "the London County Council," and substituting "a central authority composed of representatives of the municipal authorities owning their electrical supplies within the area covered by the Bill." He reminded the House that although the London County Council was to be named as the purchasing authority, yet the Bill took in areas of 51,947 acres in Essex, with a population of 703,696; 32,414 acres in Kent, with a population of 214,563; 25,232 acres in Surrey, with a population of 286,521; and 52,671 acres in Middlesex, with a population of 600,168. Therefore he asked for representation on the purchasing authority on behalf of these outside districts.

Mr. R. Whitehead (S.E. Essex) supported the amendment.

Sir John Benn (Devonport), in supporting the instruction, said that this Bill had been represented as an attempt to fasten a great monopoly on London, but in reality there already existed a monopoly at the hands of the local authorities and companies. Several committees of Parliament had declared that the London County Council was the proper purchasing authority, and both parties on that body were at present united in this opinion.

Mr. G. H. Radford (East Islington), whilst accepting the instruction, wished that it had gone further and dealt with the purchase clause, which he entirely objected to in its present form.

Sir E. Cornwall also supported the instruction.

Mr. Bonar Law (Dulwich) wished it to be left to the discretion of Parliament to select the purchasing authority, when the period for purchase arrived. He favoured representation on the purchasing authority of the outside districts for the reason that it appeared likely the company would develop its business mainly outside London owing to the inside being so well supplied at the present time, and therefore it would be possible under the instruction that the area which formed the most important portion of the company's business would be without a voice when the time for purchase came round. He therefore asked that the words "or some other body to be appointed by Parliament" should be inserted in the instruction.

Mr. W. H. Dickinson (St. Pancras) said that he and those in agreement with him had come to the conclusion that this Bill did not constitute a great monopoly. The provisions of the Bill had been greatly misrepresented, although there were clauses in it which would have to undergo modification at the hands of a Committee. He was convinced that such a scheme was the only solution of the problem in London, and as the London County Council refused to deal with the matter, it met his approval if the County Council were constituted the purchasing authority.

Mr. W. Guinness (Bury St. Edmunds) preferred the suggestion of Mr. Bonar Law, but failing that, expressed his intention of voting for the instruction.

Mr. Churchill said that the Government were seeking by this instruction to indicate a general policy in the future. They were seeking to affirm a principle which would certainly govern these Bills so far as they might progress, and which might govern other Bills if these Bills should not reach maturity. This principle was that ultimately, and he hoped as soon as possible, there should be one combined, extensive, uniform system of electrical supply for the metropolitan area under the control of the government of London. The amendment proposed by Mr. Rowland would exclude nearly half the districts concerned from any share in his proposed representation, for it would only include representatives of the municipal authorities owning electricity works within the area of the Bill. There were 77 local authorities within the area, and of these 35 did not own electrical undertakings. A purchasing authority composed in this way would be less representative, less responsible, and less competent than the London County Council. This new body would have no rating power; a special statute would be required to effect the purchase, and even if all the difficulties were surmounted, a body would be created that would be but a bad imitation of the Water Board.

Mr. J. Ward (Stoke-on-Trent), having supported the amendment proposed by Mr. Rowland, a division was taken on this, with the result that there was a majority of 88 against it.

Mr. T. Lough (West Islington), continuing the discussion against the instruction, regretted that the Government had interfered. He wanted some definite instruction to the Committee with regard to the purchase clause, which should stipulate tramway terms, under which nothing could be paid to the company for goodwill.

Mr. Churchill said he desired to press upon the House the desirability of careful and impartial consideration of the proposal by a Committee of the House. The instruction did not prevent that; any other course would be improper and disrespectful, more especially in a year when unemployment had reached its maximum, and the private enterprise its minimum. The Government, however, did not recommend the merits of the Bill; in fact, he admitted there were objectionable clauses. Clause 77, for instance [power to transfer undertakings to the company] was objectionable. Every clause of this kind had been objected to by the Board of Trade, and he was prepared to give a pledge that if the clause appeared in the Bill when it came back to the House, he would not only not support it, but would counsel the House to reject the Bill. But there were all questions for the Committee, and the House and the Government would be perfectly free to take their own course on third reading. For his own part, he was reserving his opinion, as the Government was theirs, until they had the report of a Committee as to how far the clauses of the Bill were reconcilable with the public interest.

A division for the closure of the debate was carried by a majority of only nine, but there was a majority of 133 in favour of the instruction to the Committee to insert the name of the London County Council as the purchasing authority.

NATIONAL TELEPHONE COMPANY'S EMPLOYEES

A NUMBER of questions were asked in the House of Commons on Monday as to whether the National Telephone Co. has suspended all new constructional work owing to the approaching acquisition of the telephone service by the Government. It was alleged that in consequence there had been, or would be, dismissals of telephone employees before 1911, amounting to about 6,000, a figure which was attributed to the President of the National Telephone Co. It was asked whether some means could be devised by which the capital expenditure of the company could be controlled by the Government during the few remaining years of the company's existence.

Mr. Sydney Buxton, the Postmaster-General, in reply, stated that it was not a fact that the National Telephone Co. had suspended their construction work, but they had stated that it would not be to their interest to undertake the construction of new plant, which would not be likely to be brought into use before the end of their licence, and, in consequence, they would find it necessary to make some reductions in their construction staff. The question of providing for the development of the telephone system had received careful consideration, and under an arrangement come to in the purchase agreement of 1905, a good deal of work was being undertaken by the Post Office and leased to the company until 1911. This policy, which was being pursued as actively as possible, would to some extent meet the difficulty, but the Postmaster-General added that he was discussing with the company what further arrangements could be made, so that the necessary work of construction could be continued without interruption. The company had further informed him that the discharges which had so far taken place, apart from those due to misconduct or incompetence, had been mainly caused by an exceptional falling off in orders consequent upon the recent depression of business throughout the United Kingdom. Arrangements were being made, however, to give employment in the Post Office service to competent workmen discharged from the company's service, when this was possible.

A statement has been issued by the Central Committee of the National Telephone Staff Transfer Association, as to the position of the staff on the transfer of the National Telephone Co.'s system to the Post Office in 1911. They point out that very shortly the company's spare plant will, speaking generally, be sufficient to meet the demand to the date of purchase, and that this means that construction work will stop at a very early date. As the construction work ceases, they say, the company's construction staff and others, together numbering about 6,000, will become superfluous, and will be paid off. The committee insist that the extra plant which it is necessary should be constructed is so essentially a part of the system as a whole that the work should be done by one party, and suggest that a joint purse arrangement should be come to between the Post Office and the company, whereby the constructive work can be continued, the cost being allocated between the parties in proportion as they will respectively benefit from its use.

Telegraph Traffic.—The only repair we have to notify is that of communication with Bankok, which took place on the 15th inst. The German cable manufacturers are now busy making the cable destined to connect their country with Brazil. Telegraphic connection between Mole St. Nicholas and Cape Haiti has also been restored. The Sitia-Rhodes and Pontianak-Saigon cables have still to be repaired.

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THE MANCHESTER ELECTRICAL EXHIBITION

THE popularity of the Electrical Exhibition at Manchester still continues, and on Saturday last a record gate was recorded; approximately 25,000 people passed through the turnstiles. As during the previous week, it was necessary to close the park gates now and then in order to relieve the crush at the turnstiles, but no difficulty was met in managing the crowd.

Up to date the following Local Authorities have sent deputations to visit the Exhibition:—Hull, Blackburn, Stockton, Croydon, Blackpool, Macclesfield, Birkenhead, Malvern, Wallasey, Bray, Keighley, Chesterfield, Derby, Ramsbottom, Heywood, Mortlake, Glasgow, Bristol, Whitehaven, Stepney, Newport (Mon.), Dublin, Oldham, Ipswich, Darlington, Swindon, Leek, Blackpool, Bury, Cheltenham, Manchester Corporation Tramways, and Bolton.

In addition to this, the Incorporated Municipal Electrical Association held its Council Meeting there last week, and there was also an official visit by the Electrical Contractors' Association, a report of which appears on page 564 of this issue. In our fourth Exhibition Supplement this week we publish further descriptions of the exhibits, illustrated with a large number of views of apparatus and some special drawings.

A persistent rumour was circulated at the Exhibition last week that a proposal was on foot to keep the Exhibition open until November 14th instead of closing it on October 31st, as arranged originally. There was no authority for this report, and, as a matter of fact, the majority of the exhibitors are quite satisfied that the period of one month is sufficient.

LOCAL NOTES

ABERDEEN: *Inauguration of New Plant.*—The new high tension system for supplying the Cults district was inaugurated last week. Powers to supply in this district were obtained in a Special Act in 1907. Two 100-kw. 6,600-volt alternators have been installed in the Ferryhill power station, which will supply a sub-station in Cults, which was formerly used as a steam generating plant by the Deeside and District Electricity Supply Co., now taken over by the Corporation. The converting machinery has been supplied by the Brush Co., the switchboard by Messrs. Ferranti, Ltd., and the cables by the British Insulated & Helsby Cables, Ltd., the total cost of the scheme being about £7,000. The distance from Ferryhill to Cults is seven miles.

AYR: *Extension of Electricity Area.* -The Ayr District Committee approved of an agreement with the Ayr Corporation for an extension of the electric lighting area of the latter to include the district of Alloway. No wayleaves are to be charged, and the consumers in the Alloway area are to be supplied with light on the same terms as those within the burgh.

Electricity Reserve Fund.—The following letter has been received by the Council from the Scottish office:—"With reference to your letter of the 8th instant and previous correspondence, in which you apply for authority to borrow an additional sum of £30,000 for electricity purposes, I am directed by the Secretary for Scotland to state that he consents to the borrowing by the Council of a further sum of £20,000 for the execution of capital works under the Ayr Electric Lighting Order, 1890, raising the total sum authorised for that purpose to £120,000. I am to add that the Secretary for Scotland regrets his inability, in the absence of a reserve fund, to authorise at present the borrowing of a larger amount for the service of the electricity undertaking, and I am to suggest that the Town Council should further examine this matter in connection with the question raised as to the charge made for current supplied to the Corporation tramways, which, on the information before him, appears to be inadequate."

BARGOED: *Death from Electric Shock.*—Whilst a workman was attending to one of the cables in the South Pit, Bargoed, last week, he accidentally came into contact with a live wire and was killed.

BARNSTAPLE: *Public Lighting Charges.*—A resolution was proposed at the last meeting of the Corporation to the effect that the charge for public lighting shall not exceed the rate charged to other large consumers for lighting purposes, and that the committee be requested to draw up a system of charges in conformity with this resolution. In support, it was mentioned that whilst large consumers were only charged 2¾d. per unit, the largest consumer of all, viz., public lighting, was charged 4½d. and 5d. per unit. As only the proposer and seconder voted for the resolution, no action is to be taken

BELFAST: *Home Office Regulations.*—The question of the payment of the Corporation's contribution towards the cost of opposing the proposed Home Office electrical regulations has been referred to the Electrical Engineer and the City Accountant. At the conference of local authorities which dealt with the basis of payment, the proportion to each authority was to be based upon the gross annual revenue, whereas the Corporation has passed a resolution that it should be upon the basis of capital expenditure.

BRADFORD: *Tramways Renewals.*—At the last meeting of the Corporation it was stated that during the present financial year there had been expended upon renewals of the permanent way about £22,000 up to date. For the years ending March, 1910 and 1911, it was estimated that there would be required for renewals the sums of £22,000 and £17,000 respectively, and if a similar balance to that of last year was carried to the fund each year (£17,000), the amount to credit at 1910 and 1911 would be £42,000, or less by £10,000 than at the end of last financial year.

Technical College Laboratory.—In the report of the Bradford Technical College for the session 1907–8, regret is expressed that nothing has yet been done to remove two defects which have been alluded to on several occasions in the annual report, and the continual existence of which places the engineering department at an increasing disadvantage year by year, namely, the absence of an adequate equipment in the power production and electrical engineering section.

BRAY: *Resignation of Chairman of Lighting Committee.*—The Chairman of the Electric Lighting Committee, who recently resigned on account of the small amount of interest taken in the undertaking by the other members of the Corporation, has refused to reconsider the matter.

DOUGLAS (I.O.M.): *Underground Telephone Wires.*—The Council has granted permission to the National Telephone Co. to lay its wires underground, the company paying one shilling per circuit connected to the exchange, with a minimum of £25 per annum.

EDINBURGH: *Public Lighting.*—A return as to the public lighting of Edinburgh states that at May 15th, 1908, the streets of the city were lighted by 10,081 incandescent gas lamps and 1,193 electric arc lamps, and the common stairs by 12,395 gas jets and 152 electric lights. The number of electric arc lamps had been increased by 18. The additional arc lamps had been required to light up tramway extensions in Colinton and Gorgie Roads. The number of stair lights had gone up by 272, the previous year's total being 12,123. This increase was easily accounted for, being due in part to the erection of new buildings, but mainly to the demand for improved lighting. The expenditure was—For street gas lighting (including cost of gas, with due proportion of lamplighters' wages, and incidental expenses), £22,549; for electric lighting (including incidental expenses), £11,246; and for stair lighting (including gas, proportion of wages, and other expenses), £11,619. This showed an increase of £1,814 compared with the previous year. At May last the 1,193 electric arc lamps cost £9 per lamp.

ENFIELD: *Tramways.*—In view of the delay which has taken place in the completion of the Middlesex County Council tramways from Ponders End to Enfield, owing to disagreements with frontagers, it was rumoured that the County Council intended to abandon the line in question, which will afford a valuable cross connection, linking up two of the Middlesex main roads. The Chairman of the Light Railways Committee, however, states that this is not so, and that the line will be proceeded with as soon as possible.

GLASGOW: *Tramway Receipts.*—Since the beginning of the financial year on June 1st, 80,232,777 passengers have been carried, as against 81,767,499 in the corresponding period of last year, while the receipts have been £327,762, in comparison with £332,587.

GRASSINGTON: *Electric Lighting.* A local company is being formed to provide an electric lighting installation.

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HARROGATE.—*Cottage Lighting.*—The Lighting Committee report having reconsidered the question of the lighting of small properties, especially dwelling-houses, at a fixed charge per quarter, and recommend that a charge of 2s. 9d. per quarter for every 30-watt lamp be made, subject to the following conditions: (1) The amounts to be paid quarterly in advance; (2) all departments fitted with light under this tariff are to be adequately lighted by windows during daylight; and (3) the minimum number of lamps per tenement to be two and the maximum six. The Corporation has adopted the proposal.

KEIGHLEY: *New Tramways.*—An application is to be made to the Board of Trade for a Provisional Order authorising the construction of five new tramway routes.

KETTERING: *New Generating Plant.*—A new 500-kw. continuous-current generating plant and an extension to the switchboard was put into operation last week. Messrs. Allen, Son & Co., of Bedford, have supplied the engine, The Phœnix Dynamo Co., of Bradford, the dynamo, and Messrs. Cox-Walkers, of Darlington, the switchboard extension.

LEEDS: *Guiseley Tramways.*—Notices have been served upon the Horsforth, Rawdon, Yeadon, and Guiseley Councils, and also upon the property owners concerned, with regard to the construction of the tramways to Guiseley. Parliamentary powers were obtained last session, the length of line being about four miles. The Councils mentioned above have agreed to contribute £400 per annum for eleven years.

Tramway Receipts.—The half-yearly statement and balance-sheet to September 30th shows a total revenue during the six months of £180,225, against £176,698 in the corresponding half-year of 1907. The average receipts per car mile were 10·93d., against 10·95d. The expenditure amounted to £89,229, against £86,671. The net revenue account stands for £90,996, against £90,026. Allowing for capital charges, &c., there is an available balance of £30,096, against £34,999.

Tramway Accident.—A section of the Leeds Corporation tramway service was seriously disorganised on Thursday last week owing to the slipper brake of a car having dropped and become wedged between the points and the rail. It took two hours to remove the obstruction.

LIVERPOOL: *New Tramways.*—A proposal is before the City Council that an application be made to the Board of Trade for a Provisional Order for the construction of several tramway extensions.

Year's Work of Electricity and Tramways Committee.—In acknowledging a vote of thanks for his services as Chairman of the Electricity and Tramways Committee during the past year, Sir Charles Petrie said that the sales for the past twelve months for power purposes had increased by 13 per cent., and the total number of consumers connected to the mains was 7,000. During the current year they had contributed £27,500 to the relief of rates, and, *à propos* of the recent agitation for reduced prices, he said that there was no reason why charges should not be reduced, but the sum in relief of rates could not be maintained. A new sub-station has been erected in Beaumaris Street for the supply to the north end of the city. With regard to tramways, in addition to the introduction of first-class cars, all the ordinary cars have been fitted with top decks, all the cars have been fitted with improved sand hoppers, and 100 cars have been equipped with new running gear.

Local Electrical Association.—The opening meeting of the Liverpool and District Electrical Association was held last week, when the President, Mr. H. E. O'Brien, delivered his address upon electric traction, and dealt with track equipment, switchboard control, rolling-stock, and overhead lines, and concluded with a comparison between steam and electric train work.

Tramway Receipts.—During the nine months ended September 30th, the passengers carried upon the Corporation tramways amounted to 91,540,688, and the receipts £421,813, whilst the mileage run was 9,266,521. Since the tramways were taken over from the late tramway company on September 1st, 1897, the sum of £182,657 has been paid in contributions to rates, in addition to £974,818 in capital charges, whilst the concessions to employees in increased wages, holidays, and uniforms, &c., are calculated to reach the sum of £550,000. The public were also estimated to have gained £3,300,000 in reduction of fares.

LONDON: *City of London: Street Lighting.*—At a meeting of the City of London Corporation on October 15th a recommendation of the Streets Committee that authority be granted them to appoint a deputation to visit certain cities on the Continent for the purpose of inspecting public lighting systems was adopted. The cost of the visit is not to exceed £200.

London County Council Tramways.—The total traffic receipts upon the London County Council tramway system from April 1st to October 10th were £818,633 from lines worked by electric traction, and £161,792 from lines worked by horse traction, or a total of £980,425. The receipts for the corresponding period in 1907, under the same heads were £641,311, £230,036, and £871,347 respectively.

In the House of Commons on Monday, Mr. B. S. Straus asked the President of the Board of Trade whether a new license would be issued to the London County Council to continue to work the G.B. surface contact system from Aldgate to Bow, as the present license would shortly expire. Mr. Straus also asked whether the President of the Board of Trade was aware that an expert report had stated that, even had the line been constructed exactly similar to the one at Lincoln, the difficulties and dangers which had been encountered would have been much the same. Mr. Churchill stated that no application had been made for the renewal of the present provisional license, and that he had no information with regard to the latter part of the question.

The fee for Mr. W. M. Mordey's services, in connection with the report on the "G. B." surface contact system in the Mile End Road, has been agreed at 250 guineas, and at yesterday's meeting of the Council an emergency estimate of £350 was submitted to cover this and other incidental costs.

The Highways Committee have reported with regard to the construction and reconstruction of further tramways in St. Pancras, Woolwich, Kentish Town Road, Streatham, Clerkenwell, and Islington, at an estimated capital expenditure of £281,265, of which £253,950 is for trackwork, and £27,315 for cables, ducts, overhead equipment, &c. With the exception of one line, namely, that in Streatham, to connect up with the Croydon tramways at Norbury, which is partly conduit and partly overhead, all the lines will be constructed on the conduit system. The "G. B." surface contact system was originally proposed for one of the routes, namely, from Euston Road, via Hampstead Road, Camden Road, and Parkhurst Road, to Holloway Road, but after fully weighing all the circumstances, the Committee now recommend the conduit system. The extra cost entailed amounts to about £53,000. The report has been adopted.

Battersea Tramways.—The Borough Council has consented to the electrification of the tramway on Lavender Hill and St. John's Hill, subject to satisfactory conditions being arranged. The matter has been referred to a departmental committee to report thereon.

Kensington: Opposition to Tramways.—Mr. R. A. Robinson has written acknowledging receipt of a communication addressed to him by the Town Clerk, expressing the hope that he would do all in his power to secure the rejection of the proposal of the Highways Committee to construct a tramway from Battersea Bridge to Shepherd's Bush. Mr. Robinson says that he is opposed to the scheme put forward by the Highways Committee, and that he has no doubt the strong opposition which the same has evoked will secure its abandonment.

Islington: Tramways.—The Works Committee recommend that the London County Council's proposal to construct a single line of tramway from Essex Road via Englefield Road to Kingsland, be disapproved. They suggest that the necessary widenings to permit of the construction of a double line should be carried out as a county improvement.

REDDITCH: *Electrical Undertaking.*—The estimates for the ensuing half-year show that £500 will be required from the rates in support of the electrical undertaking. The loss of several large consumers and the increased cost of fuel during the past half-year are the reasons given by the Chairman of the Electricity Committee for this condition of affairs.

ST. HELENS: *Financial Position of Tramways.*—In the elective auditors' report upon the various undertakings of the Corporation, lengthy reference is made to the tramways undertaking. On March 31st, 1903, the accounts showed a balance of £3,392 7s. 11d., which in the period of five years had been absorbed, and at March 31st, 1907, there was a net deficit of £828 3s., whilst at March 31st, 1908, there was a total deficit of £908 6s. 8d., notwithstanding the fact that £1,230 has been paid into this account during the year as a contribution from the highway account. The only possible remedy, in the elective auditor's opinion, by which the Council can alter this serious condition of affairs is by making arrangements for taking over the trams and working them as a municipal undertaking. He was convinced that if they must be burdened with a rate—and he saw no way of escape—it would be much more satisfactory to the ratepayers to pay rates for something that would be under the control of the Council, and with the power to offer better facilities to the people, than to have to pay rates to maintain a track for a private company. Another point to which attention is called is the fact that the tramway accounts contain no depreciation fund.

SOUTHAMPTON: *Electric Omnibuses.*—A London company has applied for permission to run a service of electric omnibuses, but the Watch Committee recommend that the proposal should not be entertained.

SOUTHPORT: *Inspection of Electrical Machinery.*—The minutes of the Electrical Committee last week contained a resolution that the Vice-Chairman and the Electrical Engineer should be empowered to visit various towns for the purpose of inspecting the latest types of electrical machinery and apparatus with a view to further extensions. On account of the lateness of the municipal year, this recommendation was deleted.

SWANSEA: *Telephone Accounts.*—The balance in hand, from the sale of the telephone undertaking to the National Telephone Co., after meeting all liabilities and paying off debenture bonds of £23,000, represents a surplus of £927 18s., which has been transferred to the common fund in reduction of the rates.

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Electricity Accounts.—The auditors' report upon the accounts of the municipal electricity undertaking states that the accounts, after providing interest on loans and sinking fund amounting to £8,950, shows a net profit for the year of £1,230, which, after deducting the adverse balance brought forward the previous year of £441, leaves a net credit balance of £789 as undivided profit. The capital expenditure continues to be added to. In 1906 the additions amounted to £9.852; in 1907, £11.895; and last year, £7,323, bringing the aggregate spent to the enormous total of £144,516, about one-third of which has to be repaid in 25 years, and the remaining two-thirds in 30 years. The auditors state that they can only reiterate in the strongest possible terms as to some check to this growing expenditure, and upon the absence of provision for depreciation. It is the practice in the leading towns carrying on electricity stations to make ample provision in this respect. Such items as measuring tapes, hammers, pliers, files, and other sundries, including Osram lamps, are capitalised, whilst it is a general practice to place to the same account such delicate things as motors and meters at prime cost without writing off a single penny for wear and tear. The total expenditure is divided as follows:—Buildings, £22,963; machinery, £45,062; mains, £50.069; motors and meters, £12,516; electrical instruments, £2.574; public lamps, £2.960; accumulators, £1,777; engineer's commission, £3,384; general expenses, £2,706. The sinking fund extends about 24 years. The report continues:—"Can the life of any of the above, except buildings, by any possible stretch of imagination, last beyond half this time? And if this be true another loan will have to be applied for. The growing tendency of municipalities to pile up huge amounts of capital expenditure may be a tempting one to present-day administrators, but as a sound principle of finance each generation should meet its own liabilities. This department has been in existence for seven years, yet the net result of trading shows a surplus of £789 only, without one penny provided for reasonable wear and tear of machinery, boilers, &c."

TURKEY.—*Telephone Service.*—A *Financial News* telegram states that the Turkish Government has refused the offer of a German syndicate to establish a telephone service in Turkey. It is announced that international tenders will be invited, and the monopoly given to parties offering the most advantageous terms.

WARRINGTON: *Electric Supply Charges.*—A scale of discounts for consumers of electric light has been adopted, ranging from 1s. 2d. in the £ below 250 units per quarter, to 2s. 2d. between 109,000 and 12,149 units. The scale of discounts for consumers of power ranges from 1s. in the £ for units between 2,500 and 3,749 to 2s. 6d. for units between 205,000 and 234,999. These discounts are only allowed if the account is paid within a month. Councillor Wilkinson, at the last meeting of the Council, in moving the adoption of the minutes, said that in the past the charge for lighting was 4½d.—with discount 4d. The latter would now be 3¾d. They proposed to make a similar reduction for power. It would mean a loss of £500 on lighting, and £600 on power, but they hoped this would be the means of encouraging more people to use electricity both for lighting and power.

WESTON-SUPER-MARE: *Public Lighting.*—A letter from Mr. C. H. Godward (secretary to the Weston-super-Mare & District Electric Supply Co., Ltd.) with reference to the public lighting of Walliscote Road states that he had submitted to his board the draft agreement returned with various alterations and additions, and they desired him to say that they could not accept the agreement as amended. They further wished him to state that as it seemed impossible to come to an arrangement with the Council on the basis of the altered draft agreement, they had no alternative but to withdraw the proposal put forward by their managing engineer. If, however, it would assist the Council out of their difficulty regarding the lighting of Walliscote Road, his board would be willing to supply current at a flat rate of 1½d. per unit for any lamps that Council might desire lighted. The Gas Co. is to be asked for terms for the lighting of Walliscote Road.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

CLITHEROE.—A proposal is under consideration for the erection of electricity works in connection with the gas works.

EPSOM.—Tenders are invited for a storage battery. Particulars from the Electrical Engineer, and tenders by October 23rd.

MAIDSTONE.—The sanction of the Local Government Board has been received to the borrowing of £18,400 in connection with the electric lighting undertaking.

MANCHESTER.—The Electricity Committee invite tenders for the supply, delivery, and erection of high-pressure steam and feed pipes, valves, and supports at their Stuart Street generating station (see an advertisement this week).

SIERRA LEONE (W. Africa).—An electric lighting scheme is under consideration. Messrs. Wilkinson & Broadbent, 4 Queen Street Place, London, E.C., are the consulting engineers to the Council.

SOUTH AFRICA: *Germiston.*—The Council invite tenders for a supply of electrical energy in bulk. Tenders should state: (*a*) The price per unit at which they would be prepared to supply 700.000 (Seven Hundred Thousand) units approximately per annum; (i.) for a period of five years; (ii.) for a further period of five years—the right of exercising the extension for this further period of five years to rest with the Council. The current to be three-phase alternating 50 or 60 cycles and 3,300 volts between lines; to be delivered at a point selected by the Council convenient to the boundary of the township. The load is mixed lighting and power, chiefly power, with a peak load of 350 kw. (*b*) The date on which they would be prepared to supply the current. Tenders to the Town Clerk, Germiston, Transvaal, South Africa, by Thursday, December 18th.

Miscellaneous

AYR.—Tramway extensions are under consideration.

DUNDEE.—The Harbour Trustees invite tenders for 25 tons of steel rails, tramway section, about 127 lb. per yard, with fishplates and bolts. Tenders to the Engineer by October 22nd.

JAPAN.—It is stated that the Keihin Electric Co. has practically succeeded in obtaining from London capitalists a loan of 2,000,000 yen (£200,000) for the purpose of extending its line from the Aoyama terminus of the Tokyo Railway to Shingawa.

LONDON: *London County Council.*—Tenders are invited for the supply of the following stores for one year from January 1st, 1909:—(*a*) Electric carbons and brushes; (*b*) electric fittings, globes and shades; (*c*) electric insulating materials; (*d*) electric cables and wires; (*e*) electric lamps.

LOWESTOFT.—The Local Government Board has sanctioned the borrowing of £661 for mechanical stokers.

SALFORD.—The Tramways Committee invites tenders for the supply and erection of a wheel-turning lathe and a vertical press at the Central Car Depôt, Pendleton Road. Particulars from the General Manager, and tenders to the Town Clerk by November 2nd.

STOCKPORT.—The Local Government Board has granted permission for borrowing £10.500 for the electricity undertaking.

WOLVERHAMPTON.—Extensions of the tramways have been authorised from Queen Square, along Victoria Street, Worcester Street, Penn Road, Lea Road, and Stubbs Road.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Additions to Stour Wharf, Stour Road, Poplar, for Henry Thorman.

E.C.—Bank, restaurant, shops, and offices on sites of Nos. 21, 22, and 23 New Bridge Street. Architects, Palgrave & Co., 28 Victoria Street, S.W.

Building at 71 Old Broad Street. Architect, Joseph & Smithem, 83 Queen Street, E.C.

N.E.—Mission hall, Mabley Street, Hackney. Builder, James Watt, Bromley Road, Catford

S.E.—Thirty-one houses, Lewisham. Architects, Norfolk & Prior, 4 Station Buildings, Catford Bridge, S.E.

King's Hall Palace of Dancing, to be erected at junction of St. George's Market and Dantzic Street, Southwark. W. F. Hundall, 84 Blackfriars Road, S.E.

Clergy house and other parochial buildings, in King's Bench Walk and adjoining streets, Southwark. Rev. T. Gerard Tylee, vicar of St. Alphege, Southwark.

S.W.—Additions, &c., at St. John's Parochial Hall, Brixton.

Building, Pimlico Wharf, 145 Grosvenor Road, for Allen & Co., building contractors.

Building, 34 Queen Anne's Gate. Architects, Blow & Billery, 3 Pall Mall East, S.W.

W.—Rebuilding shops, showrooms, &c., 522 Oxford Street. Builders, Hall, Beddall & Co., Pitfield Wharf, Waterloo Bridge, S.E.

PROVINCES.

ACTON.—New schools (Local Government Board sanctioned the borrowing of £18,098).

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New public offices (Local Government Board sanctioned the borrowing of £20,600). Wm. Hodson Clerk to the Urban District Council, Acton.

BURTON.—New police station and courts (£13,250). Architect, H. Beck, 30 High Street.

BLACKPOOL.—Carnegie Library (£15,000). Thomas Lofton, Town Clerk.

BIRMINGHAM.—Extensions to factory, Northwood Street, for Jones & Rooke.

Extensions to factory, Freeman Street, for Hassall & Singleton.

BOURNEMOUTH.—Rebuilding Railway Hotel, Holdenhurst and St. Paul's Roads, for H. C. Cartwright.

Alterations to Grosvenor Hotel, for A. R. Baker.

Additions to Castle Laundry, Castle Road, for R. Bevington.

Additions to St. Peter's Vicarage, Bath Road, for Rev. A. E. Daldy.

BRADFORD.—Conversion of two houses into club and dressing-rooms, and alterations and additions, Burlington Terrace, for Bradford City Football Club, Ltd.

BROMLEY.—Alterations to Lyric Theatre. Surveyor, F. J. Rorald, 72 Victoria Street, S.W.

BRENTWOOD.—Erection and completion of new central kitchen at Brentwood Asylum. F. Whitmore, County Architect, 73 Duke Street, Chelmsford.

CUMBERLAND.—Enlargement of schools at Oughterside (£1,297). C. B. Hodgson, Clerk to County Education Committee, Carlisle.

COLCHESTER.—County Lunatic Asylum (£191,545). Builders, Waring White Building Co., Ltd., 1A Cockspur Street, S.W.

EDINBURGH.—New cavalry barracks on estate of Redford, for War Office (£15,500). H. B. Measures, Director of Barrack Construction, Whitehall.

GARTH.—New Garth Institute. Architect, W. Beddoe Rees, Dumfries Place, Cardiff.

GLASGOW.—Langside District Library, Queen's Park, for Corporation. A. W. Myles, Town Clerk.

Alterations and additions to Dalmarnock Iron Works, Baltic Street, Bridgeton, for Sir Wm. Arrol & Co., Ltd.

Buildings at Aikenhead Road and Calder Street, for North British Locomotive Co., Ltd., Hydepark Works, Springburn.

HAMILTON.—School at Udston. Robert Kerr, Clerk to Parish School Board, Hamilton.

HANDSWORTH.—Alterations at William Street for Birmingham Railway Wagon Works.

ILFORD.—Alterations, Beehive School, Beehive Lane. Architect, C. J. Dawson, 11 Cranbrook Road, Ilford.

KING'S NORTON.—Infants' school (£4,173). E. Docker, Clerk to Urban District Council.

LEICESTER.—School (150 places) for Education Committee. E. V. Hiley, Town Clerk.

LOWESTOFT.—Additions to Isolation Hospital G. H. Hamby, Surveyor to Town Council.

Fitting up "Sparrows' Nest" for entertainments to be given by Town Council. G. H. Hamby, Surveyor to Town Council.

MANCHESTER.—Congregational Church House (£14,000). Architects, Bradshaw & Gass, 108 City Road, E.C.

NORWICH.—Alterations and additions to Norfolk and Norwich Hospital (£45,000). Hospital architect, E. T. Boardman.

NORTH FINCHLEY.—Roman Catholic Church, Nether Street (£5,000), to be lighted by electricity. Architects, Lamb & North.

NEWPORT (MON.).—New technical institute (£36,130) for Education Committee. Builder, W. E. Blake, Coxside, Sutton Road, and 23 Salisbury Road, Plymouth.

STRATFORD-ON-AVON.—103 Houses (£20,000). R. Dixon, surveyor to Town Council.

SOUTHAMPTON.—Sailors' Home. Architect, A. F. Gutteridge, 9 Portland Street; builder, W. E. Blake, Coxside, Sutton Road, and 23 Salisbury Road, Plymouth.

TEDDINGTON.—Shop and dairy, Kingston Road. Pyke Bros., cowkeepers, 37 High Street, Teddington.

WEST HARTLEPOOL.—Sawmill, Seaton Road, for J. W. Baird & Co.

WILLESDEN.—Boiler-house and chimney shaft, Leicester Road, for the White Heather Laundry. Surveyors, Mark W. King & Sons, 6 Holborn Viaduct, E.C.

Printing shed and boiler chamber, The Willows, Harlesden Road, for Thos. Illingworth & Co., Willesden Junction.

WEST RIDING (Yorkshire).—Secondary School at Castleford. F. A. Darwin, Clerk of County Council, Wakefield.

TENDERS RECEIVED AND ACCEPTED

ARGENTINE. The British Westinghouse Electric & Manufacturing Co., Ltd., of London and Manchester, have received an order from the Buenos Aires & Pacific Railway Co. for the complete construction and equipment of a large power station, with several sub-stations, for the supply of electricity to the city of Bahia Blanca. The contract also includes extensive additions to the existing tramway system within the city of Bahia Blanca and several outlying townships. The present contract had its origin in the taking over by the Buenos Aires & Pacific Railway Co. from a private enterprise of the supply of light and power to the city. The existing plant was found to be inadequate, and a scheme for extensions was projected by Mr. Packenham W. Beatty, the railway company's resident electrical engineer. The designs and specifications for the entire plant have been prepared by Mr. John F. C. Snell, the consulting electrical engineer to the Buenos Aires & Pacific Railway Co.

BRAY.—Two dozen meters are to be ordered from the General Electric Co. at 30s. each.

CLECKHEATON.—The tender of Messrs. W. T. Glover & Co. for 400 yards of cable has been accepted.

CORK.—For the lighting of various parishes in the Cork Rural District Council's area, the tender of the Cork Electric Light & Tramways Co. has been accepted.

GLASGOW.—The offer of the British Westinghouse Electric & Manufacturing Co., Ltd., to supply the two rotary converters, with transformers and spares, at a cost of £651, has been accepted.

HANLEY.—The tender of Messrs. Ferranti, Ltd., at £500 has been accepted for switchboard extensions.

LEEDS.—The Electromechanical Brake & Engineering Co. has been given an order for 70 magnets for brakes for the Corporation tramways.

LONDON: *London County Council.*—The tender of Messrs. J. Mowlem & Co. has been accepted at £68,602 for the execution of roadwork and plate-laying for the reconstruction of the existing tramways from Nine Elms to East Hill, Wandsworth. The following tenders were also received from the following:—Dick, Kerr & Co., £68,767; W. Manders, £70,097; J. G. White & Co., Ltd., £74,851.

The following tenders have been received for the supply of electric cable in connection with the tramways:—India Rubber, Gutta Percha & Telegraph Works Co. (accepted), £504 (less 2½ per cent.); W. T. Glover & Co., Ltd., £570 (less 5 per cent. and 2½ per cent.); Siemens Bros. & Co., £546 (less 2½ per cent.); Johnson & Phillips, £547 (less 2½ per cent. for cash monthly); W. T. Henley's Telegraph Works Co., Ltd., £541; Callender's Cable & Construction Co., Ltd., £542; British Insulated & Helsby Cables, Ltd., £551.

Hackney.—The Council has accepted the tender of W. Cory & Son, Ltd., for 4,000 tons of Cowdenbeath and Edinburgh washed pea nuts at 10s. 5d. per ton.

Stepney.—The Council has received the following tenders for the supply of twenty thousand pairs of carbons for new arc lamps:—Gilbert Arc Lamp Co., Ltd. (accepted), £101 6s. 8d; Sloan Electrical Co., Ltd., £137 10s.

For the supply of fifty tons of moulded pitch the Council has accepted the tender of J. Smart & Son, at £63 2s. 6d. The other quotations were:—Grindley & Co., Ltd., £75 alternative £81 5s.; South Metropolitan Gas Co., £77 10s.; Forbes Abbot & Leonard, Ltd., £80 12s. 6d.; Thomas Crow & Sons, £81 5s.

Stoke Newington.—The Council received the following tenders for cables to connect the new generating station with the sub-station in Edwards Lane:—Callenders Cable & Construction Co. £1,623; W. T. Glover & Co., Ltd., £1,556; British Insulated & Helsby Cables, Ltd., £1,413; W. T. Henley's Telegraph Works Co. (accepted), £1,371.

The following tenders were received for steam and other pipe work at the generating station:—Babcock & Wilcox, Ltd., £307; the Railway & General Engineering Co., £299; William Freer, £279; G. N. Haden & Sons, £275; Ashwell & Nesbit, Ltd., £268; John Spencer, Ltd. (accepted), £265.

SOUTHAMPTON.—The tender of Messrs. H. Stevens & Co. at £110 has been accepted by the Education Committee for improved lighting at the York Buildings Boys' School.

STOCKPORT.—An order has been placed with the General Electric Co. for exhaust piping and a battery meter.

WAKEFIELD.—The tender of the British Westinghouse Co. for three 60-kw. transformers at £156 has been accepted.

WEST HAM.—The Town Council received the following tenders for the supply and fixing of transformers, &c., at the Balaam Street Baths, to reduce the voltage to 25 volts to permit of the use of 10, 16, and 25 c.p. Osman lamps:—J. T. Halsey (accepted), £52 10s. 6d. (4); W. J. Woodward, £58 (1); W. Simmons, £60 16s. (4); Electricity Department, £71 15s. (1). Transformers, similar to above for effecting economy in the lighting of underground conveniences:—J. T. Halsey (accepted), £14 18s. 6d.; Vulcan Electric Co., £18 5s.; Electricity Department, £20 16s. 6d.

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COMPANIES' MEETINGS AND REPORTS

AMERICAN TELEGRAPH & TELEPHONE CO.—The gross earnings for the nine months ended September 30th are $20,999,000, and after providing for interest on bonds and the October dividend there is a net surplus of $4,423,000, against $3,254,000 for the corresponding period of last year.

CLEVELAND & DURHAM ELECTRIC POWER.—At the second annual meeting, held in Newcastle last week, the report and accounts given in our issue for October 8th were adopted. Mr. Charles Emmott, who presided, said that, unfortunately, in common with nearly every other company in their district, their revenue had most seriously been affected by the strike in the shipbuilding industry, in addition to the severe trade depreciation. A large proportion of their revenue was obtained from shipyard and engineering works, which for many months had been practically idle and taking no current. Others upon whom they had expended capital and put themselves in a position to supply could not obtain the motors they had contracted for, the makers being unable to deliver them. They had consumers who had pressed them to be ready to supply in January last, but who, for various reasons, had not taken one single unit of energy. Other consumers affected by trade depression had reduced their demand by 50 per cent., whilst other firms, with whom they fully expected to complete agreements, had postponed the negotiations pending better times. Taking all the circumstances into consideration, the directors did not feel that the results for the year were very disappointing. Referring to the accounts, the chairman stated that at present every penny was needed in the company's business, and as, moreover, a portion of the profits for the year had been derived from work carried out by the associated companies, the board were unanimously of the opinion that they would be ill-advised to pay the final dividend on the preference shares. They preferred to strengthen the position by writing down preliminary expenses, a course which he believed the shareholders would approve. The net revenue for the year, after writing down preliminary expenses by £10,000, amounted to £5,142, in addition to £3,230 brought forward. After deducting an interim dividend of 5 per cent. upon the preference shares, which was paid in April last, there is a balance of £1,252, which is carried forward.

CUBAN SUBMARINE TELEGRAPH CO.—The report for the half-year to June 30th states that the total receipts for the six months amount to £18,079, the expenses being £6,523. Adding the sum brought forward from the last account, namely, £7,000, there is a sum of £18,556 to be dealt with. After adding £4,000 to reserve, which now stands at £110,000, a dividend of 6 per cent. per annum on the ordinary shares is recommended, carrying forward a balance of £6,756. The meeting will be held on 28th inst.

DRAKE & GORHAM. The report for the year ended June 30th, 1908, states that, after payment of all charges, including bonuses due to staff, there remains a net profit of £7,577, including £1,399 brought forward, which it is proposed to appropriate as follows:—It is proposed to pay a dividend of 5 per cent. per annum, and to carry forward £1,327. Mr. Gorham has ceased to act as a managing director, but retains his seat on the board. Mr. M. G. Drake and Mr. Hamilton have been appointed managing directors in lieu of employee managing directors.

ELECTRIC SUPPLY CORPORATION. The report for the year ended December 31st, 1907, states that the gross revenue (including the revenue from Totnes and Chelmsford) amounted to £20,960, a marked increase on the total £7,285 for the previous year. The receipts from the working of the Dumbarton tramway, £3,543, will not appear again as the line has been made over to the new company. As a result of the year's working, the sum of £5,456 has been brought into the net revenue account, as compared with £2,786 in the preceding year, an increase of nearly 100 per cent., which the directors consider satisfactory and encouraging for the future. The company has thus earned net profits sufficient to pay the debenture interest, and the interest on temporary loans, while the full dividend of 5 per cent. on the share capital has been paid to the proprietors from the sum received from the guarantors. The capital for the new Dumbarton Burgh & County Tramways Co. has been fully subscribed, and the extensions of the line are now completed. The entire system, which comprises about 13 miles of tramway, was opened for traffic in July last, and should substantially contribute to the prosperity of this Corporation. Royal Assent was given in July of last year to the Bill promoted by this Corporation, referred to in the last report, for vesting in the Corporation the various undertakings and for giving legal sanction to the agreements with the local authorities. Under this Act the Chelmsford and the Totnes companies have ceased to exist, and have been merged into the general business of this Corporation. The Hendon Electric Lighting Order was excluded from the Bill, as it was deemed advisable to form a separate company to work the Order. This has been effected by the formation of the Hendon Electric Supply Co., Ltd., in which the Corporation retains a substantial interest. Good progress has already been made, and, as the district is rapidly growing, the directors consider the interest of the Corporation in this undertaking a valuable asset. Owing to the pressure of other work, the directors regret that Mr. C. F. Tufnell has found it necessary to retire from the Board. Mr. F. R. Reeves, having relinquished the secretaryship, has been appointed to fill the vacancy thus occasioned. This appointment will require confirmation by the shareholders. The meeting is on the 29th inst.

FERRANTI.—The report for the year to June 30th shows a profit of £31,165, and after crediting discounts, interests, &c., and deducting general establishment charges, repairs and renewals, legal expenses, bad debts, directors' and trustees' fees there is a balance of £15,421. After deducting expenses *re* prior lien debentures, interest on prior lien debentures, interest on first mortgage debenture stock, interest on bank loan, and depreciation there is a balance of £3,275, which has been deducted from the balance standing at the debit of profit and loss account, reducing the net debit balance to £2,136. The report calls attention to the fact that, in spite of the keen competition in the electrical industry, which does not show any sign of abatement, the results for the year are better than those for the previous twelve months. Prior lien debentures for £20,000 have been issued during the year.

METALLIC SEAMLESS TUBE CO.—At the annual general meeting on Friday, the report and accounts for the past year were adopted. Including the amount brought forward, the sum available for dividend is £6,724, and a further half-year's dividend at the rate of 6 per cent. on the preference shares and 7½ per cent. on the ordinary shares has been declared, carrying forward £4,540.

NEW COMPANIES

ECONOMIC FORCED DRAUGHT & ENGINEERING CO.—This company was registered on October 10th, with a capital of £5,000 in £1 shares, to carry on the business of mechanical and electrical engineers, boiler-makers, smelters, iron and brass founders, manufacturers of and dealers in steam, water, and electrically-driven turbines, &c. The subscribers are J. E. Hackett, 35 Windsor Road, Liverpool, engineer; G. Ogle, 8 Lambeth Road, Liverpool, engineer; J. Goss, 29 Cheapside, Liverpool, engineer. Private company. The number of directors is not to be less than two nor more than four; the subscribers are to appoint the first. Qualification, 100 shares. Registered office, 5 Castle Street, Liverpool.

FREDERICK A. ROBERTS.—This company was registered on October 10th, with a capital of £3,000 in £1 shares, to acquire the business carried on by F. A. Roberts, and to carry on the business of patent experts, electrical, mechanical, and general engineers, model makers, draughtsmen, dealers in novelties and inventions, &c. The subscribers are B. S. James, 119 St. George's Road, Southwark, S.E., mining engineer; N. Le Fevre, 1 Cranworth Gardens, Brixton, S.W., designer; J. H. Brockmann, 59A Bishopsgate Street, E.C., mining engineer; F. Brooker, 13 Larch Road, Balham, S.W., engineer; O. E. K. Roberts, 4 Clock Terrace, Hampton Street, S.E., builder; H. Gerdon, 15 Dalmeny Road, N., engineer; R. J. W. Brown, 49 King William Street, E.C., engineer. Minimum cash subscription, seven shares. The number of directors is not to be less than two nor more than five; the first are O. E. K. Roberts, R. J. W. Brown, and F. A. Roberts. Three thousand pounds is payable in cash and shares to the vendor (F. A. Roberts). Total purchase price, £3,000 (£208 cash and £2,792 shares). Contracts may be inspected at the registered office, 49 King William Street, E.C.

REES ROTURBO MANUFACTURING CO.—This company has been registered, with a capital of £250,000 in £1 shares, to acquire the assets and liabilities of Thomas Parker, at Wednesfield Road, Wolverhampton, to adopt an agreement with the said old company and W. A. Nelson, the liquidator thereof, and to carry on the business of ironfounders, engineers, manufacturers of machinery of all kinds, toolmakers, brassfounders, metal workers, boilermakers, millwrights, machinists, iron and steel converters, winners and workers of minerals and metals, &c. The subscribers are: C. T. Mander, J. E. Underhill, E. S. G. Rees, W. Armistead, C. H. Iles, C. F. Behenn, E. S. W. Moore. The number of directors is not to be less than three, nor more than seven; the first are C. T. Mander, J. E. Underhill, E. S. G. Rees, W. Armistead, George Balfour, and J. H. Keep.

JAMES SCOTT.—This company was registered on October 12th, with a capital of £2,500 in £1 shares (500 preference), to acquire the business of an electrical and mechanical engineer carried on by J. Scott at the Knowsley Electrical Works, Knowsley Road, Bootle. The subscribers are J. Scott, 286 Knowsley Road, Bootle, electrical and mechanical engineer, and F. Bradford, 17 Denman Drive, Newsham Park, Liverpool, electrical and mechanical engineer. Private company. The number of directors is not to be more than three; the first are J. Scott and F. Bradford. Remuneration, £208 and £130 per annum respectively. Registered by Drivers, Cobbs Court, Carter Lane, E.C.

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APPOINTMENTS AND PERSONAL NOTES

The post of head of the Physics and Electrical Engineering Department of the Victoria Jubilee Technical Institute, Bombay. Salary, Rs.600 to Rs.800 per month. Applications to D. E. Wacha, Provisional Honorary Secretary of the Board of Trustees, the Institute, by November 30th.

A silver cigarette-case and match-box, suitably engraved, has been presented to Mr. L. H. Howe on his leaving Windsor and Eton Electrical Installation Co. to take up an appointment under the Aldershot Town Council.

Mr. Ben H. Morgan, of Queen Anne's Chambers, Westminster, has been appointed consulting engineer to the Clyde Engineering Co., Ltd., of Sydney, New South Wales, builders of locomotives, railway carriages, steam engines, pumps, and agricultural machinery, and also to the Geelong Harbour Trust Commissioners, Geelong, Victoria.

The Coventry Electric Light Committee have acceded to an application from Mr. G. Tough, station superintendent, to be placed in charge of the electricity works for a period of six months, in order to afford him an opportunity of proving his ability to manage the undertaking. Mr. Tough has held his present post for over ten years, and, the committee state, he has proved himself most efficient, having been chiefly instrumental in bringing about reforms and economies which have placed the works costs of the county station among the lowest in the kingdom.

On the recommendation of the L.C.C. Highways Committee, Mr. C. R. Johnson, at present District Traffic Superintendent (Northern Tramway Section), has been appointed Inventory Officer in the Tramways Department, at a salary of £200 per annum. Mr. Johnson's duties will consist of keeping a careful inventory of the stock of stores, machine parts, &c., at the various tramway depots.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., quoted on Tuesday night, was £61 10s. to £62 per ton (last week £62 to £62 10s.)

COMBINATION METALLIC PACKING.—The combination Metallic Packing Co., Ltd., Gateshead-on-Tyne, notify us that they have been awarded a Gold Medal and Diploma at a special exhibition in Russia.

COOPER HEWITT LAMPS.—The British Westinghouse Electric & Manufacturing Co., Ltd., announce that Cooper Hewitt mercury vapour lamps, hitherto manufactured in France and Germany, are now being manufactured in England for sale direct to users and the trade. Inquiries for these lamps should be addressed as heretofore to the British Westinghouse Company at Trafford Park, Manchester, or any of their branch offices.

DISSOLUTION OF PARTNERSHIP.—K. O. Müller and C. Müller, carrying on business as electrical accessories merchants, 10 Arcade, Westgate, Bradford, have dissolved partnership.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A first meeting of creditors was held last week in the bankruptcy of Charles Arthur Hemingway, trading as Hemingway & Pitt, electrical engineer, Eton Street, Richmond, when a statement of affairs, as at October 5th last, was presented. This showed liabilities amounting to £2,603 19s. 1d. After allowing £56 5s. 10d. for preference claims the assets were expected to produce £787 11s. 5d., a deficiency being thus disclosed of £1,816 7s. 8d. The following were appointed to act as a committee of inspection:—Mr. Whitford (General Electric Co.), Mr. Rooke (Sloane Electrical Co.), and Mr. E. H. Hawkins (Poppleton & Appleby).

NEWALL ENGINEERING CO.—Messrs. Peter Hooker, Ltd., of Walthamstow, have purchased from the liquidator of the Newall Engineering Co., Ltd., the entire plant, stocks, patents, and goodwill of that company's business in limit gauges, measuring machines, micrometers, surface plates, and other products, established now for about seven years, and will continue the same as a department of their own business under the name of The Newall Engineering Co., at their works, Blackhorse Lane, Walthamstow, London, E.

MISCELLANEOUS CITY NOTES

BUENOS AYRES LACROZE TRAMWAYS CO.—Subscriptions are being invited to an issue of £200,000 five per cent. first mortgage debenture stock at 96. The stock is secured by a trust deed dated July 25th, 1905, and supplemental trust deeds dated June 7th, 1906, and August 27th, 1907, in favour of the Anglo-American Debenture Corporation, Ltd., as trustees. Specific mortgages, in accordance with the Argentine law, have been executed, constituting the debenture stock now issued, a first mortgage and charge on the lands, buildings, and depôts, including machinery, rolling stock, and concessions of the company. The tramways were converted to electric traction in 1905, and now consist of 38½ miles, of which 25½ miles are owned by the company, four miles are owned jointly, and nine miles are worked under running powers over several companies' lines.

CALCUTTA ELECTRIC SUPPLY CORPORATION.—An interim dividend of 6½ per cent. per annum for the half-year ended June 30th upon the ordinary shares has been recommended.

COMPANIES STRUCK OFF REGISTER.—The names of the following companies have been struck off the register, and the companies dissolved:—Electrical Appliances Syndicate, Electrical Productions, Electro Smelting Co., Irish Electric Railways Co., Helios Electrical Construction Co., North-West London Electric Supply Co., and Uddingston District Electric Lighting Co.

EDISON & SWAN UNITED ELECTRIC LIGHT CO.—The directors have recommended the payment of a dividend for the year, at the rate of 2½ per cent. per annum, being 1s. 6d. per share on the "A" shares partly paid, and 2s. 6d. per share fully paid, each less income tax. The annual meeting of the shareholders will be held on Thursday, October 29th, 1908.

ORIENTAL TELEPHONE & ELECTRIC CO.—The following interim dividends have been declared:—(1) 3 per cent. on the 6 per cent. cumulative preference shares for the current year, less income tax, and (2) 3 per cent. on the ordinary shares, free of income tax, payable to those shareholders whose names are on the share registers of the company at this date. The share transfer books will be closed from the 15th to the 28th inst., both days inclusive.

UNITED ELECTRIC TRAMWAYS OF MONTE VIDEO.—Mr. George A. Touche has been elected chairman in succession to the late Mr. William Trotter.

COMPANY MORTGAGES

Particulars of mortgages and charges have been filed as under:—

ALUMINIUM CORPORATION. A deposit of deeds on August 29th, 1908, to secure all moneys owing to Lloyds Bank, Ltd., up to £26,200, has been registered.

AMALGAMATED RADIO TELEGRAPH CO.—A debenture, dated September 11th, 1908, to secure £350, and further advances, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holders—H. Malpas and Mrs. M. M. Malpas, 46 Halsey Street, Chelsea.

BRADFORD ELECTRICAL ENGINEERING CO.—A debenture dated September 17th, 1908, to secure £100, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder—J. Garnett, 40 St. Paul's Road, Bradford.

BUENOS AYRES ELECTRIC TRAMWAYS CO. (1901).—An acknowledgment of indebtedness dated September 18th, 1908, securing £1,100 (making, with £78,600 already outstanding, a total of £79,700, part of £100,000 five per cent. second or "B" debentures authorised and secured by trust deed of March 30th, 1906), has been registered. Property charged—Concessions and premises mortgaged by said trust deed and the company's general assets. Trustees Sir Walpole Greenwell, Bart., and F. C. Tiarks.

ELECTRIC LIGHT, POWER & HIRING CO.—Deposit of deeds in 1906, securing £11,899.

ENTWISTLE & GASS.—Debentures, dated 1889, securing £10,900.

H. HOOPER & CO.—Particulars of £1,000 debentures, created by resolution of September, 1908, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £500. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

HORSFALL DESTRUCTOR CO.—A letter of charge, under seal dated September 17th, 1908, to secure advances which the mortgagees may from time to time make in connection with the company's contract with the City of Melbourne for the erection of a destructor plant, has been registered. Property charged—Moneys payable to company under the said contract. Holders—Findlay Durham and Brodie, 110 Cannon Street, E.C.

KENSINGTON AND KNIGHTSBRIDGE ELECTRIC LIGHTING CO.—Trust deed October 1st, for securing £50,000 second debenture stock, to be issued jointly with the Notting Hill Electric Lighting Co., Ltd.; trustees: R. E. B. Crompton and A. E. Franklin (freehold land situate near Wood Lane, Hammersmith, together with the generating station, fixed plant, and machinery).

MORRIS-HAWKINS.—Deposit of deeds, dated September 3rd, 1908, to secure all moneys due or to become due to the London Joint Stock Bank, Ltd., 5 Princes Street, E.C., has been registered. Property charged—Certain freehold land and premises at Dagenham.

MOUNTAIN & GIBSON.—Issue on September 25th, of £1,000, and on September 28th of £300 debentures, part of series of which particulars have already been filed.

SANDYCROFT FOUNDRY CO. Issue on September 19th of £300 six per cent. debentures, part of series of which particulars have already been filed.

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COMPARATIVE RUNNING COSTS OF ARC LAMPS AND METAL FILAMENT LAMPS

Up to a year or so ago, the only practical sources of electric light were arc lamps and carbon glow lamps. Each had its own particular sphere of usefulness; the arc lamp was only generally known in units of hundreds of candle-power, and the glow lamp only in units of 50 candle-power and less. Carbon glow lamps of 100 and even 500 candle-power have been manufactured, but these never came into extended practical use on account of their high running costs. There was thus always a great gap between the 50-c.p. carbon glow lamp and the arc lamp of several hundreds of candle-power. Some time ago, however, the small pattern of enclosed arc lamps appeared on the market, and also Nernst lamps for one or two hundred candle-power. The former, partly on account of the simple mechanism necessary to bring the cost down to a reasonable value, are not in every way satisfactory as regards evenness in burning, and the latter, beside being somewhat troublesome and costly to keep running, have shown themselves ill adapted for use on alternating-current or low-pressure continuous-current circuits. The high candle-power metal filament lamp, however, seems to be admirably suited to fill this gap, and, as has been mentioned at various times in these columns, has already found a considerable field of usefulness in street lighting.

These are the views expressed in an interesting paper read before the Verband Deutscher Elektrotechniker at their summer meeting at Erfurt by Mr. H. Remané, of the Auergesellschaft of Berlin (the makers of the Osram lamp in Germany). The author dealt in this Paper with the relative advantages of arc lamps and metal filament lamps for lighting units of between 100 and 500 mean hemispherical candle-power. The curves given in the Paper were based on figures obtained in practice with Osram lamps of from 100 to 400 Hefner candle-power (mean horizontal candle-power), which can be obtained for any pressures between 110 and 250 volts. The specific consumption or "efficiency" of these lamps varies from 1·0 to 1·1 watt per (mean horizontal) Hefner candle, or 1·1 to 1·21 watts per British standard candle (using the latest determination of the ratio of the Hefner to the British unit—namely, 0·91). It is stated that the falling off in candle-power is about the same with these high candle-power lamps as with the low candle-power Osram lamps—namely, from 5 to 6 per cent. after a life of 800 hours, which is assumed to be the average life. The following constants in connection with the high candle-power lamps are also given: The mean spherical candle-power is, on the average, 79 per cent. of the mean horizontal candle-power, which value has also been obtained for the low candle-power Osram lamps at the Physikalisch-Technische Reichsanstalt; the specific consumption or "efficiency" reduced to the mean spherical candle-power works out at 1·39 watts per Hefner candle; the mean hemispherical candle-power is about 82 per cent. of the mean horizontal; and the specific consumption based on this value of the candle-power is 1·33 watts per Hefner candle. These high candle-power lamps are generally provided with reflectors, and for outdoor work the lamp itself is protected by means of a clear glass globe. This globe reduces the mean hemispherical candle-power by about 7 per cent. In making the comparisons, figures obtained with lamps protected in this way were employed.

The curves in Fig. 1 show the specific consumption or "efficiency" in watts per Hefner candle reduced to the mean hemispherical candle-power for Osram lamps and various small arc lamps of different candle-powers. The figures on which the curve for the Osram lamp is based are as follow: Four sizes of lamps of 100, 200, 300, and 400 mean horizontal candle-power respectively have mean spherical candle-powers of 79, 158, 238, and 316 c.p., and mean hemispherical candle-powers (with reflectors and protecting globes) of 105, 209, 316, and 414 c.p. The specific consumption or "efficiency" of all four sizes is 1·05 watts for Hefner candle, reduced to the above values of the mean hemispherical candle-power. The curve for the Osram lamp in Fig. 1 is thus a straight line. In order to obtain the curve for the continuous-current arc lamps, the following figures were used: Three sizes of open arc lamps with pure carbons taking 3, 4, and 5 amperes respectively, running two in series, on a 110-volt circuit with 42 to 45 volts per lamp, were assumed to consume 165, 220, and 275 watts respectively. These have mean hemispherical candle-powers of 112, 187, and 262, and specific consumptions of 1·47, 1·17, and 1·05 watts per Hefner candle. To represent the alternating current arc, lamps taking from 6 to 20 amperes and running three in series on a 110-volt circuit were taken as examples. The specific consumptions of these are shown by the curve in Fig. 1. Continuous-current enclosed arcs of from 2·5 to 6·5 amps, and for pressures of from 75 to 80 volts are represented by the uppermost curve of Fig. 1. In all cases the figures at the points on the arc lamp curves denote the current taken by

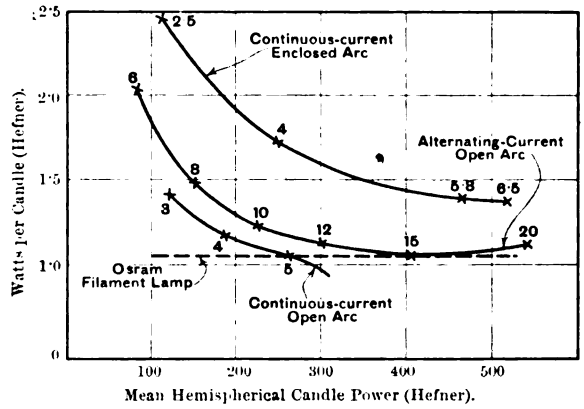

FIG. 1.—SPECIFIC CONSUMPTION OR "EFFICIENCY" FOR VARIOUS CANDLE POWERS IN WATTS PER MEAN HEMISPHERICAL CANDLE.

(The Figures on the Curves denote the Current taken by the Lamps.)

the arc lamp corresponding to that candle-power. As the figures are meant to be those which are obtainable in practice, the absorption of the diffusing globes of the arc lamps, which amounts to about 25 per cent., was allowed for, and the consumption of the series resistances was also included when calculating the specific consumption.

The curves of Fig. 1 show that a specific consumption or "efficiency" as low as that of the Osram lamp is obtained with a 5-ampere continuous-current open arc, or with a 15-ampere alternating-current open arc, both with pure carbons. For candle-powers below the amounts represented by these currents, the consumption in watts per candle is higher than that of the Osram lamp. The 500-candle-power 6·5-amp. enclosed arc has a specific consumption about 30 per cent. higher than that of the Osram lamp, and for candle-powers lower than this the inferiority of the arc lamp is still more evident. In comparing the relative advantages of the two types of lamps, it must be remembered that with the open arc lamps the arrangement of the lamps has also to be made so as to allow of connecting the proper number of lamps in series in each case.

The author then considers the relative running costs obtained with arc lamps and Osram lamps respectively, and deduces the curves shown in Fig. 2. These curves are reckoned on the basis of the mean hemispherical candle-power in all cases, and

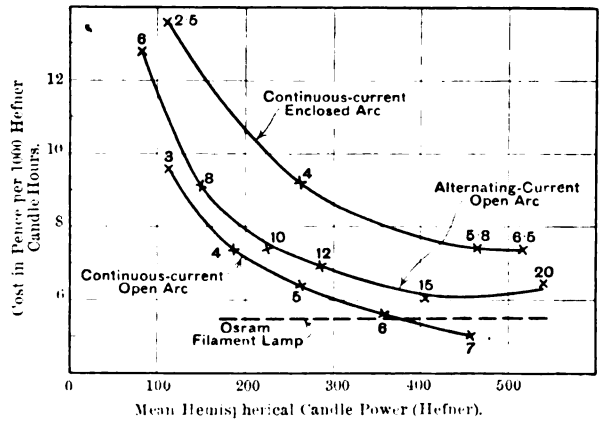

FIG. 2.—RUNNING COSTS IN PENCE PER 1,000 CANDLE HOURS.

(The Figures on the Curves denote the Current taken by the Lamps.)

an average tariff of 45 pfennigs, or 5·4d. per unit. The average life of the Osram lamp was taken at 800 hours, and the prices as follow: 200 c.p., 9s.; 300 c.p., 12s.; and the 400 c.p., 15s.; In estimating the running costs for the arc lamps, the cost of the carbons and attendance was added to the cost of current, but no addition was made for repairs or renewals. The cost

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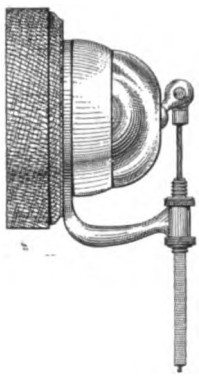
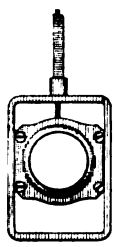
of renewals was, of course, included in the case of the Osram lamps. The curves of Fig. 2 show that the running costs per 100 candle-hours are the same for a 370-c.p. Osram lamp as for a 6-amp. continuous-current open arc lamp; for candle-powers below this, the costs for the Osram lamp are less. Comparing the latter with the enclosed arc, it is found that the running costs for a 6·5-amp. arc lamp are over 35 per cent. higher than those for the equivalent Osram lamp. The running costs for the 15-amp. alternating-current open arc lamp come out about 11 per cent. higher than those for the equivalent Osram lamp. Thus the curves point to the conclusion that in most cases where a light source of from 100 to 500 mean hemispherical candle-power is required, it will be more economical to use a high candle-power metal filament lamp than a small open or enclosed arc lamp. If the costs are estimated on the basis of a lower average cost of current, the positions of the curves are altered, but the relative positions remain about the same.

In the discussion following the Paper, several speakers complained that the figures for the specific consumption or "efficiency" of the arc lamps were not representative, the values given being far higher than those obtained with the improved patterns of these small arc lamps. However, Mr. Remané, in his reply, pointed out that the figures were taken from the latest published results issued by the large firms making these lamps, and contended that the values used were quite representative. The figures assumed for replacement of carbons and for attendance were not challenged. Some difference of opinion was expressed with regard to the colour and the irregular burning of small arc lamps, and some speakers pointed out that metal filament lamps would not show to such advantage as indicated by the curves, if they were used as a substitute for small arc lamps in factories, as the vibration would shorten their life considerably.

A NEW BEDSIDE SWITCH

THE accompanying illustration represents a new arrangement which has just been brought out by Messrs. Drake & Gorham for actuating bedside switches. An ordinary tumbler switch is used, and by means of a simple attachment this is actuated by a "Bowden" wire in a flexible metallic tube by a convenient sliding ring arrangement, which can be placed under the pillow or elsewhere. The device is much less liable to damage than the ordinary flexible cord and "pear" switch, and entirely obviates any remote possibility of shocks which might exist with damaged flexible wires. There are other obvious applications of this ingenious device, such as where re-arrangement of furniture, &c., have made existing switches inaccessible and wiring alterations are undesirable. These switches have made their appearance on Messrs. Drake & Gorham's stand at Manchester since the opening of the exhibition.



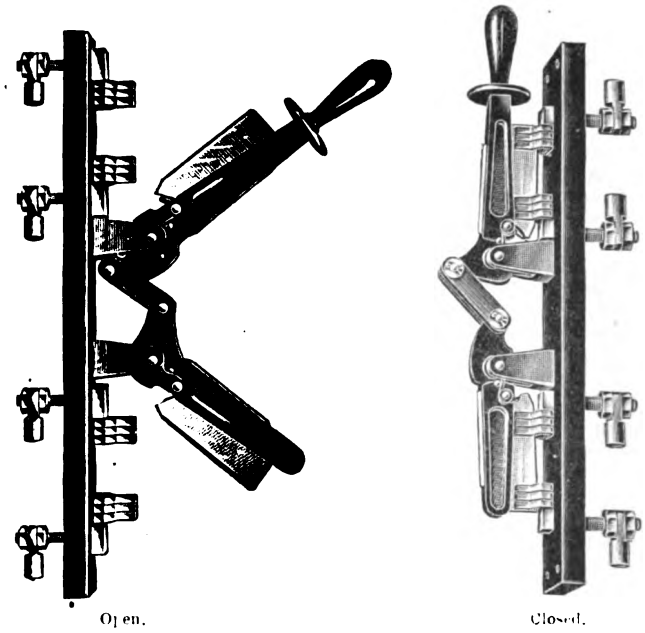


New Drake and Gorham Bedside Switch with Bowden Wire Extension.

London Electric Power Bills.—A conference was held at the National Liberal Club on Wednesday last week in connection with the opposition of the London Borough Councils to the London and District Electric Power Bill. Mr. T. Lough, M.P. (West Islington), presided, and the following resolution was passed on the proposition of Mr. W. Crooks, M.P. (Woolwich):—"That this meeting, while recognising the desirability of making provision in London for the supply of electricity in bulk, is of opinion that this can only be safely done under the control of a central municipal authority, and views with profound alarm the London and District Electricity Supply Bill, which would confer immense powers over a vast area on the promoters. It regards with particular apprehension, as contrary to precedent, the provisions of the measure which would enable the promoters to acquire, without coming to Parliament, the undertakings of public authorities throughout the various areas, and for these reasons it appeals to the Government, and to all members of Parliament representing the wide district included, to oppose the further progress of the Bill, and asks for consideration of Mr. Kearley's Electric Supply Bill." A committee was afterwards appointed to represent the delegates, with instructions to take all possible steps to defeat the Bill.

DISTRIBUTION BOARDS

THE accompanying illustrations show a type of distribution board which the General Electric Co. have put on the market recently. In these boards good workmanship and suitability to their purpose have been put before extreme cheapness, and



Open. Closed.

Fig. 1.—Tandem Coupled "Peel" Switch.

their substantial nature is a welcome contrast to some of the productions of the price-cutting to which there has recently been a tendency in this class of work. A current density of not more than 800 amperes per square inch has been allowed for in all current-carrying parts, which alone does not allow them to be sold at "competition" prices. The form of switch used in an adaptation of the company's well-known "Peel" switch,

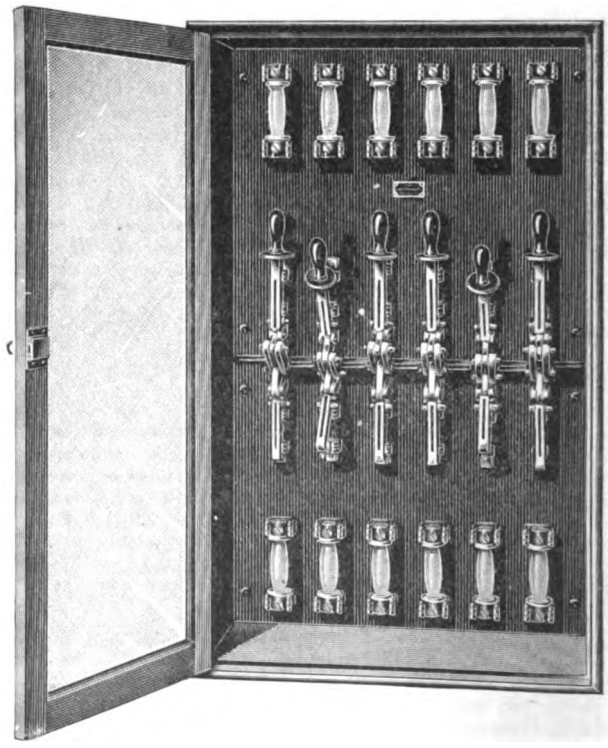


Fig. 2.—G.E.C. Distribution Board.

a special tandem pattern of which has been designed in order to minimise space. The action of this is shown in the illustrations. The equipment of the board is completed by enclosed porcelain tube fuses on both poles, and the whole is enclosed in a strong teak cabinet with glazed front.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

THE first meeting of the Council of the International Electrotechnical Commission was held in the Medical Examination Hall, Victoria Embankment, on Monday. Sir John Gavey, C.B., was in the chair, and delegates were present from the following countries:—United States, Great Britain, Germany, France, Sweden, Paraguay, Spain, S. Africa, Russia, Mexico, Denmark, Japan, Canada, Italy, Brazil, Hungary, Australia, and Argentine.

It will be remembered that the International Electrotechnical Commission owed its inception to the following resolution passed at the close of the meetings of the Chamber of Government Delegates at the International Electrical Congress held at St. Louis in September, 1904:—

"That steps should be taken to secure the co-operation of the technical societies of the world by the appointment of a representative Commission to consider the question of the standardisation of the nomenclature and ratings of electrical apparatus and machinery."

The preliminary stages of the movement were taken in hand by a temporary committee of the Institution of Electrical Engineers, and a meeting for the formation of the Commission was held in London in June, 1906. Lord Kelvin was elected the first president, and Colonel R. E. Crompton honorary secretary of the Commission. A set of proposed rules relating to the general organisation of the Commission was drawn up and adopted, subject to ratification by the authorities who had appointed the delegates.

Sir John Gavey, before calling upon the Rt. Hon. A. J. Balfour, M.P., to welcome the delegates, explained that his presence in the chair was owing to the lamented death of their late President, Lord Kelvin.

The Right Hon. A. J. Balfour, M.P., said he had the greatest pleasure in offering the warmest welcome to the delegates. After paying a tribute to Lord Kelvin, he said that what was wanted was a plain and intelligible medium between the manufacturer and the user. The Commission should aim at the framing of rules which would not hamper the free development of the electrical industry, and although another Commission was sitting at the present moment dealing with electrical units, the present Commission was more immediately connected with the practical aspects of electrical theory.

The first business was the election of a new President, and on the motion of Dr. E. Budde (Germany), seconded by Sir John Gavey (Great Britain), Prof. Elihu Thomson (United States), was unanimously elected to this office for the coming year.

On the motion of the French delegates, supported by the Mexican delegates, Col. Crompton was re-elected honorary international secretary.

The next item on the agenda was the consideration of one or two modifications, prior to the ratification of the rules. The first was the replacement of the word "Local" throughout by the ward "Electrotechnical," and after a brief discussion, in which the German delegates objected, it was decided to leave the matter over for a private committee meeting, which was held on Tuesday. Rule No. 6 at present reads as follows:—"The central offices of the Commission shall be situated, for the present, in London, at the offices of the Institution of Electrical Engineers, 92 Victoria Street, Westminster, S.W., and, temporarily, the secretary of the Institution of Electrical Engineers may act as secretary." It was unanimously resolved to replace this by the following:—"The central office of the Commission shall be established at present in London at 28 Victoria Street, Westminster, S.W."

Another proposed modification, stipulating that any change in the voting power can only be made by unanimous vote, was also postponed to the private committee meeting referred to above.

Colonel Crompton then read his annual report as hon. secretary, which is given in abstract below:—

At the close of our preliminary meeting, held on June 26th, 1906, you entrusted to my care the further organisation of the work of this Commission, and it is my duty, therefore, to report to you in detail what has taken place since that date.

In October, 1906, the Central Office was started with M. Le Maistre's help. I brought the matter before the British Institution of Electrical Engineers. The Council of the Institution responded very sympathetically, and in December of that year decided to defray the entire cost of the preliminary meeting and preliminary organisation, thus making a free gift to the Commission of nearly £200. The Central Office was thus enabled to start the year 1907 entirely free of debt, but as only a few subscriptions had at that time been received, the Council of the Institution of Electrical Engineers decided to make the Commission a loan of £200. During this year subscriptions have been received from Canada, Denmark, England, France, Germany, Hungary, Mexico, Spain, Sweden, and the U.S.A., and correspondence has been opened with several of those countries not represented at our preliminary meeting with the result that very considerable progress is being made towards the formation of a committee in several countries.

In the Argentine Republic Mr. Stewart and Prof. Jorge Newbery are prosecuting the first inquiries. A committee was formed in Austria in September, 1907, but since that time it has, I am afraid, been in a state of suspended animation. I hope, however, that matters will be properly rearranged shortly. In Australia the matter is in the hands of Mr. Atlee Hunt, Secretary to the Minister of External Affairs in Australia. In Belgium the Union Syndicate des Electriciens Belges have taken the matter up jointly with the Société Belge d'Electriciens, and a successful issue may be honed for very shortly. The Société Belge d'Electriciens very generously forwarded, not a subscription, as their committee was not formed, but a donation of £20 towards the expenses of the Central Office. With regard to Brazil, considerable difficulty has been experienced in getting into touch with the representatives of the industry, but it is hoped that a committee will be formed during the present year. The Electrical Section of the Royal Institut van Ingenieurs of the Hague, Holland, being somewhat small in numbers, do not find themselves at present able to join in the work of the Commission.

With regard to Italy, the acting secretary had the pleasure of meeting Mr. Semenza at the Electrical Congress at Marseilles, and I have every hope of seeing the matter pushed forward to a successful issue at no distant date. The Council of the Japanese Society have, I understand, appointed a committee to raise the necessary funds to enable them to carry out, in an adequate manner, the work of an Electrotechnical Committee, which Dr. Fujioka says they feel sure of being able to do shortly. In Norway the formation of a committee has been sanctioned, and it will be constituted at the beginning of next year. At the request of a Roumanian engineer, resident in this country, full information with regard to the Commission has been sent to Roumania. A committee will be formed in Russia, I think, next month. The South African Association of Engineers, whose representative present to-day is Mr. Lee Murray, are also taking great interest in the subject. A committee has not, as yet, been formed in Switzerland. I should like here to make reference to the generous donation of the Danish Committee, which was formed in June, 1908. The Danish Engineering Society, who were communicated with in 1907, were unable to form their committee during that year, but to show their interest they took in the work of our Commission, they very kindly sent a donation of £20 towards our expenses.

Thus ten Electrotechnical Committees have been officially constituted, and are in proper working order; in six countries committees will be formed very shortly, and in another six countries the matter is being considered with a view to forming a committee.

Colonel Crompton then referred to one or two items on the agenda of the committee, which have held private meetings during the week. Mention was first made of the suggestions with regard to nomenclature, which were sent out in February, 1903, to all Electrotechnical Committees. These suggestions, on the whole, were well received, but the criticisms of the German committee on certain of the suggestions were so much to the point that after careful consideration he decided to amend the former suggestions. The French committee have requested that the subject of the metric system should be considered, and this will form one item on the agenda before the committee. The question of symbols has been set in train by the British committee, and this subject will also be considered by the committee. It is no doubt, however, an extremely difficult question and must be approached with the greatest caution. There is also another important question which has been brought before the Commission by the French committee, and that is the question of a provisional standard of light. This question will also be examined by the committee. A further question which has been referred to the Commission is the subject of regulations for fire insurance for interior electrical wiring. This matter was discussed at the Electrical Congress at Marseilles, and he suggested that this also be referred to the committee to be reported upon.

Turning now to financial matters, the report suggested that each year the total expenses of the Central Office should be equally divided by the number of Electrotechnical Committees actually formed. The estimate for the next year should be framed so as to provide for a small surplus at the end of the

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year, and this would have the effect of diminishing the amount asked for to cover the expenses of the following year. In the case in which the amount asked for from each committee had not been entirely expended, the balance would be so much to the credit of each committee, and the Central Office would then ask for some figure smaller than £50 depending on this balance.

In conclusion, Col. Crompton asked the Council to confirm his selection of Mr. Le Maistre, and to formally appoint him secretary of the Commission.

On the motion of the Canadian delegate, seconded by the French delegate, the report was adopted, and a separate resolution passed, expressing the appreciation of the Council at the action of the Institution of Electrical Engineers in founding not only the British committee but also the Central Offices of the committee.

Sir John Gavey proposed the appointment of a committee to consider and report to the Council upon proposals with reference to nomenclature, standards of light, &c., and it was resolved to appoint the whole Council. A number of other matters were also referred to this committee.

This closed the business of the meeting. As already mentioned, the committee meetings are private.

On Monday the delegates were entertained at dinner by the "Dynamicables" at the Franco-British Exhibition. On Tuesday the Central Telephone Exchange, Carter Lane, London, was visited. On Wednesday visits were paid to the Lots Road power station and the Earl's Court signalling cabin of the Underground Electric Railways Co. of London. The delegates have been invited to the Institution dinner to-night. A committee meeting was held on Tuesday and another will be held to-day, and to-morrow the Council will meet to receive the report of the committee.

Manchester Association of Engineers.—We are pleased to announce that Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation, has been awarded the "Constantine" Gold Medal, which is presented annually for the best Paper read before the above society during the session, for his Paper on "Steam Turbine Engineering," read in March last (see Electrical Engineering, Vol. III., page 433).

Utilisation of the Tides for Industrial Purposes.—It is stated in a British Consular report that a company has been formed at Hamburg for utilising the force of the tides at Cuxhaven (at the mouth of the Elbe) for the production and transmission of electric power to factories for making ice, liquid air, as well as substitutes for nitrates, &c. It is stated that the necessary capital, viz., about £150.000, has now been raised amongst financial firms at Hamburg, and that various buildings, plant, and other preparations at Cuxhaven connected with the undertaking are now in course of completion.

Leeds Local Section I.E.E.—The first meeting for the session of the Leeds Local Section of the Institution of Electrical Engineers will be held on Wednesday next, October 28th, at the University, Leeds, at 7 p.m. Mr. H. E. Yerbury, the chairman, will deliver his inaugural address, and this will be followed by a Paper by Captain Gardener on "Electric Signalling on Railways." At the November meeting of the section a Paper will be read by Mr. W. N. Y. King on "Comparison of Natural and Induced Draught Systems."

Storage Batteries in Generating Stations.—*A propos* of the discussion at the Nottingham Convention of the Municipal Electrical Association upon Mr. A. M. Taylor's Paper on storage batteries, the "D.P." Battery Co., Ltd., of Bakewell, send us the following figures as an example of the saving resulting from the installation of a battery in a station which has been erected and running some years. The results of the working were kindly furnished by the electrical engineer to the station. A Diesel oil engine was the motive power, having a guaranteed consumption of 0·468 lb. per b.h.p. hour at three-quarter load. It appears that in November, 1906, before the battery was installed, 10·2 units were generated per gallon of fuel, whereas in November, 1907, after the battery was put in, it was found possible to obtain 12·3 units per gallon. Assuming, therefore, that this improvement is solely due to the introduction of the battery, its use enabled an increase of 20 per cent. in the output to be obtained on the same consumption of fuel. Putting the matter in another way, in November, 1906, the total units generated were 24,628, and 22,718 lb. of oil were consumed; and in November, 1907, with the battery in use, 24,516 units were generated from 18,198 lb. of oil. Thus the consumption of fuel was reduced by 24 per cent. on practically the same load. The average fuel consumption for four months' working, viz., November to February inclusive, was 0·580 lb. per b.h.p. hour without battery, and 0·474 lb. per b.h.p. hour with battery. The reduction in the average consumption thus shown is 22·15 per cent. These figures are striking, but are by no means the actual measure of total economy claimed for the installing of a battery was followed by a reduction in the wages sheet, stores supply, &c.

CATALOGUES AND PAMPHLETS RECEIVED

BATTERIES.—An attractive show-card is being issued by Messrs. Siemens Brothers and Co., Ltd., of 12 Queen Anne's Gate and Woolwich, calling attention to the various forms of primary batteries for bells, telephones, motor-car ignition, &c., made by them. Representations of the ordinary fluid Leclanché cell and the well-known "Obach" dry cell are given.

DRAWING AND SURVEYING INSTRUMENTS.—A booklet from H. Morin, of Paris, describes a number of drawing, surveying, and other instruments, including a useful form of water-level for lining up shafting, machines, &c., and measuring small deflections of bridges, floors, and other structures. Another speciality is a hyperbolic square by which the area of plane figures can be readily measured without the use of a planimeter.

ELECTRICAL SUPPLIES.—One of the most handy forms of complete catalogue of electrical plant, fittings, and accessories that we have seen is the handsome new publication of Messrs. Verity's. Departing from their well-known single quarto volume, the firm have produced a catalogue in three separate cloth-bound octavo volumes, each of nearly 400 well-printed pages. The three books are contained in a neat cloth-covered case, with partitions, and the whole in external appearance more resembles a three-volume novel than a technical catalogue. The sections are devoted to plant, fittings, and sundries respectively, and it is not too much to say that prices are given for everything connected with electrical engineering and the allied industries, from a complete turbo-generator to a conduit clip. Attention should be particularly drawn to the fittings volume on account of the quality of the illustrations and the variety and artistic nature of the designs they represent.

INSTRUMENTS.—A well-arranged leaflet from Messrs. Johnson & Phillips, of Charlton, contains illustrations and particulars of a considerable variety of ammeters and voltmeters. Permanent magnet-moving coil instruments are included in the round, sector, edgewise, and portable patterns for a large number of ranges. Another special feature is the collection of hot-wire switchboard and portable ammeters and voltmeters for continuous and alternating currents, with maximum readings ranging from 0·2 to 1,500 amperes and 1 to 5,000 volts. The list also contains particulars of a cheaper line of spring-controlled dead-beat moving iron ammeters and voltmeters for continuous and alternating currents in round or sector pattern cases.

METALLIC PACKING.—A collection of leaflets, &c., from the Combination Metallic Packing Co., Ltd., of Gateshead-on-Tyne, gives an idea of the universality of the company's metallic packing for marine purposes by a list of some 1,600 ships on board which it is in use. It is also estimated that over 10,000 sets of this style of packing are in use in the electric light and power stations. As well as the well-known piston-rod packing, particulars are given of jointing rings for various purposes. Further leaflets describe the "Moller" drain-cock for steam pipes, steam whistles, &c., in which the drain is always open when the steam is shut off, but closes with the opening of the steam valve.

RESISTANCES.—A comprehensive new list from the Union Electric Co., Ltd., contains particulars of regulating and other resistances for various purposes. The series of shunt regulators is very complete, and ranges from simple patterns for temporary and portable use, to complete switchboard equipments of several interlinked regulators for groups of machines working in parallel, operated singly or together, either by hand or automatically. In one form of automatic regulator, the controlling device consists of a solenoid with movable core, to which is attached a trough of insulating material, containing mercury. The ends of the resistance spirals are fixed above this trough in the form of a comb, with teeth of gradually decreasing length; consequently, as the core of the solenoid moves either down or up, more or less of the resistance spirals are brought into the circuit. The list also deals with arc lamp and other series resistances, calibration resistances for meter testing, banks of lamps for test-room purposes, and artificial loads for technical college laboratories, &c.

TRANSFORMERS.—Messrs. Johnson & Phillips, of Charlton, have issued a new leaflet describing their single- or three-phase air-cooled and oil-cooled transformers. The air-cooled patterns are standardised up to 100 KVA., and the oil-cooled patterns up to 400 KVA. Oil-insulated and water-cooled transformers can be made up to any size

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Wireless Telegraphy.—The *Times* correspondent at Wellington (N.Z.) states that an English wireless telegraphy syndicate has submitted proposals for establishing wireless telegraphic connection between New Zealand, Australia, and seven important Pacific islands. The proposal is being strongly supported in the Pacific, and it is understood that the Commonwealth Government is inclined to accept it. The New Zealand Premier also favours the project, but he wishes the Auckland and Chatham Islands to be included in the scheme. If the project is carried out several of the Union Company's steamers will probably be fitted with wireless apparatus.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9½—10	
Do. 6% Cum. Second Pref.	10	6	6%	10⅝—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	4½*	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	96—100	
Brompton & Kensington E. S. Co.,Ld.	5	10	5%*	7—8	
Do. 7% Cum. Pref.	5	7	7%	7—8	
Central E. S. Co., Ltd.. 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	3⅜—3⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	3¾—4⅜	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3½—4	
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	2⅞—3⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9½—10½	
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3⅜—4½	
County of London Elect. Sup. Co. Ltd.	10	5	—	7—8	
Do. 6% Cum. Pref.	10	6	6%	10½—10¾	−⅛
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6—6½ xd	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	90—93	
Kensington & Knightsbridge E. L. Co.	5	10	4%*	7⅞—8⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	96—100	
London Electric Supply Corporation	3	2½	—	⅜—1⅜	
Do. 6% Pref.	5	6	6%	4½—4⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4½—4¾	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅝—4⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	+1
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply..	5	8	2½%	5½—5¾	
Do. (fully paid)	4	8	2½%	4⅞—4⅝	
Do. 5% Pref. Do.	5	5	2½%	5¼—5¾	
Dc. Do.	4	5	2½%	4—4¼	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅜—12⅜	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅝—6⅛	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	7¼—8¼	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅛—2⅜	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅝	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	98—101	
Urban Elec. Supply Co., Ltd.	5	5	5%	½—1	
Do. 5% Cum. Pref.	5	5	5%	1⅞—2⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	7⅛—8½	−½
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3%*	69—71	
Do. 4% Preferred	Stock	4	4%	86—88	
Do. Deferred	Stock	2	—	49—52	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	85—87	
City and South London Cons.	Stock	4½	1½%	32½—33½	
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	2%*	7¾—8¼	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	¼	¼%	39—40	
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	+1
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—78	
Metropolitan District	Stock	—	—	13—14	
Do. 6% Perp. Deb.	Stock	6	6%	124—127	
Do. 4% Deb.	Stock	4	4%	82—86	
Do. Perp. Extension Pref. (5%)	Stock	—	—	24—29	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	50—55	
Underground Elec. Railways Co. of London 5% Profit Shg. Sec. Notes	Various	5	5%	43—47	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅜—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	83—88	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	¾—1¼	+⅛
Do. 6% Cum. Pref.	10	6	6%	3⅝—4⅝	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾ xd	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100 xd	−2

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	92—94	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	72—77	−1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5%	⅜—⅝	+⅛
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—¼	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	½—¾	
Do. 5% Cum. Pref.	1	5	2½%	½—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	92—95	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	77—81	−1
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	3—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	58—61 xd	
Do. 6% Pref. Ord.	Stock	6	6%*	102—103 xd	−1½
Do. Def. Ord.	Stock	1	—	16¾—17¼	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	88—90	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3¼	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13¼—13⅜ xd	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—102½	
Do. do. (Mauritius Sub.)	25	4	—	101½—103½	
Eastern Ext. Australasia & China	10	7	5%	12⅝—13⅛ xd	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½%*	135—138 xd	−1
Do. 3½% Pref.	Stock	3½	3½%*	84—86 xd	−1
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	29—31	−1
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅛—⅜	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	117½—119½	−½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5½—5¾	
Do 3½% Deb. Red	Stock	3½	3½%	98½—100½	
Do. 4% Deb. Red.	Stock	4	4%	102—104	
Western Telegraph Co., Ltd.	10	7	6%*	13⅜—14½	
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	7%	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	16%*	31½—32⅝	+1⅛
Do. 6% Pref.	1	6	6%	1⅛—1⅜	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6½—6⅝	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—⅞	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜	
Do. 6% Cum. Pref.	1	6	6%	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A." £3 paid	5	2/6	—	⅝—⅞	+⅛
Do. do (fully paid)	5	4/2	—	1⅛—1⅜	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	⅞—1⅛	
Do. 7% Cum. Pref.	2	7	—	1¼—1⅜	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7⅛—8	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½—11⅛	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16½—17½	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red.	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	¾—1¼ xd	
Do. 6% Cum. Pref.	5	6	3/-	2½—3 xd	−¼
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Oct. 15th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

21,271, **Direct Reading Potentiometer for the Measurement of Resistances.** Eyershed & Vignoles, Ltd., and S. Evershed. This apparatus, which is especially suitable for the measurement of low resistances, comprises an indicating instrument of the aperiodic moving-coil type with two separately wound and oppositely acting coils, termed the main and balance coils respectively, and also a direct reading resistance box in the main coil circuit, and a reciprocal reading resistance box in the balance coil circuit. The main coil is connected in parallel with the test resistance and the balance coil in parallel with the standard resistance. By varying the resistances in circuit the torques of the coils are balanced, and then the resistance is read direct from the main resistance box. Special contacts for connecting both the main circuit and the potentiometer circuit to the resistance under test are also described in the specification. Seven claims, seven figures.

23,816, **Control of Tramway Brakes.** M. Cummins. When the hand-brakes of a tramcar are applied, and the wheels skid, the motor armatures do not rotate, and the rheostatic or magnetic brakes are rendered inoperative. The present invention provides for an interlocking arrangement, which compels the driver to release the hand-brakes before applying the rheostatic or magnetic brakes. One claim, three figures.

28,137, **Centrifugally Operated Switch for Squirrel-Cage Motors.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). To increase the starting torque and to diminish the starting current of squirrel-cage induction motors, the end rings of the rotor are sometimes cut in several places. This, however, has a bad effect on the slip and efficiency at high speeds, as it is equivalent to inserting resistance in the rotor circuit. To overcome this defect the present invention provides for the use of small centrifugally acting switches which bridge over the breaks in the rotor rings when a certain speed is attained. Two claims, two figures.

1908 Patents

1,420, **Preparation of Wood for use in Accumulator Cells.** The Chloride Electrical Storage Co., Ltd., and B. Heap. Wood, preferably a light white wood, for use as separators, supports, or containing vessels of accumulators, is, according to this invention, prepared as follows:—It is first soaked in an alcoholic solution of caustic alkali, with an addition of about 25 per cent. by volume of water for a period varying from two to twelve hours. After successive washings in alcohol it is dried slowly in a current of warm air. This removes the resins and natural acids without affecting the shape or giving rise to splitting on drying. Three claims.

9,697, **Tumbler Switch.** The Thames Iron Works, Shipbuilding & Engineering Co., Ltd., and W. H. Flood. A tumbler switch for heavy work, consisting of a movable contact pivoted at the end of a toggle lever and provided with a rod which slides through a guide on the lever. When the tumbler is depressed a spring coiled round the rod is compressed; at the end of the movement the spring is released and the movable contact forced suddenly into the fixed contacts. Three claims, five figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

17,195, Hatfield. Electrolytic rectifiers.
17,532, Mitchell. Surface contact traction systems.
19,068, Rüdenberg. Producing alternating currents of high periodicity.
21,176, Sohm. Electric signal systems.
21,516, Good. Automatic transformer switch.
21,574, Thompson (*Polyphos Elektrizitats Ges.*). Induction coils for generating high tension current.
21,742, Paterson. Manufacture of vulcanised bitumen.
21,958, Morris & Lister. Switches.
22,117, J. Stone & Co. & Preston. Secondary batteries.
22,140, Ashton. Spring supports for electric lamps.
22,203, British Thomson-Houston Co. (*Allgemeine Elektricitats Ges.*). Control of electric motors.
22,527, Jacoby. Alternating current motors.
22,869, British Thomson-Houston Co. (*General Electric Co.*). Resistance material.
23,456, Griffin. Magnetos for use on internal-combustion engines.
24,027, Timar & Von Dreger. Arc lamps.
24,260, Page. Means for operating from a distance electrical organ-blowing apparatus.
24,999, Boocock. Track brakes for tramcars and railway trains.
27,224, British Thomson-Houston Co. (*General Electric Co.*). Electrolytic condensers.
28,003, Whipp, Whipp, & Bourne. Loose handle single-pole circuit breakers.
28,106, Tate. Storage battery plates.
28,199, Scott. Electric circuit breakers.

1908 Patents

461, Stearn & Topham. Incandescence electric lamps.
498, Samaia. Apparatus for setting tramway points from a car.
3,504, Wenger. Process for the precipitation of electrolytic copper in the form of sheets with soluble iron anodes.
4,617, Mackenzie (*Ford*). Igniting apparatus for internal-combustion engines.
7,069, Drewell. Connection for closing an optional branch of a frequently branched circuit by means of a limited number of switches.
9,254, Kennedy. Electricity integrating meters.
9,640, Siemens Bros. Dynamo Works, Ltd. (*Siemens Schuckertwerke Ges.*). Switching apparatus for controlling electrical machinery.
9,838, Meyer. Regulatable inductive resistance.
10,878, Paschen. Method for regulating the degree of hardness of Röntgen tubes.
12,352, Nobbs, Nobbs, & Rosenthal. Electric radiator for heating buildings.
14,775, Schiessler. Transmitting apparatus for submarine signalling.
18,184, Steynis & Chaumat. Production of ozone.
18,331, Cooper. Systems of operation for alternating-current motors and generators.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

14,420, Lohay. Control of mechanism from a distance
17,438, Siemens & Halske Akt.-Ges. Manufacture of objects of tungsten or of alloys thereof.
17,610, Siemens & Halske Akt.-Ges. Process for improving the ductility of tungsten.
19,054, Beach. Control systems for electrically-propelled vehicles.
19,311, Siemens & Halske Akt.-Ges. Manufacture of incandescence bodies of tungsten.
19,889, Siemens-Schuckert Werke Ges. Repulsion motors.
19,932, Siemens & Halske Akt.-Ges. Manufacture of filaments from tungsten or alloys thereof.
20,205, Cremer. Method for removing corrugations from the tread of rails.
20,282, Aders. Selective actuating mechanism.

Expiring Patents

The following patents expire during the current week after a life of fourteen years:—

20,259, of October 23rd, 1894. **Electrolytic Apparatus.** Carl Kellner. An apparatus for the electrolysis of alkaline salts with the aid of a stationary mercury cathode. The amalgam is moved from the decomposing chamber where it is formed to a combining chamber where the metal separates out from the amalgam, by the movement of inverted bell-shaped partitions. The bells are provided with outlet pipes to carry off the evolved gases.

20,397, of October 25th, 1894. **Arc Lamp Cut-out.** H. J. Creffield. A mechanism for short-circuiting an arc lamp running in series with several others, when the carbons are burnt out, or at any predetermined time. The upper carbon holder is provided with a stop, which, when the carbons are nearly burnt out, bends a spring and closes an auxiliary circuit. This causes the arc to be cut out and the lamp short-circuited through the series coil.

20,475, of October 26th, 1894. **Prepayment Meters.** W. Alexander and W. E. Thompson. A coin-actuated mechanism for electric and other meters. This consists of an escapement wheel held in position by a pawl which can only be moved by the insertion of a coin. The insertion of a coin permits the rotation of the wheel through a certain angle, and this switches on the supply. When the wheel has returned to its original position the supply is switched off.

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Supplement to "Electrical Engineering" of Oct. 22, 1908.

THE MANCHESTER ELECTRICAL EXHIBITION OF 1908

PART IV.

Published by

THE PROPRIETORS OF "ELECTRICAL ENGINEERING," 203-206 TEMPLE CHAMBERS, LONDON, E.C.

AND ALSO ON SALE AT STAND NO. 189, ELECTRICAL EXHIBITION, MANCHESTER.

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METALLIC FILAMENT LAMPS.

Since we **FIRST INTRODUCED** these lamps on to the English Market in 1907, they have **BECOME CELEBRATED** for

REMARKABLE SAVING OF CURRENT, LONG LIFE, SPLENDOUR OF LIGHT,

and have FIRMLY ESTABLISHED themselves in the CONFIDENCE OF LEADING AUTHORITIES, the demand now even Surpassing Expectations, and the lamps are being adopted more and more extensively by CORPORATIONS, PRINCIPAL CONTRACTORS, &c., throughout the United Kingdom.

Will burn in any position. **For Direct or Alternating Current.** **Efficiency: 1¼ watt per C.P.** **Average life over 1000 hours.**

There are no TOUGHER or more EFFICIENT METAL FILAMENT LAMPS on the market than our "METALIKS."

PRICES.

50 to 70 Volts,	16 C.P.	3/-	each.
50 „ 65 „	25 „	3/-	„
66 „ 130 „	25, 32 & 50 C.P.	4/-	„
70 „ 130 „	100 „	7/6	„
200 „ 250 „	50 „	6/-	„
200 „ 250 „	100 „	8/6	„

Large Stocks of the above Voltage and Candle Powers kept at all our Depots for immediate delivery.

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Our Filaments are made under a SPECIAL CHEMICAL process, by which they are of a tougher nature than any other METAL filament lamp of this type on the market, at the same time being quite as Highly Efficient.

Practically no Diminution of Candle-Power after **LONG LIFE.**

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Stand No. 198.

We are in the **POSITION** to **OFFER YOU** the **MOST FAVOURABLE TERMS,** and **SATISFACTION IS GUARANTEED.**

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THE

MANCHESTER ELECTRICAL EXHIBITION

OF

1908

FOURTH NOTICE

Robertson Electric Lamps, Ltd.,

BROOK GREEN WORKS, HAMMERSMITH. (STAND NOS. 187 & 217.)

Lamp Manufacture.—This firm's attractive stand occupies one of the most prominent positions in the centre of the building, and attracts a large crowd of visitors every afternoon and evening, when several skilled operators from the Hammersmith works demonstrate some of the principal processes in the manufacture of the well-known "Robertson" lamps. The operations shown include :—(1) Attaching the glass tube to the bulb for the purpose of exhausting ; (2) mounting the filament on to the nickel extensions of the platinum leading-in wires and the iron supporting wire ; (3) sealing the mounted filament into the glass bulb ; and (4) exhausting the bulb with the aid of a vacuum pump. The attachment of the glass tube and the sealing-in is carried out with the aid of gas blow-pipes supplied with air under pressure from a small blower. The other processes of manufacture are represented by samples of the prepared cellulose fluids, the squirted filaments, and other items, in a glass show-case. A feature of the stand is the model of a glass cone similar to those in use at the company's glass works at Lemington-on-Tyne. This cone, which serves as an office for the stand, is decorated with lamps, and a realistic effect of flames belching forth from the top of the cone is obtained by the use of a little red muslin and a powerful electric fan.

Metal Filament Lamps.—The manufacture of metal filament lamps is now being carried on at Hammersmith, and these British-made "Osram" lamps will soon be on the market. On the G.E.C. stand opposite the "Robertson" stand, a number of "Osram" and carbon filament lamps of various candle-powers are arranged, with ammeters, to show the comparative current consumption. A large 400-c.p., 200-volt "Osram" lamp, consuming 440 watts, is also exhibited. The fact that the luminous body is distributed over a large area renders the use of a diffusing globe unnecessary.

The Telephone Exchange.

The National Telephone Company's exchange serves also as an exhibit, as the switchboard, with the operators sitting at it, is visible through the glass front of the stand on which it is placed. This exchange provides the telephone service to some of the principal exhibitors, and also to the call offices adjoining the main entrance. It represents a standard private branch exchange as supplied for large offices, warehouses, works, &c., an arrangement which has very great advantages when the extensions exceed a certain number. The switchboard is of the standard common battery type, equipped for two operators' positions, with 100 extension lines and 40 junctions to the main exchange. There are 15 cord circuits per position, with the usual "supervisory" or clearing signals, so that fifteen conversations can be going on simultaneously. The extension lines are arranged to call automatically when the receiver is lifted from the hook, the signal being received on the magnetic visual signal on the switchboard. The junction circuits are arranged so that they may be used either for outgoing or incoming calls. A battery of eleven separate cells supplies the current both for speaking and signalling purposes, and it is charged from special power leads from the main exchange. The usual lightning arresters, heat coils, &c., have been fitted.

Stand of Robertson Electric Lamps, Ltd.

Oliver Arc Lamp, Ltd.,

CAMBRIDGE PLACE, BURRAGE ROAD, WOOLWICH.
(STAND NO. 143.)

Arc Lamps and Accessories.—Several examples of the "Oriflamme" magazine open flame arc lamp are exhibited. The magazine holds from six to nine pairs of carbons, and by this means the lamp has a burning life of from 36 to 40 hours with each trim. The magazine containing the negative carbons is fixed, and that containing the positive carbons is pivoted for

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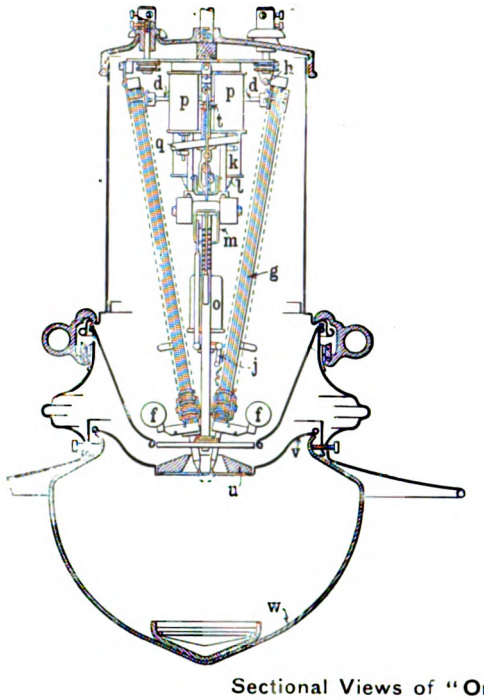
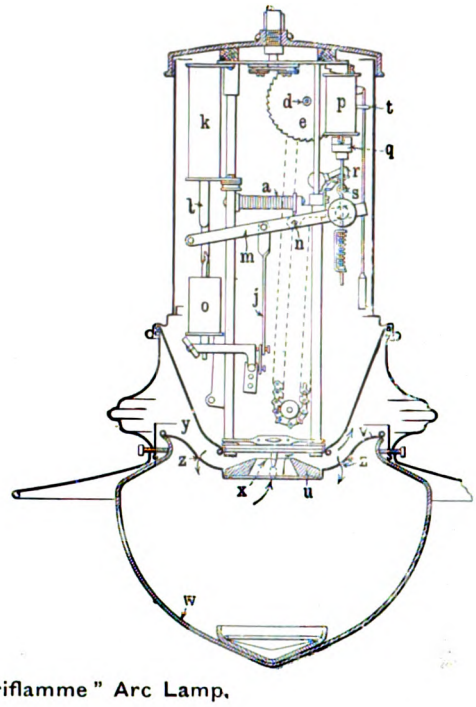
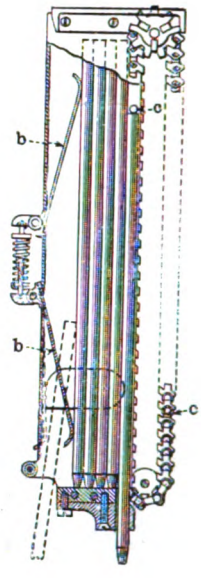
the purpose of striking and regulating the arc. The working of the lamp is illustrated in the accompanying figures, which show sectional views of the lamp, and the general arrangement of the magazine and feeding chain. Each magazine is provided with a carbon feeding chain *c*, and the two chains are worked simultaneously from a toothed wheel, *e*. The pawl engaging with this wheel is pulsated electrically by a small magnet, *p*, whose circuit is closed by means of a rocking mercury switch, *r*. The racking down of the carbons goes on at regular intervals, and when a pair is burnt out, the ends are discharged into the globe, and a new pair immediately moved into position. The changing of the carbons occupies about 20 seconds, during which period, of course, the lamp is extinguished. In the drawings we give above, *k* is the differential controlling solenoid; *a* the magnetising coil for the blow-out field; *p*, *p*, the magnet driving the ratchet feed; *g* the magazine, which is pivoted, and is moved by means of the rod, *j*; *m* the rocking arm; *f* the counterweight on the loose piece on the carbon holder; *w* the fireclay plate through which the fumes from the arc pass; and *b*, *b*, the levers pushing the carbons forward, the wire spring for controlling which is to be seen outside the magazine. The "Oriflamme" lamp is made in three standard sizes for continuous current, namely, 7, 9, and 11 amperes, with 34 volts across the terminals. On alternating-current circuits the lamps are burnt singly with choking coils; but on a continuous-current 200-volt circuit five may be burnt in series, with a consumption of 360 watts per 9-ampere lamp. The cost of carbons is said to be only 0·11d. per lamp-hour. Twenty-eight "Oriflamme" lamps are in use for the general illumination of the Exhibition.





Sectional Views of "Oriflamme" Arc Lamp.



View of Magazine.

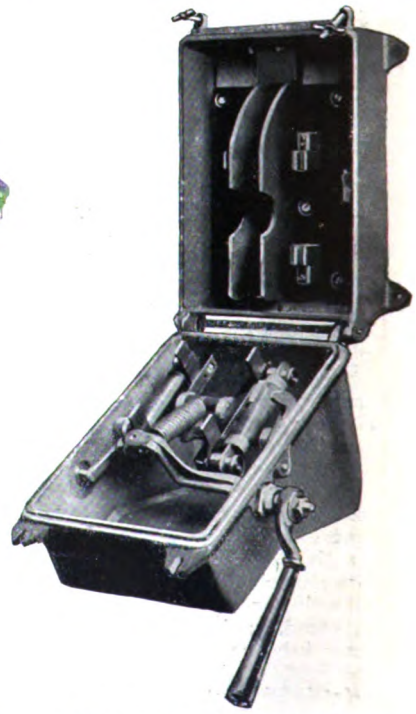
Parmiter, Hope, & Sugden,

Hulme Electrical Works, Hulme, Manchester. (Stand Nos. 135 & 159.)

Iron-clad Switches.—In addition to their standard designs, a number of new patterns of iron-clad switches are shown by this firm. One of these is a patent "spring on" switch fuse, which is manufactured either two- or three-pole, and is suitable for 600-volt circuits. The main features of this new switch, a view of which we are able to publish, are as follows:—The operation of the switch is independent of the handle, and both make and break are as positive and quick as possible; the breaking of the switch is not dependent on the spring, but has a mechanical "kick-off"; the switch can only be left either full-on or full-off; the case is gas tight; and, finally, the cover is interlocked with the switch to comply with the Mining Regulations. As the operating mechanism is in the lid, the fuse contacts are necessarily in a position clear of all live parts when it is open to renew the fuses. The fuses, which are easily replaceable, may be either of the renewable or cartridge type. Several examples of the "Ajax" combined switch and fuse boxes, including those with the switch handle on the side of the box and not projecting through the cover, are exhibited. Among the other exhibits is a new form of aluminium lamp-reflector, mounted upon a portable stand, and intended particularly for use in drawing offices. The reflector and lamps can be removed from the stand and used as a drying lamp.

Arc Lamps.—A number of open flame and enclosed arc lamps and accessories are exhibited on this stand by the Gilbert Arc Lamp Co., Ltd., of Chingford, who are represented in Lancashire and Yorkshire by Messrs. Parmiter, Hope & Sugden. The most important item is an example of a multi-carbon lamp. This type of lamp, which we illustrate below, has lately undergone many improvements in connection with the operating mechanism. As can be seen from the illustration, there are five pairs of converging carbons, which give a burning life of from 50 to 65 hours on one trimming. Although called a magazine lamp, there is really no true magazine, as the arc continually shifts from one pair of carbons to another, and

Gilbert Multi-carbon Flame Arc Lamp.



"Spring-on" Switch Fuse—Open.

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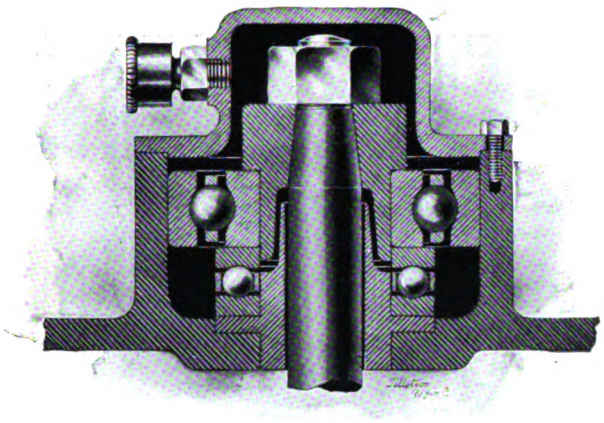
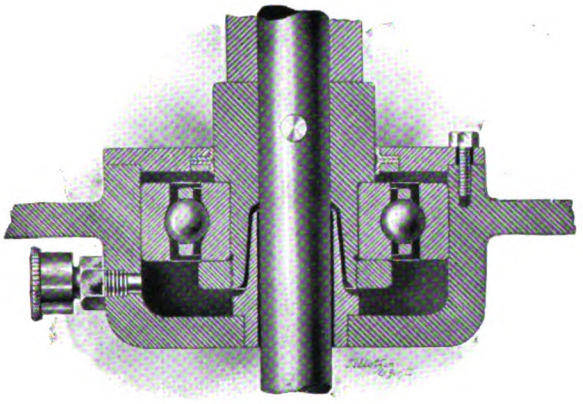


BALL BEARINGS



Electrical Exhibition, Manchester.

Stand No. 126/165.

THE HOFFMANN MANUFACTURING CO., Ltd., CHELMSFORD.

HOLDEN & BROOKE LTD.

"Parallel Flow" Oil Separators.
(Brooke's Patent.)

Highest Efficiency.

See List 127 E.

Without loss of Vacuum.

For freeing from oil or grease exhaust or other steam, as when condensing.

"High Velocity" Feed Water Heaters.
(Brooke's Patent.)

Heating Feed Water, &c., by Live or Exhaust Steam, or (as illustrated) by both.

Feed Water brought up to practically *Boiler Temperature* itself.

By our "High Velocity" System far greater heat is obtained than by any other.
See List 156 E.

Leinert's Liquid Meters.
(Patent.)

Free from Complications.

Action and all parts visible.

See List 144 E.

Automatically measure and record (by actual weight) Water, Oils, and other Liquids. Accuracy not affected by changes in temperature and specific gravity of liquids dealt with.

Automatic Vacuum Dischargers.

See List 72 E.

For automatically draining and discharging water or other liquids from any Chamber under Vacuum, such as Oil Separators, Exhaust Steam Pipes, &c.

Steam Dryers.
(Brooke's Patent.)

See List 140 E.

No rivets.

No leaky seams.

The *only ones really reliable* with *high pressures* and *superheated steam.*

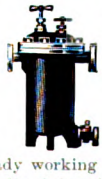
Injectors.

See List 137 E.

For all pressures and for *Hot Water.* Started and regulated by *one movement.*

Steam Traps.
(H. & B.'s Improved.)

See List 126 E.



Renewable Valve Seat.

Automatic Self-Grinding Valve.

Steady working with definite intermittent discharges.

Also Manufacturers of: PUMPS, COMPRESSORS, "PROTECTED SEAT" VALVES, EXHAUST HEADS, WATER LIFTERS, EJECTOR HEATERS, SIRIUS TRAPS, INJECTORS FOR ALL PURPOSES, &c., &c.

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THE ZOELLY TURBINE

NO STRIPPING OF BLADES. **HIGH EFFICIENCY.**
LARGE CLEARANCES. **LOW REPAIR BILL.**

For detailed description, see "Electrical Engineering" of Sept. 24, 1908, or write to JOHN MUSGRAVE & SONS, Ltd., for Pamphlet.

Photograph of **Stand No. 53**—John Musgrave & Sons, Ltd.—at the Manchester Electrical Exhibition, at which a Zoelly Turbo-generator and Cruse Superheater are on view.

THE CRUSE CONTROLLABLE SUPERHEATER

THE CUBA MILL, Ltd., write:—

"THE NET COAL SAVING by your Two Patent Controllable Superheaters is **OVER 20 PER CENT."**

For detailed description, see page 34 of the Supplement.

JOHN MUSGRAVE & SONS

BOLTON LIMITED **ENGLAND**

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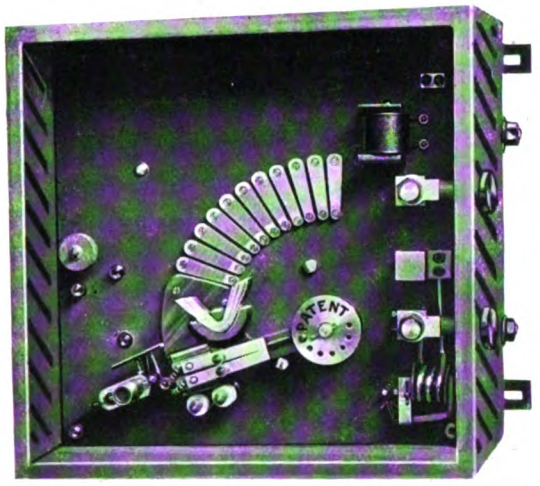
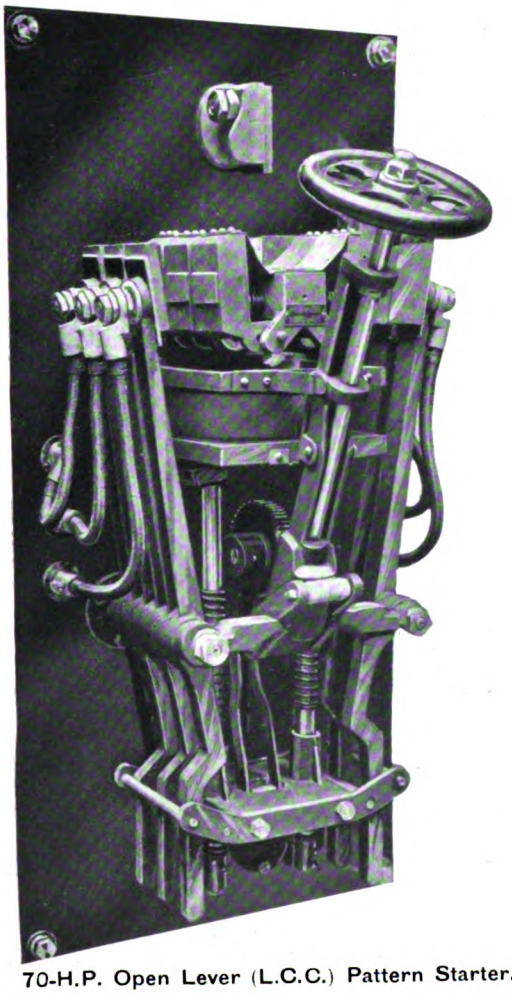
the latter are fed down together, and not in succession. A new feature in the lamp is the provision of a subdivided economiser, which, by preventing the burning of carbons by an adjacent arc, considerably lengthens the burning life. The change-over from one pair of carbons to another is almost



Motor Starter with Renewable Contacts and Adjustable Spring.

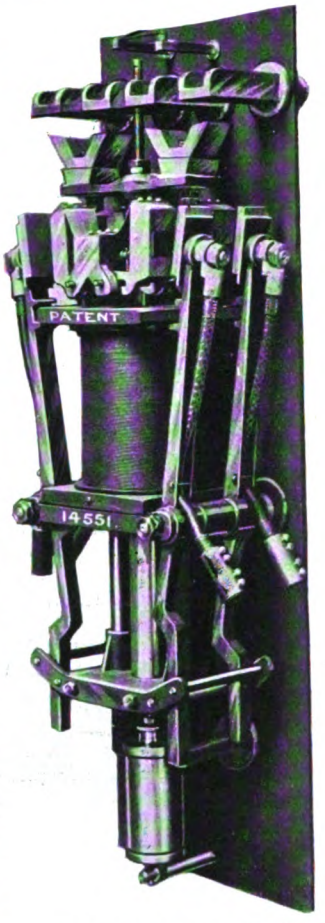
instantaneous, and is hardly noticed. Eight of these lamps are used to illuminate the roadway between the Exhibition and the main road. Several examples of the firm's standard patterns of enclosed arc lamps are shown, and among these is a new ornamental three-ampere lamp, with an overall length of only 18 in., and provided with a handsome spun copper case, bronzed



70-H.P. Open Lever (L.C.C.) Pattern Starter.

and relieved. The accessories exhibited include the firm's raising and lowering gear, the contact hood for which is fitted with an extremely simple automatic catch, and their well-known automatic switches for inserting incandescent lamps in circuit in case of the failure of an arc lamp.

Motor Starting Switches.—The Premier Electric Control, Ltd., of London, also represented in Lancashire and Yorkshire by this firm, exhibit a selection of motor starting switches and controlling rheostats in which are embodied a number of interesting features. One of these is the use of renewable contacts on the switch arms; another is the employment of a brass hook or catch on the lower pole of the no-voltage release magnet, in consequence of which the necessary pull of this magnet is considerably reduced. This can be seen in the illustration given on this page. It will also be noticed that provision is made for regulating the tension of the switch arm spring, and that the pressure of the brush on the contacts can also be adjusted. The use of a lid in preference to a box-shaped cover is also a feature of these switch boxes. A large lever rheostat of the pattern supplied to the London County Council's tramway sub-stations is also shown. This switch, which we also illustrate, is fitted with a slow action worm-gear, has no sliding contacts, and has a carbon make and break on each step.



200-H.P. Automatic Starting Switch.

Automatic Motor Starters.—Yet another firm, namely, Electric Control, Ltd., of Glasgow, are represented by Messrs Parmiter, Hope & Sugden, and exhibit on this stand. The apparatus shown, comprises a representative selection of automatic starters for direct-current motors, one of which, a 200-h.p. starter of special design, we illustrate here. These starters have only one solenoid, and there are no sliding contacts, as each step of the resistance is cut out by a separate lever with carbon contacts. In the larger sizes, the final contact is made by means of a laminated copper brush; this copper brush merely short circuits the carbon contacts. As the solenoid is shunted across the supply mains, it operates as a no-voltage release. The most interesting item of this firm's exhibit, however, is an automatic starter for alternating current. This is for a 100-h.p. 400-volt, 50-cycle, three-phase induction motor. It comprises one primary switch, three switches for cutting out rotor resistance, and a large switch to finally short circuit the rotor. Owing to improvements in the mechanical design, these solenoids operate with practically no noise, and by a special spring action, chattering at the carbon contacts is quite impossible. The design of the alternating-current starters is similar to that of the direct-current starters in that there are no sliding contacts.

A. G. Thornton, Ltd.,

PARAGON WORKS, KING STREET WEST, MANCHESTER.
(STAND NO. 222.)

Blue Printing Device, Drawing Instruments, and Slide Rules.—This firm shows one of the convenient apparatus for printing blue prints, which are gaining considerable favour. An arc lamp, which moves up and down, vertically, is surrounded by a canvas screen rotating close to a glass cylinder. The tracing and printing paper are fed into this, and rotate past the lamp, and an exposure of very little over a minute is sufficient to print an ordinary blue. The machine is driven by a small motor, and the reciprocating motion of the lamp is actuated by a simple chain and crank action. The firm also exhibits an ingenious self-filling drawing pen, and a pen spring bow, in which the pen is vertical instead of sloping. Among the slide rules are the Perry slide rules, in which work can be done in fractional indices, and also a very neat 5-in. slide rule with a magnifying cursor, in which the scale is arranged in precisely the same way as an ordinary 10-in. slide rule.

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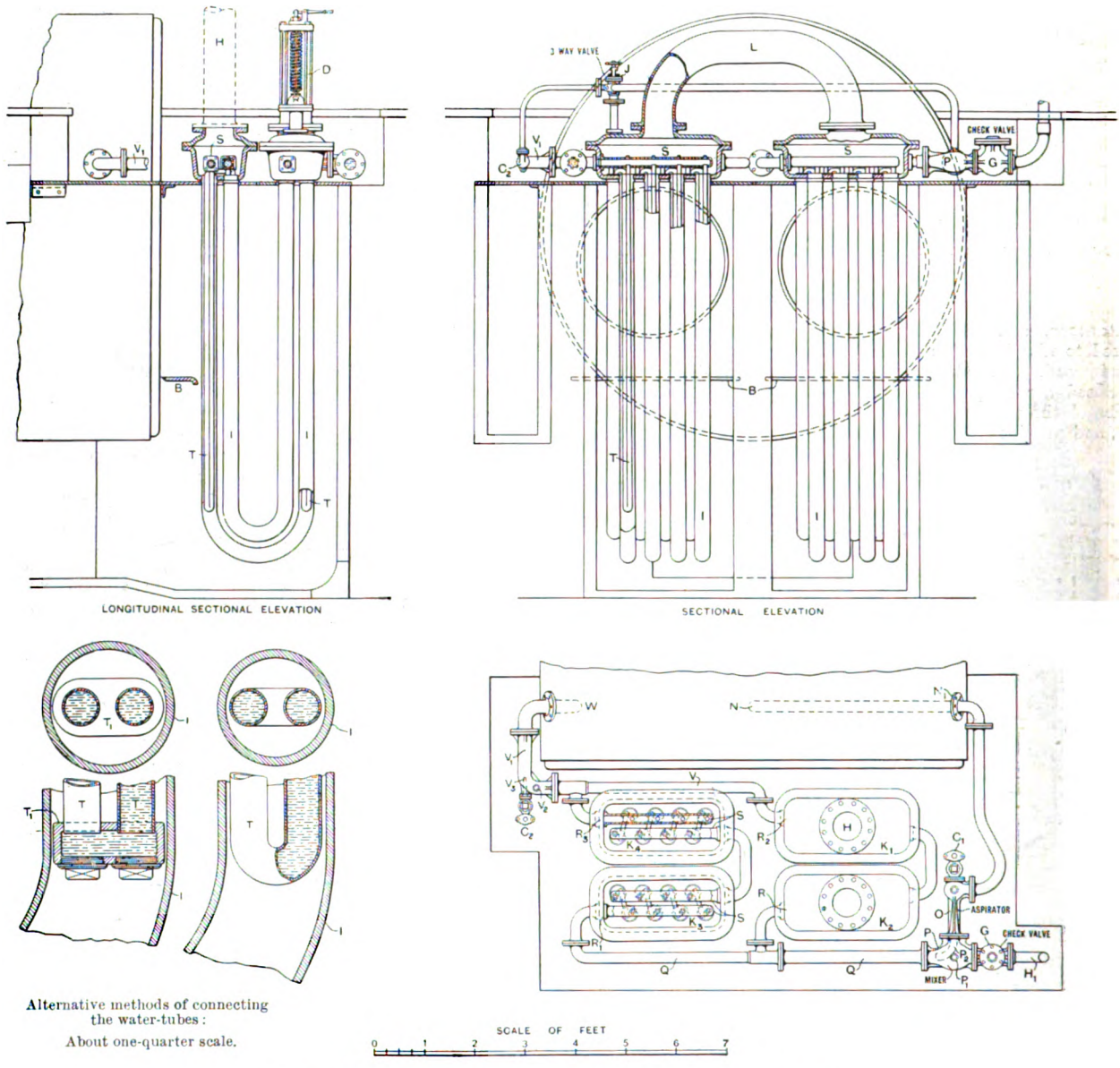
John Musgrave & Sons, Ltd.,

Bolton, Lancs. (Stand No. 53.)

Zoelly Turbine.—The central feature of this stand is a 600-kw. Zoelly turbine driving a 500-volt, 50 cycle, three-phase Siemens generator. This machine is identical in every respect with the one described in detail in our issue of September 24th, and in use at the Falcon Spinning Mill—in fact, it is destined for this mill at the close of the Exhibition. It is driven by an electric motor for the purpose of showing how perfectly balanced it is, and also to show the operation of the governor, oil circulation, &c.

Barring Gear.—There is also on exhibition an electrically-driven barring gear, which has been manufactured for use in conjunction with a slow-speed vertical cross-compound engine of 4,000 i.h.p. maximum output, made for the City of London Electric Lighting Co., Ltd., for their Bankside station. This will make the seventh engine of this size and type manufactured by Messrs. Musgrave & Sons for the Bankside works. The motor is a 25 b.h.p. machine running at 500 r.p.m. The gear is knocked out automatically when the speed of the fly-wheel catches up the speed at which the barring gear is driving it.

Cruse Superheaters.—Messrs. Musgrave have now taken up the manufacture and sale of these superheaters under licence from the inventor and patentee, Mr. Henry Cruse, who claims for his superheater that it is more efficient than any other pattern. They are exhibiting one of the larger types of "controllables," as adapted to Lancashire boilers up to 30 ft. by 9 ft., with double bottom boxes. We illustrate below a modified and less expensive type applicable to both the Lancashire and the water-tube type of boiler, a drawing of which is also shown on Messrs. Musgrave's stand. The object of the Cruse superheater is to afford accurate temperature control, and the firm is prepared to guarantee that the temperature shall never differ by more than 25° F. from the prearranged temperature. This is arrived at by passing a stream of water through a second set of tubes within the steam tubes of the superheater. A part of the feed water is employed for this purpose, but so that the temperature shall be kept constant even when the boilers are not being fed, an automatic aspirator arrangement, working on the principle of an injector, is employed to supplement this. The steam from the boiler junction valve enters the superheater at H; it travels through the outer weldless steam tubes I and pressed steel boxes K the whole length of the superheater. In its course it passes from the front box K^1 through the looped tubes I to the top box K^2; from box K^2 it travels by means of weldless steel connecting bend L to back box K^3, and from this box, through the looped tubes I, it enters front steam box K^4, which it leaves at M for the engine, superheated to the required temperature. Circulating water rises through a trunk or bent pipe N from the bottom of the boiler, which it leaves at N^1—low water level. It enters, by gravity, the aspirator or superheated steam jet O, through which it is propelled with greater or less velocity according to the



Alternative methods of connecting the water-tubes: About one-quarter scale.

Cruse Superheater for Water-tube or Lancashire Boiler.

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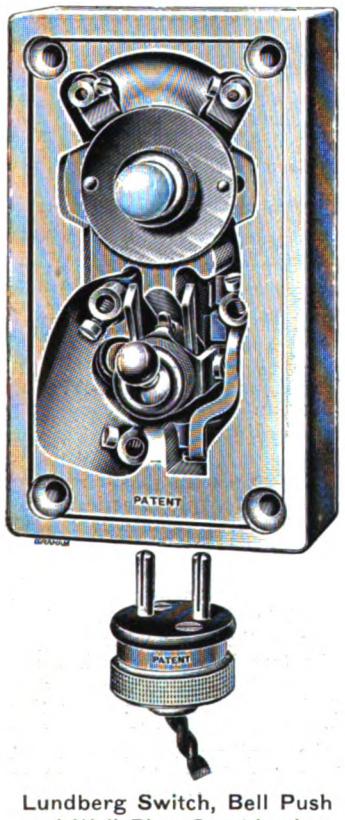
temperature of the superheat. The circulating water next enters the mixing box P, wherein it is met by and mixes with the feed water from the economisers. These combined streams of water now flow through pipes Q, and are fed at R and R^1 to the internal water or controlling system (headers S and loops T) inside the steam boxes K and steam tubes I, in two parallel streams flowing from back to front of the superheater, as shown in the illustration. The water leaves the superheater at R^2 and R^3, and, after again uniting in pipe V, is returned to the boiler through bend and accelerator V^1, at W. The body of water during its travel through the internal tube system of the superheater will have controlled and regulated the temperature of the superheat added to the steam, and will in its turn have been reheated during the process, approximately, to the full temperature of the saturated steam in the boiler, according to the pressure. It will be noted that this apparatus consists of two independent superheaters working in series; both may, however, be made to work in parallel. The water system may also be made to work in four parallel series instead of two.

The Sunbeam Lamp Co., Ltd.,

Gateshead-on-Tyne. (Stand Nos. 200 & 201.)

Lamps.—A selection of "Sunbeam" tungsten filament lamps are exhibited in all positions, for pressures up to 250 volts, and of various candle-powers up to 100 c.p. These lamps, as well as the glass bulbs, are British made. Large carbon filament lamps for radiators, advertising signs (including a "winking-pup") and "turn-down" double filament carbon lamps are also exhibited. These latter are adapted for use in an ordinary fitting, but they have a collar and a length of flex, to which is attached a two-way pear-switch. The candle-power can be reduced from 16 c.p. to 2 c.p. by changing over to the small filament.



Lundberg Switch, Bell Push and Wall Plug Combination.

Fittings.—A novelty in the way of electroliers is the "Converta" fitting which is exhibited on this stand. This consists of an ordinary circular electrolier, with the lamps surrounded by a short hanging silk curtain. The lamp brackets are hinged, however, and can be turned round so that the lamps project radially outside the curtain when a stronger general illumination of the room is required. Many patterns of artistic electroliers, table, wall, and porch fittings are exhibited on this stand. These latter are designed and manufactured by Jesson, Birkett & Co., Ltd., of Birmingham.

Switches.—A show-case full of the "Lundberg" specialities is also exhibited on this stand. These include the new "Twinob" switch and the "Pixy" bell push, both of which we have described and illustrated in recent issues. Other novelties are the combination switches, consisting of one or two wall plugs, a switch and a bell push, all mounted on a single porcelain block, as shown in the accompanying illustration. A neat porcelain or metal cover is provided, and the whole can be arranged for surface or flush fixing. Another novelty in this line is the two-way "Tripin" combination switch. With the aid of this switch a single-way circuit can be converted to a two-way circuit without altering the wiring. The "Tripin" switch must be substituted for the ordinary tumbler switch, and then the lamp can be controlled either from this switch or from a pear-push or other switch connected to the "Tripin" switch. This should be useful in bedrooms where it is desirable to have control from two points, and where the wiring has already been arranged for a single way only.

New Gutta Percha Co., Ltd.,

Dashwood House, New Broad Street, London, E.C. (Stand No. 137a.)

Wires and Cables.—The company's cables and wires, insulated with Gutta Gentzsch and Pernax, have, we are informed, been supplied to many of the English railway companies during the past five years, but are now exhibited for the first time. The insulating material does not contain any gutta percha, but is a "gutta percha substitute," which consists of best Para rubber mixed with a waxlike material, previously treated by a chemical process, to give the requisite physical and mechanical characteristics. The material does not act on the wire, and there is no vulcanising process, so that the wire is not tinned. The dielectric thicknesses equal to those adopted by the Cable Makers' Association for vulcanised rubber cables have been adopted, but the price is considerably cheaper than for vulcanised rubber. Specimens of the wires are shown in water, salt water, dilute hydrochloric acid, and dilute sulphuric acid, and samples of sheet are also exhibited. The company's representatives inform us that they have been booking orders from several Corporations.

Marples, Leach & Co.,

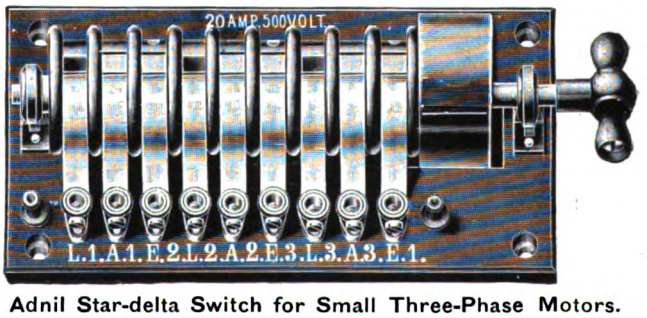
Artillery Lane, London, E.C.. (Stand Nos. 104 & 105.)

Motor Starting Switches.—Motor starting switches, it will have been observed, are a great feature at this Exhibition, and at Messrs. Marples, Leach & Co.'s stand this is no exception. The switch which we illustrate below is a compact and ingenious type of fool-proof combined starting and main switch. All the operator has to do is to put up the handle closing the main switch, and the contact brush moves up slowly over the starting contacts. The action of pushing up the switch compresses a helical spring, which actuates the contact brush against the action of glycerine dash-pot. A catch holds this down, however, until the handle has been pushed right home. It is thus impossible to move the starting switch until the main switch is closed, so that the motor can never be switched on except when the starting part of the switch is in its off position. This switch has been given the suitable name of the "Direkton." The illustration represents a 10-h.p. switch, about one-eighth full size.

"Direkton" Combined Main and Starting Switch.

Among the large collection of starters of various types, mention may also be made of the star-delta switch illustrated below. This is arranged for starting the motor, first by connecting the rotor in star and then in mesh. It is only possible to turn the switch in one direction, and it has the three positions—off, star, and delta. Its construction is clearly seen from the figure.

When motors are used for organ-blowing, trouble is often experienced through the organist not working the starting switch properly. An automatic arrangement to obviate this is



Adnil Star-delta Switch for Small Three-Phase Motors.

shown. The bellows are connected by a wire rope to the handle of a combined starting and regulating switch. The resistances in connection with this are heavy enough to take current continuously, and the motor is thus running at full speed when

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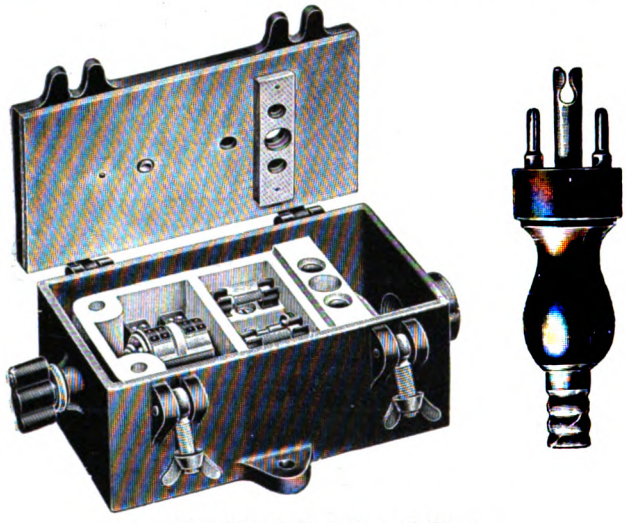
the bellows are empty, and gradually slows down when they are nearly full. A useful strong, oil-immersed auto-transformer starter for alternating-current motors is another exhibit on the stand. Another is a three-phase crane controller, the fingers of which have renewable tips.

Motors.—Some motors are shown in which, in place of an ordinary cast liner for the bearings, a hard rolled brass liner is employed, the grain of which is in the same direction as the rotation of the shaft. This is first shaped on a mandrel, then forced through a die, and, after being fixed in place, has a mandrel forced through it, thus making an exact fit with the shaft, which is ground true and not turned.

Among the very numerous motors shown, a particularly interesting one is the "Century" single-phase self-starting repulsion-induction motor. While the motor is running up to speed, the induced current in the armature is short-circuited through carbon brushes bearing on the commutator, and so situated in relation of the field as to control the direction of the rotation and the amount of starting torque. When full speed is reached a governor on the shaft of the motor acts and short-circuits all the commutator bars to one common ring, at the same time releasing the tension of the carbon brushes and pushing them back away from the commutator. The machine then runs as an induction motor. When the motor is stopped, the governor returns to its original position as the machine slows down.

Other Exhibits.—A fine sample board of Bergmann tubing for conduit wiring is shown, and also a collection of meters, including two-rate meters. The bell and telephone exhibits are very numerous, and frequent demonstrations of the quality of



Combined Switch and Plug.

a large motor-driven bell and hooter, are given for the benefit both of the visitors and the other exhibitors. The latter only appreciate these signals when they are sounded at 10 p.m. to indicate that it is closing time. A loud-speaking telephone is arranged in such a way that the loud-speaking receiver, which is in one with the transmitter, is in operation when the usual receiver is on the hook, but not when it is removed. A combined switch and plug, made for Admiralty purposes, is shown, arranged that when the switch is on the plug cannot be removed. On a small drilling machine the motor is fixed with the shaft vertical. One edge of the base is hinged to the standard of the machine. It is belted to the drill, and a screw bearing on the base of the motor at the opposite side of the hinge regulates the tension of the belt. A new arc lamp is also exhibited, called the "Reboja." Five lamps are burning across the 200-volt direct-current mains, and the lamp, which takes 10 amperes, only requires 30 volts across the arc.

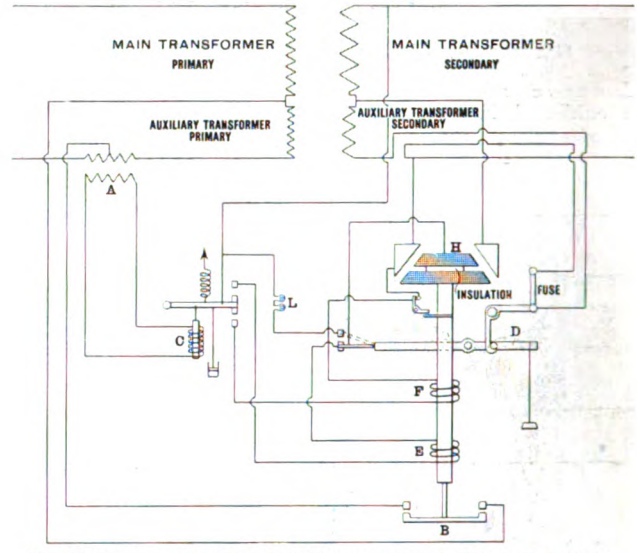
The New Electric Rifle & Target Co., Ltd.—53A Shaftesbury Avenue, London, W. (Stand No. 291.) Six sets of electric rifles and targets are shown, and can be used. The way in which these work is as follows :—Rigidly attached to the barrel of the rifle is a downwardly projecting rod, on the end of which is a needle. Immediately below the needle is a little cup divided into twenty-four compartments. When the trigger is pressed the cup rises, and the needle enters the compartment corresponding to the point on the target at which the barrel is aimed. Each compartment contains mercury, and is connected to a small lamp behind the corresponding point on the target; the needle completes the circuit, and the "hit" is indicated. The lamp remains alight only a few seconds, the time being controlled by a dash-pot.

Westinghouse Electric & Manufacturing Co., Ltd.,

Trafford Park, Manchester. (Stand Nos. 79, 81, 101 & 103.)

Motors.—The heavy machinery manufactured by this firm is represented by the 700 kw. rotary convertor and the three 250 kw. transformers at the Exhibition sub-station, which we have already described. On their stand this firm exhibits a rainproof ventilated motor shown in operation under a spray of water. A continuous motor of the same type, but for forced ventilation, and a semi-enclosed motor with openings protected by a double thickness of fine wire gauze, for use in carpenters' shops, are also shown. Several examples of the firm's unit type resistance starters, in which each unit consists of a coil of Eureka wire totally embedded in steatite and entirely fireproof and incorrodible, are to be seen.

Series Transformer Switch.—Perhaps the most interesting exhibit is a new automatic transformer cut-out for the same purpose as the "Berry" series transformer switch, which we described fully in our issue of February 6th, 1903. The object of this switch, which is used in conjunction with two transformers, a large and a small one respectively, is to short-circuit the small transformer, which is in series with the large one, when



Westinghouse Automatic Transformer Cut-out 2-Wire Series System.

the load becomes too much for the former. In the Westinghouse arrangement, the relay which controls the short-circuiting switch is operated from the secondary of a special series transformer. The advantage of this is that the relay only has to carry a small low-tension current. As shown from the diagram which we give below, a lead is brought out from some point in the primary winding of the series transformer A, and carried to one terminal of the high-tension switch B. When the switch is open, the current passes through all the turns in the primary winding of the series transformer, but when the switch is closed a certain proportion of the turns are cut out. By this means one of the chief difficulties encountered in this system, namely, that the relay coil must operate accurately with the full load current of the auxiliary transformer, but must not burn out when perhaps ten times this current is flowing is overcome; as by cutting out part of the turns of the series transformer, the current through the relay coil C is very considerably reduced. The series transformer, which supplies the relay coil, has a small magnetic section, so that when the current exceeds a certain value, the magnetic circuit is saturated, and the increase of current through the relay coil is not proportional to the primary current. The diagram which we give shows also the mechanical arrangement for closing the switch in the event of anything going wrong with the electrical circuits. This consists of a weighted lever D held in position by a trigger, which is in turn secured by a fuse in series with the primary or secondary of the auxiliary transformer. In the event of the fuse blowing, due to an overload of the auxiliary transformer, the trigger is released, and the lever moves upwards, and thus closes the switch. In order to prevent the opening coil E from operating to open the switch after the fuse has blown, a contact is placed at one end of the lever arm, so arranged that when the lever moves upwards the circuit through the opening coil is opened, and at the same time a circuit is closed through one or more lamps L, which serve as a signal to indicate that the fuse has blown. In the diagram which we give above, the auxiliary transformer is taking the

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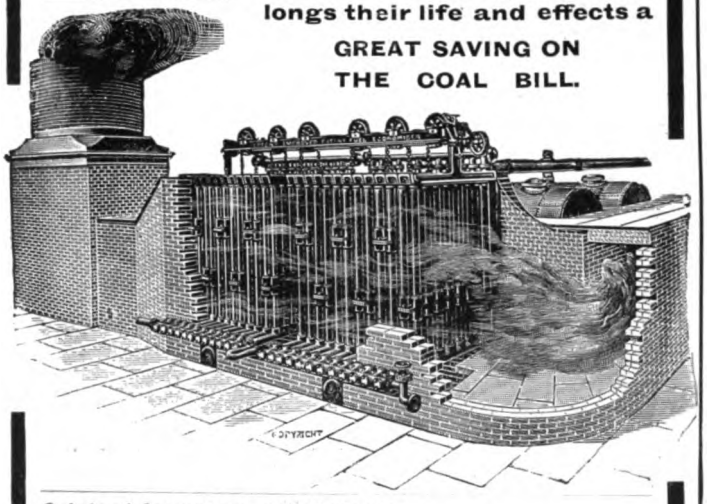

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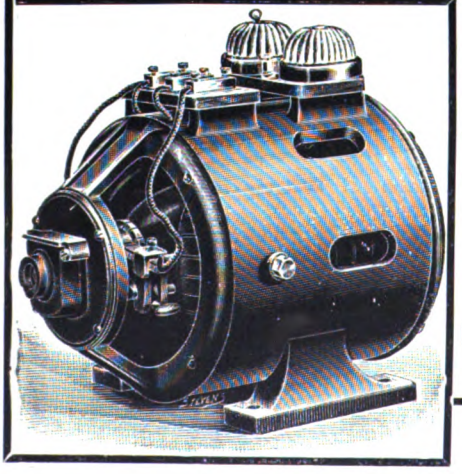

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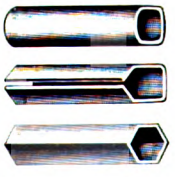

GRAND PRIX

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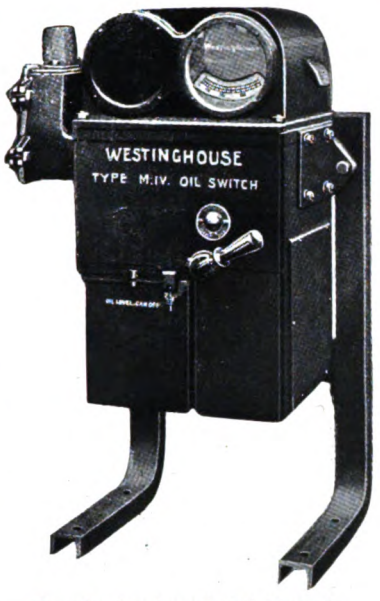
load. Should the load become too great the relay coil completes the closing coil circuit, and the low tension switch H is closed. This, as can be seen from the diagram, short-circuits the secondary of the auxiliary transformer, and the high-tension switch B attached to the other end of the plunger short-circuits the primary of the auxiliary transformer, and also a few turns of the relay series transformer, which last prevents the overheating of the relay coil as explained above.



Totally Enclosed Oil Switch.

Instruments.—A new type of "edgewise" switchboard instrument is exhibited. The "V" form of the scale allows readings to be taken from practically any position in front of the switchboard. Among the meters is a new pattern of single-phase watt-hour meter. It has been designed to give accurate readings with very low power factors, and the five-ampere 220-volt size is said to start with a load as small as four watts. It should, therefore, be useful for small transformer installations.

Switchgear.—The exhibit of switchgear includes an interesting inverted type switch pillar for use in mines. All the movements are interlocked; the door cannot be opened for inspection when the isolating switch is on, and the isolating switch can neither be opened when the coil switch is closed, nor closed when the door is opened. Another interesting oil switch, in which the oil tank is detachable without dismantling the switch, is shown. The switch itself is loose-handled and fitted with automatic no-volt and overload devices. An ammeter and a voltmeter can be fitted in the hood of the case. The maximum breaking capacity of such a 3-pole switch is 1,200 kw., and the pressure can be anything up to 3,300 volts.

Solenoid Operated Circuit Breaker for Remote Control with Magnetic Blow-out.

A mining panel consisting of flame-tight and explosion-proof switch and fuse boxes for A.C. or D.C. pressures not exceeding 600 volts is also shown. The boxes are ribbed in the interior to make them strong enough to withstand an internal explosion, and an important feature in the design is the provision of a "V"-shaped metal projection on the underside of the rim of the cover, and a corresponding "V"-shaped groove in the rim of the base. The gap between the two provides a long and narrow path from the inside to the external atmosphere, and any gases escaping after an explosion are cooled before they reach the exterior of the box. The switch and the boxes are interlocked in the usual way.

An auxiliary fitting which has recently been designed for use in power stations where space for the extension of the switchgear is limited, is exhibited; this consists of a double-acting solenoid and plunger, which can be fitted to the standard pattern circuit breaker enabling the latter to be operated from a distance by means of a small switch. The solenoid has two separate coils to produce the double action of opening and closing the switch respectively.

A starting switch for squirrel-cage induction motors is shown; this has four positions, namely, off, star connection, delta connection, and delta connection with the fuses in circuit. By keeping the fuses out of circuit when starting, they can be made of a size to give good protection for the motor without fear of their being blown on starting.

Henry Wallwork & Co., Ltd.,

UNION BRIDGE IRON WORKS, ROGER STREET, MANCHESTER.
(STAND NO. 42.)

Worm Gears and Gear Cutting Machines.—Two fine examples of gear-cutting machines should not be overlooked. The first of these is a gear-cutter for generating spurs, worm wheels, and spirals with hobs, and is direct geared to a 3½ h.p. motor with a raw-hide pinion. All the movements of this machine are through hollow-faced spiral gearing running in oil. It will take a 36-in. wheel, and can cut a maximum pitch of 2½ D.P. in steel. The second machine, also for generating worm wheels, is fitted with a tangential feed of the cutter employing either a hob or a fly tool. An example of worm gearing, for use in the electric driving of lead-rolling mills, is also exhibited. This has a speed reduction of five to one, and is said to be capable of transmitting 96 h.p. with an efficiency of 90 per cent. The rim of the wheel is of phosphor bronze, but the worm is of forged steel, hardened and ground. Worm and wheel are enclosed in a case which, however, is cut away to show the worm. A number of standard patterns of twenty to one reduction worm gears, mounted on bedplates, with electric motors of various outputs, are also shown. These have either ball bearings or ring self-oiling bearings. The thrust of the worm is taken by a double-ring Hoffmann ball-bearing. With multiple-thread gears, a single or double thrust bearing is mounted on the wheel shaft, according to whether the wheel is to run in one direction only or in both. A large and varied selection of malleable iron castings is shown, among which are to be found resistance grids, tramway fittings, and fuse-box covers. Aluminium, gun-metal, and brass castings are also exhibited, together with patterns in both wood and iron.

Wallwork Semi-Portable Lamp-Bracket.

Adjustable Lamp Brackets.—The patent universal electric lamp brackets manufactured by this firm can also be seen on this stand. These brackets are suitable for both office and workshop use, and can be obtained in iron, nickel plated, or of solid brass. A large number of different patterns are made, and they can be adopted for use in any position. They are provided with from one to three arms, and either a table stand or a rosette for fixing to wall or ceiling as desired. A useful development of this bracket, in the form of a semi-portable lamp bracket, for fixture to work bench, marking out, or tool table, is illustrated

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above. These lamp brackets are strong, steady, and well made, and the long list of firms using them, given in Messrs. Wallwork & Co.'s circular, is a striking testimonial to their utility and reliability.

Buffoline Noiseless Gear Co., Ltd.,

Chapel Street, Levenshulme, Manchester. (Stand No. 106.)

Pinions and Gears.—"Buffoline" pinions are exhibited, and also blanks in the rough, from which the pinions are cut out by milling machines. The material is buffalo hide, which is built up under hydraulic pressure. It is suitable for exhibition purposes, owing to its noiseless running, which recommends this gear for every other class of work as well. It is claimed that its wheels are rather more durable than paper, and that they run even quieter. In addition to the wheels shown at the company's own stand, Buffoline gears are used in connection with the exhibits of Electromotors, Ltd., F. Pearn & Co., Ltd., William Matthews & Co., Ltd., Pollock & McNab, and Marples, Leach & Co. The company also show a 32 : 1 worm reduction gear for hoists, &c. The worm is of case-hardened steel, and the wheel of phosphor-bronze, and, although very compact, it is capable of transmitting 150 h.p.

William Matthews & Co.,

Brookside Works, Moston Lane, Manchester. (Stand No. 106.)

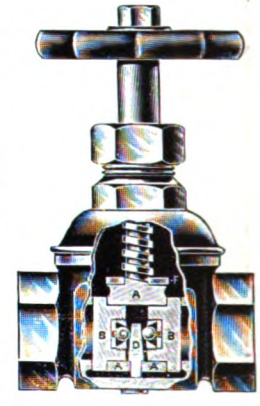
Pumps.—A large pump shown on this stand is for deep bore-holes, and is arranged for driving by sweep crank gearing and electric motor. Similar types of headgear are driving the firm's bore pumps in various parts of the country and pumping quantities up to 50,000 gallons per hour from depths varying from 50 to 300 ft. The bedplate of the pump exhibited is 16 ft. 6 in. long over all, by 7 ft. wide, and weighs 3½ tons. It has a motor base cast with it, designed for carrying two sizes of motor, the reason being that if at any future period it is found necessary to place the pump deeper in the bore-hole, a larger motor may be attached without necessitating any extensive structural alteration. The gearing consists of a first reduction gear, machine-cut wheel 6 ft. diameter, which weighs roughly one ton, and one "Buffoline" raw hide pinion of special wearing quality. The motor is one of the Lancashire Dynamo & Motor Co., Ltd., 55 b.h.p., 570 r.p.m., 50 cycles. The crankshaft gearing is of the double helical type, made up of two large machine-moulded helical wheels, each 7 ft. diameter, and two pinions, shrouded to the top of the teeth. The crankshaft is of Siemens-Martin steel, 6¼ in. diameter in the neck and 7 in. in the bearings, highly finished, and weighing about 25 cwt. A ram, trunkslide, connecting rod, and stand pipe, also shown on the stand, are designed to work in conjunction with the gearing, the ram having a crosshead cast with it, and worked by the connecting through the trunkslide being coupled up at the bottom end to the pump rod with a socket and cotter joint. The pump consists of a cast-iron barrel, 12 in. diameter, 36-in. stroke, truly turned and bored to receive a cast-iron bucket and foot valve, both of which are fitted with the firm's latest design of "double beat" metallic valves. The total weight of the whole pump and gearing when finished will be very little short of 30 tons, and is part of an installation for Messrs. J. & P. Coats, Ltd., of Paisley, Glasgow. The firm is prepared to put bore-holes down of any diameter, from 3 in. to 40 in., and to any depth.

Dr. Heinr. Traun & Sons, 8 Redcross Street, London, E.C. (Stand No. 192.) *Moulded Ebonite.*—Numerous samples of moulded ebonite are shown, which demonstrate to what an extreme accuracy this firm can mould it. Pieces of telephone apparatus, &c., which would require a great deal of work to drill and cut, involving also considerable waste of material, are shown, perfectly finished. Very many parts of telephone apparatus are exhibited, including base plates with even the narrow slits for the wires moulded, and also high tension distributor, &c., for motor-cars. The latter are moulded in a special ebonite of a brown colour, which has heat-resisting properties. Pumps for acid, made completely of ebonite, are exhibited, and also accumulator boxes, and strain insulators and other accessories for overhead trolley work. We are informed that a test of Messrs. Heinr. Traun & Sons ebonite sheet made at the Physikalisch-Technische Reichsanstalt showed a tensile strength of 7 kg. per sq. mm., a specific gravity of 1·16, and a disruptive voltage of 50,000 volts per millimetre thickness.

Small & Parkes, Ltd., Hendon Vale Works, Harpurhey, Manchester. (Stand No. 10.)—*Packing and Belting.*—This firm shows ten different varieties of their "Karmal" packings. They claim that this material is self-lubricating so long as there is a fibre of it in the box. In addition to packings for all steam pressures, the material is also supplied for pumps, elevators, accumulators, hot water, and various special purposes. The makers claim that this is the only lubricating packing on the market that will work with water at 212° Fahr. They also exhibit their patent "Roko" belting, which has an edge designed to prevent fraying, and a pile surface to take up all the jambs and strains and to save the body of the belt from wear and tear. These belts are said to show a minimum of cracking and stretching, and at the same time to have an exceedingly good grip.

W. H. Roy & Co., 30 Spring Gardens, Manchester. (Stand No. 248A.)—This firm shows sections of a cooling stack, of which they make a speciality. The cooling laths are securely fixed at each end, and rigidly supported at the centre of their length, and no nails are used. They are fitted with dripper bars designed to distribute the water accurately from the gutters to the top tiers of cooling laths in place of the ordinary system of distribution of V notches, so that there is no trouble from the notches being choked with sediment. The water flows through a square notch along the top of the bar, and falls off in regular drops on to the upper edges of the top tier of laths. A photograph is exhibited of a cooling tower supplied to the Huddersfield electricity works, capable of dealing with 500,000 gallons per hour. There is also a drawing of a central jet condensing plant supplied to the Lancashire & Yorkshire Railway Co.'s Horwich locomotive works by the Mirrlees Watson Co., with open type towers, built by Messrs. Roy. Drawings and photographs of Reid's patent oil separators are shown. Cases have arisen in which silt is carried over from the boilers into the wheel chambers of turbines, and it is suggested that a separator of the Reid type, modified to deal with live steam temperatures, should be employed in cases where this danger is anticipated.

J Shaw & Son, Ltd., Albert Brass Works, Huddersfield. (Stand No. 140.) *Valves and Fittings.*—In the valve illustrated the discs are pressed to the seats by a wedge *D* operating on the ball-bearings *C*, *C*, which are fixed in the centre of the discs. This method, the makers claim, is preferable to the usual spring system. The special packing ring *F* on the spindle forms a steam-tight joint when the valve is open, apart from the packing in the stuffing boxes. Messrs. J. Shaw & Son also make a special alloy, which they call "Nico," intended to stand extremely high superheats without cutting.



Shaw Patent Parallel Valve.

Brunner, Mond & Co., Ltd.—Northwich. (Stand No. 129.) *Chemical Products.*—This firm exhibit a collection of samples of chemical products used in the electrical and engineering industries, including pure zinc for batteries, &c., and rods of pure cadmium metal. Attention should be drawn to the compressed tablets of ammonium chloride for Leclanché cells, known as voltoids, and other forms of this material for galvanising, soldering, and other purposes.

W. H. Perkins.—Cowlishaw Street, Manchester. (Stand No. 289.) *Pattern Shop Equipment.*—Two or three examples of pattern-makers benches are shown, and also some patent vices and routers.

The "Clipper" Belt Hook Co.—251 Deansgate, Manchester. (Stand No. 300A.) *Belt Fasteners and Ceiling Clips.*—This firm is exhibiting a selection of their belt tools and hooks, including a new form of fastener called the "Clipper Cable," which is intended for use when the belt cannot be easily taken down from its running position. It is a simple fastener in one piece, and no tool is required for fixing, except a punch for making the necessary holes in the belt. Girder clips made of narrow steel strip and intended for fixture to ceiling girders are also shown. These clips merely grip the girder flange, and no screwing or tapping is necessary to fix them.

The Kearney High-Speed Railway.—17 Old Queen Street, Westminster, London, S.W. (Stand Nos. 245 & 250.)—A working model of this railway system, the principle of which we described in our issue of June 18th, 1908, is exhibited. Mr. Kearney is personally demonstrating and explaining the system.

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☞ **Manchester Exhibition Supplements.** With this issue, No. 5 of a series of five supplements describing the Manchester Electrical Exhibition is given *Gratis*. All readers should see that this supplement is included in their copy of to-day's "Electrical Engineering."

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SUMMARY

Our account of the principal exhibits at the Manchester Exhibition is continued in the fifth of our series of special supplements which accompanies this issue.

A letter from Messrs. Handcock & Dykes deals with the relative importance of commercial and engineering problems as subjects of discussion for an engineering institution, and one from Mr. W. A. Toppin comments on systems of charging for electrical supply. (Page 582.)

The annual dinner of the Institution of Electrical Engineers was held last Thursday at the Hotel Cecil. About 400 persons were present, including a number of the delegates to the International Conference on Electrical Units and Standards and the International Electrotechnical Commission. The speeches turned largely on the inter-relations of science and industry and the standardisation work of the two Congresses. (Page 582.)

Some interesting notes and suggestions with regard to wiring for 25-volt lamps are contributed by Mr. A. H. Dykes. He compares the relative advantages of the balancer transformer, the auto-transformer, the ordinary double-wound transformer, and the transformer with a three-wire secondary, pointing out that with the two former systems the insulation of the installation has to be strong enough to withstand 200 volts. With the ordinary transformer he suggests using concentric wiring with uninsulated return, and as a development of this a transformer with a tapping from the centre of the secondary and wiring on the three-wire system with the conduit as the neutral wire. (Page 583.)

On Friday last, Mr. Miles Walker, as Chairman of the Manchester Local Section of the Institution of Electrical Engineers, gave an address on the progress of electrical design in relation to the reduction of capital cost. After showing the effect of the capital cost on the cost of electric power, he pointed out a few directions in which improvements might be made to increase the output of a machine of a given weight. He suggested that experiments to find a suitable iron and a suitable insulating material for electrical work should be carried out for the benefit of the electrical industry, by a laboratory equipped and maintained at the expense of the Institution of Electrical Engineers. (Page 585.)

A new motor starter and a new electric heater are described in short illustrated articles. (Page 586.)

The sub-station at the Manchester Exhibition had to be shut down for 8½ minutes on Saturday last owing to the failure of a cable between the H.T. switchboard and a motor-generator, which earthed one phase and blew the feeder fuses at the generating

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station. As part of the arc lamps lighting the hall are separately supplied, the Exhibition was left sufficiently well lighted to prevent any confusion, although the hall was full of people at the time. (Page 587.)

A House of Commons Committee, presided over by Mr. Luke White, commenced consideration of the London and District Electricity Supply Bill on Monday, and is sitting every day. The details of the Bill have not been varied since it was passed by the House of Lords, with the exception that the House of Commons Committee have been instructed to insert the name of the London County Council in the Bill as the purchasing authority. We give some notes summarising the features of this and the two other Bills, which will also come before the Committee, and an account of Mr. Parshall's evidence and cross-examination. (Page 587.)

It is announced that the Buenos Ayres Municipality has decided not to proceed with its proposed scheme of tube railways in the city until next year.—The Folkestone Corporation have refused to allow the National Electric Construction Co. to substitute a combination of the conduit and overhead trolley systems for the surface contact system which the company originally contracted for.—A credit balance of £639 is shown in the accounts of the Govan Electricity Department for the year ended May 15th after meeting capital charges.—A cable is being laid by the Grimsby Electricity Department for giving a supply of electricity to the Admiralty wireless telegraph station at Humberstone.—The Hastings Tramways Company has refused to run its cars on Sundays, owing to the condition imposed by the Corporation that Sunday receipts shall not be taken into account should the Corporation desire to purchase the undertaking at any time.—The accounts of the Poplar Electricity Department for the year ended March 31st, 1908, show a gross profit of £16,920 against £14,576 for the previous year. After providing for capital charges, &c., there is a net balance of £2,264, but after meeting the deficit of the previous year, &c., the balance carried forward is £162.—Arrangements are being made between the West Ham Electricity Committee and the Charing Cross, City and West End Electricity Supply Co., for giving each other a supply of electricity on emergency. (Pages 589-590.)

An application is to be made to the Local Government Board for a loan of £30,000 by the Cardiff Electricity Committee. Stores are required by the Tramways Department of the Bradford Corporation; overhead tramway material by the London County Council; tramway track material by the Leith Burgh Council; and pipework, &c., by the Watford Corporation.—Specifications for considerable extensions at the Sydney and Dunedin power stations are in preparation, and inquiries are being made with regard to a water-softening plant by the Eastbourne Electricity Committee. The gas engine plant in the London County Council generating station on the Embankment has been sold for £450, a supply now being taken from the Charing Cross Company. (Pages 591-592.)

The first ordinary general meeting of the Victoria Falls Power Company was held in London on Friday, when the Chairman made a lengthy reference to the proposals for promoting a competing power scheme on the Rand. Mr. H. Wilson Fox, the vice-president of the company, also made a statement with regard to the company's policy concerning the utilisation of the Falls.—The accounts of the Edison & Swan United Electric Light Company for the year to June 30th show a balance of £19,193 available for distribution. (Pages 592-593.)

Among the specifications published by the Patent Office on Thursday last was one by E. A. Mitchell for a surface-contact system with magnetically-actuated switches within the studs. The specifications of the British Thomson-Houston Co. cover an arrangement of connections for lift-motors and an improved electrolytic lightning arrester. C. H. Stearn and C. F. Topham patent a spring support for metal filaments; and a radiator in which the bare-wire heating wires are immersed in oil is described by C. N. Nobbs, C. G. Nobbs, and J. E. Rosenthal. Regenerative working with single-phase commutator motors is the subject of a specification by W. Cooper. Short abstracts of these are given in our Patent Record. (Page 595.)

Under "Electrometallurgy and Electrochemistry" is given a note on a new method of obtaining nitrogen from the atmosphere by means of electrolytically prepared magnesium alloys. A process for coating metals with platinum is also described, and an improved form of the Girod arc furnace. (Page 597.)

The report of the International Conference on Electrical Units, which concluded its sittings under the presidency of Lord Rayleigh last week, has now been issued. The final result of their work has been agreement as to the adoption of certain definitions of a system of international units sufficiently near the true C.G.S. values to serve for the purpose of electrical measurements and as a basis of legislation. The international ohm is to be the resistance of a specified column of mercury, and the international ampere is to be the current which deposits a certain amount of silver under specified conditions. The international volt and watt are to be derived from these two primary units. The Conference have also approved of the use of the Weston normal cell as a convenient method of measurement for practical purposes. The Conference recommend the establishment of an international laboratory for keeping and maintaining international electrical standards. (Page 597.)

The Committee which was appointed to investigate the alleged damage caused to submarine cables by trawlers are of opinion that there is little risk of damage if the trawls are properly constructed and kept in repair. They are not prepared to recommend the proscription of any area, but suggest a system of Government inspection of the gear of trawlers. (Page 598.)

In the notes on 25-volt wiring, which Mr. A. H. Dykes contributes to this issue, an interesting suggestion is made. Mr. Dykes points out that when an auto-transformer is employed to reduce the pressure to 25 volts in the case of installations connected to A.C. town mains, the full pressure—say 200 volts—will still exist between one of the conductors and earth, but that if an ordinary transformer with a separately wound secondary be utilised, the potential will be limited to 25 volts, and this opens up possibilities for the consideration of systems of wiring differing from the standard methods now in vogue. One of these is the employment of a concentric system consisting of a conductor drawn into a well-bonded conduit (Mr. Dykes suggests the "Kalkos" tinned-brass conduit), with the conduit itself as a return circuit. A further development of this is a three-wire system; that is to say, a 50-volt secondary on the transformer with a neutral terminal connected to the centre of the winding. The house-wiring is divided into two separate circuits, one connected to each side of the secondary, with the conduit as the common return. As a matter of fact, this is more than a mere suggestion, for Mr. Dykes's firm has applied this system on work for which they are consulting engineers, and we hope to describe shortly an installation carried out

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on these lines. It is true that all these arrangements for connecting 25-volt systems on to the town mains are likely to be only temporary expedients. Before very long we shall have, at any rate, 50-volt metal filament lamps of low candle-power on the market in quantities, and it is not unreasonable to expect that small lamps at 100 volts will shortly follow, although the 200-volt 8-c.p. metal filament lamp is doubtless some distance off. Nevertheless, Mr. Dykes's proposals have a distinct utilitarian side, and we regard his article as a most useful contribution to the practical study of how to derive the greatest possible benefit from the new lamp that has revolutionised the electric lighting industry.

From the statement made by Mr. Wilson Fox, the Vice-President of the Victoria Falls Power Co., at the first annual meeting on Friday, it is clear that the project of erecting an electrical power transmission line from the Falls to the Rand does not come within the immediate intentions of the company's engineers. Apart from the question of wayleaves, which apparently have not yet been granted by the Transvaal Government, it appears that the steam generation on the spot is likely to be so economical that there is a doubt whether it would be possible to generate electricity by water power and transmit it 600 or 700 miles at a smaller cost. Whilst keeping the larger object always in mind, therefore, the company is extending its steam plant, and with very satisfactory results, owing to the cheap supply of coal available. On the other hand, should events justify it, there is the probability that a station will be erected at the Falls solely for the purpose of supplying industries which the officials of the company are endeavouring to attract there. In all this the company is but carrying out the programme laid down in the prospectus, viz., building up a business before seriously taking in hand transmission from the Falls. The rumour that has been going around to the effect that a competitive power scheme was to be brought into existence on the Rand naturally received some severe criticism at the meeting on Friday, probably with the main idea of allaying any fears that might exist amongst the shareholders with regard to their investment under such conditions. To what extent the latter are likely to mature no one seems in a position to say very definitely at the moment.

Manchester Local Section, I.E.E.—At the inaugural meeting on Friday last, Mr. Miles Walker gave an address on the subject of the design of electrical machinery. We give the address in an abbreviated form elsewhere in this issue. The address was followed by a smoking concert. A very varied programme had been arranged, and one of the most appreciated items was a song by Mr. P. C. Pope descriptive of the Electrical Exhibition.

Storage Batteries in Generating Stations.—Interest will be added to the note (page 576) in our last issue wherein figures were given of the saving resulting in the installation of a D.P. battery in a generating station that had been running for some years, by the mention that the station in question is that of the Portsdown & Horndean Light Railway Co., at Purbrook, Cosham, Hants. The plant in the station consists of two 150 b.h.p. Deisel oil engines direct coupled to two 100 h.p. Brush dynamos, with 500 ampere-hour battery and Lancashire Dynamo Co.'s booster, supplying current at 500/550 volts for traction purposes. Owing to the variable load, the battery is always floating on the line. The battery consists of 250 cells of the D.P. Battery Co.'s L.S. 15 type in glass boxes with glass insulators. Capacity, 500 amperes for one hour, with a final voltage of not less than 1·8 volts per cell.

ARRANGEMENTS FOR THE WEEK

MONDAY, NOVEMBER 2ND.

P. & O. Batti-Wallahs.

7.45 p.m. Smoking concert at the Holborn Restaurant.

TUESDAY, NOVEMBER 3RD.

Institution of Electrical Engineers: Manchester Local Section.

7.30 p.m. Ordinary general meeting at the University. Paper to be read:—"Practical Considerations in the Selection of Turbo-Alternators," by Dr. M. Kloss.

Institution of Civil Engineers.

8 p.m. First ordinary meeting of the Session. Mr. J. C. Inglis will deliver his Presidential Address, which will be followed by the presentation of the medals and prizes awarded by the Council. There will be a reception by the President in the library after the meeting.

CORRESPONDENCE

SYSTEMS OF CHARGING.

To the Editor of Electrical Engineering.

Sir,—In your remarks on page 559 of your issue of the 22nd inst., you appear to suggest that any time spent by the Institution of Electrical Engineers in discussing such purely commercial problems as systems of charging could be far more profitably employed in "the wide field of engineering subjects."

When Parliament in its mercy is pleased to make an allocation from the Unemployed Fund for the Institution and its members, so as to render them above sordid financial considerations for evermore, we shall be entirely with you, and engineers can dream of and discuss for ever their hobbies without troubling one iota as to whether there be money in them or not. Meantime, however, this happy state of affairs does not obtain. For years now electrical engineers have spread their wares before the public, but the public have proved tardy buyers; in other words, highly technical and interesting as their wares have been, they have not justified themselves, in so far that *they have failed to make money*. They have not passed the only test the financial world can or should apply. In consequence, financial support is now withdrawn; electrical engineering concerns are practically at a standstill; the unemployed are numbered by thousands; and capital flows abroad, where it is more profitably employed.

Electrical supply undertakings to-day only offer the investor an average yield of 4·01 per cent., to say nothing of losses in the past, and purchase clauses, some of which will have to be considered in the near future. Without straw you cannot make bricks, and without money neither the electrical nor any other industry can live. Surely under these circumstances the policy of the Institution is right to set about getting the straw before building castles in the air with its bricks.

We are, Sir,
Yours truly,
Handcock & Dykes.

1 Victoria Street, Westminster,
October 26th, 1908.

[A great deal of time was spent by the Institution of Electrical Engineers last session discussing the systems of charging for electricity supply, and we cannot agree with Messrs. Handcock and Dykes that a resumption of the discussion on the same subject at the beginning of the coming session will materially assist in solving the "unemployed" problem.—Ed. E.E.]

To the Editor of Electrical Engineering.

Sir,—With reference to Mr. Wilkinson's letter on this subject which appeared in your issue of October

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15th, undoubtedly lighting stations will feel the effects of the new type of lamp very much for the next few years. Alternating-current stations will suffer worse than the direct current ones for several reasons. The pressure can be easily reduced, allowing small candle-power lamps to be used, thus assuring the extensive use of these lamps in private houses. The all-day losses on the transformers and single long hour burning lamps will, as a rule, not be metered at all, as for A.C. registration meters of the electrolytic type are inadmissible, and these are the cheapest meters on the market.

The contract demand system of charging advocated by Messrs. Handcock & Dykes which necessitates a limit indicator, will, I am afraid, give a vast amount of trouble in practice, especially if meters are dispensed with, as Mr. Wilkinson proposes. Experience with this contract system has shown that some consumers take a very unfair advantage, whilst the honest ones grumble at not getting the same advantages whilst having to pay the same amount as their dishonest neighbours.

It would be interesting to know the system of charging most in vogue on the Continent, where electric light is, as a rule, much more extensively used, especially by the smaller consumer, than is the case in this country.

Yours, &c.,

Greenock, Oct. 27th, 1908. W. A. Toppin.

Wireless Telephony.—The *Financial Times* quotes the *Matin* to the effect that Vice-Admiral Aubert presented a report on Saturday last to the French Minister of Marine upon the recent experiments on wireless telephony between the Eiffel Tower and Villejuif, a distance of about six miles. It is stated that the experiments have been completely successful.

The Board of Trade and Provisional Orders.—The Board of Trade has issued a circular letter calling attention to the large number of cases in which, in recent years, Provisional Orders obtained by local authorities under the Electric Lighting Acts have had to be revoked by reason of the powers thereunder not having been put into operation. It does not appear to the Board to be desirable, or in the interests of a district, that an application should be made for an Order unless there is a serious intention on the part of the promoters to exercise the powers under the Order, if granted. In regard to future applications, therefore, the Board will, before granting an Order, require (in addition to the particulars as to financial position, &c., specified in No. XI. (5) of their rules under the Electric Lighting Acts) to be furnished with evidence that a scheme has been definitely considered by the promoters, and that the application is made with the view of putting that scheme into operation on the Order being obtained.

The Association of Teachers in Technical Institutions.—We have received from the Association of Teachers in Technical Institutions a copy of a memorandum which has been sent by the Association to the Board of Education, drawing their attention to the desirability of making certain alterations in the conditions of the Whitworth Scholarship and Exhibition Competitions. The most important alterations suggested are the inclusion of electrical engineering as a subject, and the rendering of the workshop qualification more rigorous. Other proposed changes include the introduction of a proposed preliminary qualifying test and alterations in the grouping of the subjects and relative value of the marking in each. It is also proposed to omit the examinations in building construction and naval architecture, and to introduce a special freehand drawing test. It is suggested with regard to electrical engineering that the examinations of the City and Guilds of London Institute should be accepted.

The annual meeting of the association will be held at St. Bride's Institution, Bride Lane, Fleet Street, on Saturday, November 7th, at 3 p.m., when the annual report will be considered, and other business transacted. The report mentions what has been done in approaching the Board of Education, the City and Guilds of London Institute, and the London University with regard to the reorganisation of certain schemes of work and examination and records resolutions regarding hours of working of teachers, and the provision of a common matriculation examination for all British Universities. Work has also been done in the direction of urging the registration of teachers and the inclusion of teachers in the provisions of the Superannuation Bill to be put forward by the National Association of Local Government Officers. A further meeting is to be held in the evening of the same day, at which Mr. W. J. Lineham will read a Paper on "Technical Education at the Franco-British Exhibition."

ANNUAL DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS

THE annual dinner of the Institution of Electrical Engineers, held last Thursday at the Hotel Cecil, was an even more brilliant gathering than usual owing to the presence of the delegates from all parts of the world who are now in London in connection with the meetings of the International Conference on Electrical Units and Standards and the International Electrotechnical Commission. The attendance, too, was probably all the larger owing to the fact that on account of the illness of Lord Kelvin the function was abandoned last year. Mr. W. M. Mordey, M.Inst.C.E., President of the Institution, presided, and on either side of him sat the Right Hon. R. B. Haldane *H.M. Secretary of State for War*, and the Right Hon. Lord Alverstone, *Lord Chief Justice of England*. The large hall was crowded to the utmost, and about 400 members and visitors found places at the tables, which had been so carefully arranged by Mr. G. C. Lloyd, Secretary of the Institution, and his staff.

In addition to the long list of well-known electrical men present as Past Presidents, Vice-Presidents, Members of Council, and Chairmen and Secretaries of Local Sections of the Institution, the assembly included :—Dr. E. Warburg, *President of the Physicalische Technische Reichsanstalt*; M. P. Boucheret, *Président, Société Internationale des Electriciens*; Prof. J. J. Thomson, *Honorary Member*; Dr. S. W. Stratton, *Director, Bureau of Standards, Washington, U.S.A.*; Mr. R. A. Robinson, *Chairman, London County Council*; Mr. I. Réné Benoit, *Director, International Bureau of Weights and Measures*; Mr. George Franklin, *President, National Telephone Company*; Mr. Ormond Higman, *Chief Electrical Engineer, Inland Revenue, Ottawa*; Dr. Osuke Asano, *Department of Communications, Tokio*; Dr. Desire Harsanyi, *Director, Hungarian Royal Commission for Weights and Measures*; Mr. L. T. Weiss, *Engineer-in-Chief of Telegraphs, Brazil*; Dr. Jaeger and Dr. Lindeck, *Members of the Reichsanstalt*; Mr. Sherigu Kondo, *Department of Communication, Tokio*: Major W. A. J. O'Meara, *Chief Engineer to the Post Office*; Sir Robert Hunter, *Solicitor, General Post Office*; Sir H. Babington Smith, *Secretary, General Post Office*: Mr. Whittaker Thomson, *Chairman of the Highways Committee, London County Council*; Mr. A. P. Trotter, *Electrical Adviser to the Board of Trade*; and delegates from a large number of countries to the International Conference.

In view of the international nature of the gathering, the usual loyal toasts were extended to include the rulers of all countries represented by the guests. The toast, "Science and industries," was proposed by the Right Hon. R. B. Haldane, M.P., F.R.S., who spoke of science as being cosmopolitan and belonging to no one nation, and passed on to consider the influence of highly abstract science upon the highly concrete. He instanced what Mr. Franklin, whose name was coupled with the toast, and his associates, in telephone work had done for the application of electrical science to the needs of daily life. Prof. J. J. Thomson, who would also reply, was associated in their minds with the highly abstract aspects of science. The speaker looked back upon his student days at the University of Göttingen, where he well remembered the monument to Weber, bending over whom was Carl Friederich Gauss, the greatest mathematical worker the world had seen since the days of Newton, possessing in a remarkable degree that power also possessed by J. J. Thomson of applying highly abstract mathematical considerations to the problems of physics. In conclusion, he emphasised the good of these international gatherings. There was no real rivalry in the search after truth; all men were converging on a common problem when they worked on the application of science to industry.

Prof. J. J. Thomson, F.R.S., was the first to respond. He commenced by a feeling reference to the death of Lord Kelvin. Pure science owed a great debt to engineering proper. It was largely through the achievements of engineering that public appreciation had been directed towards science; in many ways, too, engineering developments had facilitated the carrying out of scientific research. In speaking of the advances which science, pursued for its own sake, had conferred on engineering, he took as an example the iron ring wound with a few turns of wire, which could be seen in the hands of Faraday at the Royal Institution, on the experiments with which practically the whole of modern electrical practise was based, and, looking into the future, suggested that the discovery of radium might have still more far-reaching results.

Mr. G. Franklin (President of the National Telephone Co.), who also replied, said that as science was essential to industry, so also industry was essential to science, and in establishing the connecting links between the two much had been done by the right hon. gentleman who proposed the toast. The surest basis of advance of industry was the scientific basis.

The toast of "The Institution of Electrical Engineers" was

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then proposed by the Right Hon. the Lord Alverstone, G.C.M.G. (Lord Chief Justice of England). In an interesting speech he referred to the fiftieth anniversary of the establishment of Transatlantic telegraphy, and called to mind how as a boy he was taken to see the cable of 1857 being coiled into the tanks of the *Agamemnon*. He well remembered following its progress and rejoicing in the limited success of 1858. In passing on to the work of the conferences whose work was to standardise units and nomenclature, he hoped that, in addition to the honoured names already perpetuated, that the names of Kelvin, Thomson, and Siemens could be added, so as to be always in the minds of practical electrical engineers. In looking round he saw many leaders present, and his thoughts turned to some others who had passed away, including Sir Frederick Abel, Sir Charles Bright, John Hopkinson, Scudamore, and others. He congratulated the Institution in having acquired one of the most commodious buildings in London, and wished them God speed and great success.

The President, in his reply, welcomed the delegates from abroad on behalf of the 6,048 members of the Institution. The work that the Conference was carrying on might be said to have commenced at the meeting in 1861 of the British Association, when it was proposed to adopt four electrical standards—Electromotive force, quantity, current, and resistance. A committee was first formed to consider these questions in 1862, and the work had progressed continuously from that time. Mr. Mordey referred to the deaths of Lord Kelvin and Mascart, and mentioned the establishment of the Institution of the Kelvin lectures in the delivery of the first of which Prof. Silvanus Thompson had set such a high standard. With regard to the failure of the first Atlantic cable, this had succumbed to excess of volts, although the name volt was then unknown, and not from any want of skill on the part of Lord Kelvin or Sir Charles Bright, as an outcome of whose work communication was successfully established eight years afterwards. Submarine telegraphy had for some time remained practically where Kelvin had laid it then, but later great advances had been made by Mr. Sidney Brown, who applied to cable problems some of the knowledge gained in other branches of electrical engineering, and had rendered possible increase some 20 or 30 times the working speed available on the 22,500 miles of cable of the world. Another epoch was marked by the putting down by Holmes, in 1858, of the first magneto machine for arc lighting at the South Foreland lighthouse, and the first commercial application of electric lighting at the building of Westminster Bridge in the same year.

The toast of "The delegates to the International Conference on Electrical Units and Standards, and the International Electrotechnical Commission," was proposed in a characteristic speech by Professor Silvanus Thompson, F.R.S. Of these two bodies one, he said, had been concerned with standardising units, and the other with an attempt to create a new electrical engineering language. In looking back at previous work done in connection with units and standards he referred to the congresses at Paris, Frankfurt, Chicago, and St. Louis. As a result of the present conference, the ohm might now be said to have two values, the C. G. S. value, and the resistance of a certain column of mercury 106·3 cm. long, a figure to which the last conference had added two zeros. The two definitions together practically amounted to the establishment of the specific resistance of mercury by law, and he suggested that this might even entail a revision of our ideas as to the mass of a cubic centimetre of water. In conclusion, he welcomed the delegates, and paid tribute to the work of the two distinguished men whose names were coupled with the toast.

Dr. E. Warburg (President of the Physicalische Technische Reichsanstalt) pointed out that the main object of both bodies was a striving towards uniformity, and uniformity meant simplification. The establishment of community of interests was one of the best means of drawing countries together.

Monsieur P. Boucheret (President of the Société Internationale des Electriciens) then rose, and, speaking in French, expressed the congratulations of the Société Internationale des Electriciens, and in this he followed in the footsteps of the late M. Hospitalier, who had addressed a banquet of the Institution two years ago. He then spoke of the work of the Electrotechnical Commission, and paid great tribute to the energy of Colonel Crompton for what had been done since the St. Louis Congress. It was the Paris Congress of 1881 which originated much of the movement towards standardisation, which had been of such benefit to engineers, and with regard to the work of engineers he said, "L'Ingénieur a changé la face du monde."

Dr. E. W. Stratton (Director of the Bureau of Standards, Washington, U.S.A.) also responded. He referred to the addition of the two zeros to the figure for the length of the column of mercury as being to enable the Conference to report that no change had been made. The Conference would be remembered for more than dealing with the fifteenth or sixteenth place of decimals if its labours resulted in the establishment of a permanent authority, which would enable the laboratories of the great countries of the world to work in harmony.

The toast of the guests was proposed by Prof. Gisbert Kapp, and replied to by Mr. R. A. Robinson (Chairman of the London County Council).

SOME NOTES ON 25-VOLT WIRING

MANY people apparently believe that the 25- or 50-volt metal filament lamp is only a passing fad, and that before very long its use will have died out. Meantime, they hesitate to avail themselves of the undoubted advantages which its use offers at the present time. While it is true that metallic filaments are being improved, and that probably in time 200-volt lamps will be available of smaller candle-power than at present, such a lamp must always have a much longer and finer filament than one of the same candle-power for 25 volts.

It follows that the low-pressure lamp will not only be mechanically stronger, but will be capable of being run safely at a higher efficiency, and these advantages alone will well repay the cost of the slight loss of energy in the transformer. As it is practically certain that in the near future current will be charged for on the contract demand, or some similar system, the magnetisation current will in any case be charged at so low a rate as to make its cost inappreciable.

In converting an old or designing a new installation, a choice has to be made between three types of transformers, and it is important to consider the advantages and disadvantages of each. For purposes of comparison, assume that the maximum load on the secondary or low-tension side is to be 1,000 watts—*i.e.*, 25 volts, 40 amperes, the primary voltage being 200.

If the lights can be conveniently divided up into eight groups of 5 amperes each, all of which are in use approximately at the same time, the most efficient form, electrically, will be the balancer transformer (Fig. 1), consisting of a single winding divided into eight circuits.

The no-load losses in a balancer of this size will be approximately 18 to 20 watts, or 2 per cent., and the full-load losses the same, as if the circuits be equally loaded only the magnetising current passes through the winding. The maximum transformer losses will obviously be when half the circuits are fully loaded and half light, when the current passing through the unloaded windings will be 5 amperes, plus the magnetisation and transformer losses in the loaded section—

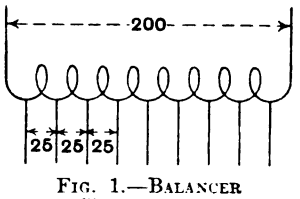

Fig. 1.—Balancer Transformer.

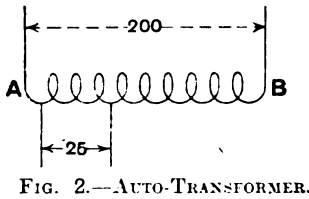

Fig. 2.—Auto-Transformer.

say, 28 to 30 watts, or 5·75 per cent. The pressure regulation is very good; between no-load and half-load the voltage on any circuit will generally not vary more than 1 per cent. (with constant primary volts), whilst at full load, of course, there is no drop at all. The list price would probably be about 65s. In using such a transformer, however, it must not be forgotten that although the voltage of each circuit is only 25, the voltage between different circuits may be as much as 200, and the terminals on the distribution fuse-boards must be arranged accordingly.

On account of the difficulty in splitting up the circuits easily, the more popular form of single-winding transformer is the auto-transformer (Fig. 2). This is somewhat more expensive to wind, the list price being

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probably about 73s., and the losses are somewhat greater, being probably 20 to 22 watts on open circuit and 45 to 48 on full load. At half-load there is little difference between this and the former type. The maximum variation in the secondary volts between open circuit and full load is about 3¾ per cent. If the transformer is so connected that the point *A* is the

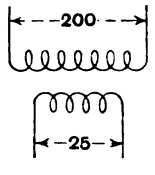

Fig. 3.—Double-Wound Transformer.

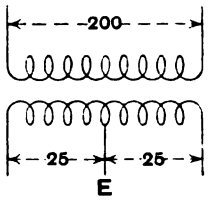

Fig. 4.—Transformer with Three-Wire Secondary.

middle point of the three-wire system, and if, further, the middle wire is at approximately earth potential, the pressure on any part of the house-wiring will not exceed that of the earth by much more than 25 volts. One cannot, however, rely on both these conditions always prevailing, and it will frequently happen that *B* is at earth potential, so that with this type of transformer as with the balancer, although the voltage of the house circuit is only 25, the potential of any wire above earth may be the full 200.

In cases where the insulation of the wires is not of the best, where it is desired to use a simpler, cheaper system of wiring, or where it is desired to secure the maximum safety from leakage, the use of a double-wound transformer is well worth consideration, although admittedly it is somewhat more expensive in first cost and also in transformer losses. A double-wound transformer (Fig. 3) would be listed at about 81s., and would consume about 24 watts on open circuit and 54 on full load, and would have a voltage drop from open circuit to full load of 4¼ per cent. This can be improved on if a little more money, say 108s., be paid, when the open circuit losses can be reduced to 14 and the full load to 44 watts.

The great advantage of a double-wound transformer, however, is the fact that it enables one to use concentric wiring. Concentric wiring with earthed outer presents very many advantages, and should be the cheapest form of wiring, but so far its use has been restricted to isolated plants or a few special cases where for any reason a house transformer has had to be used. By using a double-wound transformer where the secondary is entirely separate from the general system of distributing mains, the opportunity at once presents itself of earthing one pole of the secondary and using concentric wiring with an uninsulated return, thus saving half the insulated wire, half the fuses, and securing practically absolute immunity from shock or leakage currents. A very convenient system which the writer has adopted is to run the wiring in "Kalkos" tinned-brass tubing, using a single insulated wire and the brass tube as the return or uninsulated outer.

A further improvement, and one which the writer usually adopts, is to make the secondary winding two sections of 25 volts each, one each side of a three-wire system, with the middle point earthed (Fig. 4).

This reduces the cost of the transformer to, say, 73s., the same price as an auto-transformer of the same capacity. The open circuit losses would be 24 and the full load 51 watts. If the maximum efficiency type be used at a higher price, say 91s., the open circuit losses can be brought down to 14 and the full load to 41 watts. On this system each three-wire circuit consists of two insulated wires in one tube, the tube being the neutral or earthed conductor, and the lights being connected between either wire and the brass tube. The ordinary Kalkos fittings, plugs, holders, ceiling roses, &c., are used, one terminal of the plug or ceiling rose being earthed on to the outlet-box. In this way one secures all the advantages of 50-volt distribution, whilst no portion of the circuit is more than 25 volts above earth; there is no possible chance of stray currents, the risk of fire is reduced to an absolute minimum, and at the same time the amount of material required, and therefore the cost of the installation is reduced to a figure which cannot possibly be reached with ordinary double wiring in screwed tubing.

Such a system appears to the writer to fulfil every requirement for wiring buildings of a substantial character and private houses where appearance is studied and the wires have to be concealed, but there is a very large class of installations where the lowest possible first cost consistent with safety is called for. In such cases the use of a double-wound transformer of low voltage removes most of the objections to the use of flexible or so-called "Continental" wiring. It is at once obvious that the house-wiring, being entirely separated from the mains, is quite independent of the general leakage, and there must be a fault on both poles of the house-wiring itself before any leakage can occur. Under these circumstances, with a voltage of only 25 above earth, ordinary "flexible" is perfectly safe, and by its use the cost of wiring can be brought down to such a figure as to bring it within the reach of all.

A further improvement is to use a flexible concentric system with earthed outer, which can be quickly and easily cleated up to the walls, and where the bare outer covering forms a protection to the insulated inner wire. Such a system appears to the writer as likely to be the final solution of the cheap wiring problem. It is safe, easily fixed, inconspicuous, not easily damaged, and at the same time the cheapest of any to instal.

When the existing Wiring Rules were drawn up, 25-volt wiring was not contemplated, and it will doubtless be necessary to modify some of the regulations. It will no longer be necessary to assume that 60 watts will be consumed at each point as the new 16 c.p. (Hefner) lamps at 25 volts only require 18 to 25 watts depending on whether the filaments are of tungsten or tantalum. Sub-circuits up to 100 watts are at present limited to 5 amperes, which would mean only five to six lamps per circuit. The writer would suggest using 7/20 circuits with 10-ampere fuses carrying 10 to 12 lamps. Many of the existing ceiling roses, switches, plugs, &c., will obviously need to be redesigned in the direction of increasing the size of terminals to permit of looping (where thought desirable) the larger wire; but there are already on the market patterns which leave little to be desired, and as this class of wiring becomes more general, no doubt others will be brought up to date.

So far the use of 25-volts lamps on supply companies' mains has alone been considered, but there is another very large field for them in small private installations, where their use enables the number of accumulators to be cut down, thus leading to very considerable reduction in first cost. Whilst it is not likely that consumers on the mains of continuous stations will wire their points in series in order to use the small unit, comparatively sturdy, low-voltage lamp, such lamps are already being used to a larger extent than many people realise in cases where the lighting is principally by means of electroliers. It is a very simple and inexpensive matter to alter the wiring of an electrolier from parallel to series, and thus be able to use small bulb low-unit lamps which can be burned at any angle. By using shunt "Leuconium" lamps, the additional advantage is secured that the breakage of one lamp does not affect the remainder of the series.

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THE PROGRESS OF ELECTRICAL DESIGN IN RELATION TO THE REDUCTION OF CAPITAL COST

On Friday last Mr. Miles Walker, as Chairman of the Manchester Local Section of the Institution of Electrical Engineers, gave an address on the above subject at the inaugural meeting of the section. He first spoke of the important position which Manchester held in the electrical world as a manufacturing centre, and also mentioned that the city had the largest municipal power station in England. The output of the station had been 63,000,000 units in the past year; the total cost of generation and distribution had been steadily decreasing, and new plant was being added. Continuing on this subject, Mr. Walker pointed out that not only in Manchester, but in all the neighbouring towns, electricity was being generated on a very economical basis. Salford had a total cost, including distribution and management, of only 0·62d. per unit; Bolton and Bury only about 0·56d., and at Stalybridge last year, the cost was only 0·45d. per unit. The load factor there was as high as 36·8 per cent.

Mr. Walker then pointed out how widely the field of supply would open out with a slight reduction of price, and how important an element in this was the reduction of capital cost. The average cost per unit (without providing for interest and depreciation), of all the electricity generated in the British Isles for lighting and power purposes—excluding stations for traction work only—was as high as 1·14d. per unit last year. But in large modern stations situated where coal is cheap, the cost was much lower. The total cost per unit had fallen in Manchester during the last five years, and it was still falling. Perhaps it was too much to hope that in a general supply as in Manchester, the figure would fall as low as 0·28d., the calculated figure for bulk supply to London, but for the sake of argument, ·035d. might be taken as a possible future cost if the load factor increased to 30 per cent.

Before we can arrive at the price at which electricity can be sold without loss, continued Mr. Walker, we must add to the total cost an allowance for interest and depreciation. The allowance per unit made in Manchester for interest and sinking fund is now as low as 0·55d. per unit, but it still makes a large addition to the price of electricity, and unless this falls as quickly in the future as the cost of generation and distribution, at the time when the latter has fallen to 0·35d., the capital charges will more than double the price of electricity to the consumer. The allowance for depreciation and interest may be taken as 3½ per cent., merely for the purpose of estimating the figure in pence per unit, which should be added to the cost of electricity before we can arrive at an average price per unit, which will give a reasonable return on the outlay. Now we can see how the older companies are handicapped in reducing the price of supply. The capital charge alone amounts to 1·45d. per unit, so that even if the works costs are reduced to 0·25d., the companies could not get a reasonable return on their capital without charging more than 1½d. per unit as an average price. Where competition is possible a new company with small capital could so much under-sell them that the rate of depreciation of their plant would become worse than ever. This serves sufficiently well to illustrate the great importance of low capital cost.

Now let us see how the progress of design has helped to make a little capital go a long way. A great number of factors are all helping in the same direction:—The steam turbine with its high speed, low cost, and small floor space. Improvements in the efficiency and power factor of electrical machinery. Improvements in materials which the designer employs. Improvements in insulation and in cables, which enable higher voltages to be used. Improvements in the lay-out of plant, and the marshalling of consumers so as to keep up the load factor of the station.

The capital cost of some power schemes in the past has been more than £120 per kilowatt installed. The average capital cost of the older supply companies in the British Isles is over £75 per kilowatt. There is very little doubt that in the near future complete supply systems will be equipped at a total capital cost varying between £20 and £35 per kilowatt, depending on the nature of the district. The generating station itself may cost as low as £12 per kilowatt, if of reasonable size. In this connection, Mr. Pearce has been good enough to furnish me with some interesting figures, based on the cost of the recent extensions at Manchester. These are as follows:—Generating machinery, including turbine, condenser, alternator, and foundations, can be put in at a cost of £3·75 per kw.; boilers and steam supply, including economisers, superheaters, coal and ash conveyors, foundations and steam pipes, at a cost of £2·25 per kw.; switchgear for generators and feeders, rated at the generator capacity comes to about £0·5 per kw.; and if we allow £5·5 per kw. for land, buildings and accessories, this gives a total of £12·00 per kw.

Mr. Walker then showed some photographs of machines built in 1902 and 1903, and machines of the same output, built in 1907, to show the reduction in size and weight which had been attained by improvements in design. He also gave several comparative figures for the efficiency of machines built in the same periods, and commented on the increased use of motor converters in preference to motor generators.

Continuing, Mr. Walker said:—It is interesting to ask how far further improvements will be made in the future. Ordinarily the output of a given frame is limited by its temperature rise under load. This can be reduced either by improving the efficiency so that less heat is produced, or by making provision for carrying the heat away. The first is to be preferred wherever it is possible. The improvements made in the last four years in the quality of the iron and in the methods of working the iron, have very greatly reduced the iron losses, particularly in the case of transformers. It would be worth while to make very elaborate, and even costly experiments to determine whether any substantial improvement can yet be made in the quality of sheet iron used for electrical purposes. Investigations of this kind, the results of which would benefit the industry as a whole, ought to be carried out by some official technical institution. One of the things which we may look forward to in the growth and strengthening of the financial position of our institutions is the undertaking of important experimental work of this character. If a manufacturer undertakes the work he is often hampered by want of facilities, want of funds, and want of time, and even if he is successful his competitors often reap as great a benefit from his researches as he does.

The lines along which improvements have been made in the past with respect to the dissipation of the heat produced, are:—(1) Larger surface has been presented to the air; (2) the air is caused to pass quickly through the machine; (3) pockets in which the air remains unchanged are avoided; (4) care is taken that cold air enters and the hot air is expelled in such a way that it does not return; (5) in places where air ventilation cannot be carried out, good provision is made for heat conduction. An inquiry into the heat-conducting qualities of insulating materials is another matter which might be referred to an official experimental institution. Some good work in this direction has already been carried out by the National Physical Laboratory. If an experimental institution would provide a thoroughly satisfactory insulator, that would do more than anything else to cheapen the cost of electric supply, and add to the general reliability of electrical plant.

Automatic Gates for Level Crossings.—An apparatus for automatically closing the gates of a level crossing on the approach of a train is described in an American Consular Report. The apparatus has been installed at several crossings on the Montreux-Bernese Oberland Electric Railway in Switzerland, and has given great satisfaction. At a distance of 500 feet from the crossing, the approaching car, by making contact with a special wire, closes a circuit which sets a mechanism in motion. This mechanism shuts the gates, keeps a warning bell ringing, and at night lights up a red lamp on the gate. After the car has passed the gates, and travelled another 500 feet, the circuit is broken, a counterbalance weight opens the gates, the bell stops ringing, and the lamp is switched off.

Rugby Engineering Society.—The Presidential Address of Mr. A. F. Bennett at the inaugural meeting of the session on Thursday, October 15th, dealt with the progress of steam engineering, and traced the different stages through which the theory and practice of steam engine construction had passed in arriving at the present state of development. He commenced with the work of the earliest experimenters of whom any record exists, and paid particular attention to the earlier progress of steam locomotion. With regard to the present and the future, he said that the steam turbine had now unquestionably prevailed as the most efficient form of steam prime mover, and there was little doubt that the further extension of its use would be rapid and complete. With equal certainty it might be said that the internal combustion engine had come to stay. In the best modern steam engines, barely 20 per cent. of the heat supplied is turned into useful work, whilst gas engines had given thermal efficiencies of over 30 per cent., and in the case of the Diesel engine over 40 per cent. had been obtained. Independently of the question of the gradual using-up of the available fuel supply, the problem of more efficient heat utilisation could not fail to be the problem of the future. The possibilities of that type of machine in which the fuel is burnt on the piston and a high range of working temperatures secured, would, in spite of practical difficulties, assert themselves strongly in the future.

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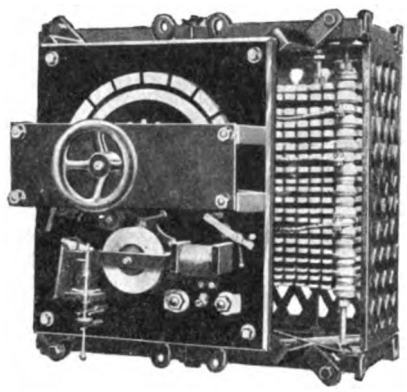
A NEW MOTOR STARTER

THE accompanying illustration represents a new type of starter with an automatic step-by-step motion, which Messrs. Siemens Brothers' Dynamo Works, Ltd., have recently brought out to eliminate certain troubles to which some forms of ordinary starters sometimes give rise.

When starting up the motor the operator simply moves a hand-wheel to a certain position, and then releases his hold of it, whereupon the mechanism of the starter comes into action and completes automatically all operations without further interference on the part of the attendant. A special feature of the starter is the step-by-step motion of the switch arm, the great advantage of which is that sparking is reduced to a minimum, since the switch arm moves sharply from one contact to the next, and then remains for a few seconds on this contact while



THE SIEMENS "FLYWHEEL" STARTER.

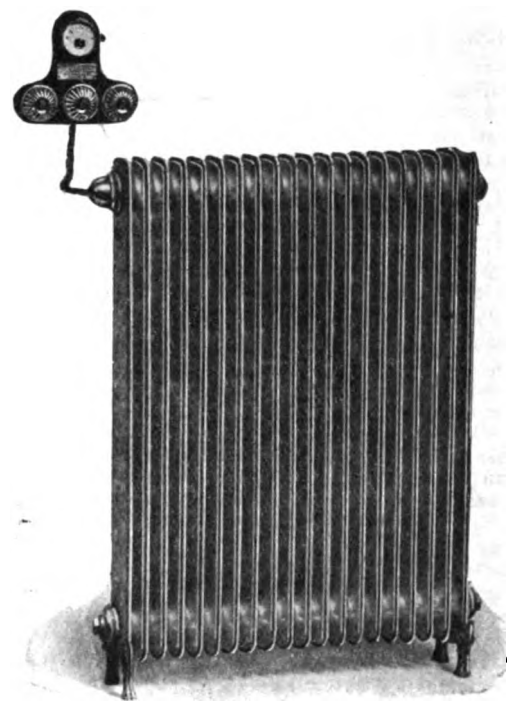
the motor has time to accelerate. The time of starting is arranged to suit the particular size of motor; for instance, for a 30 b.h.p. motor the standard time of starting is 30 seconds.

Since the exact time spent on the contact is known, the resistance can be so designed as to give uniform acceleration. Should an overload or failure of the supply occur either whilst starting or running, the starter arm returns automatically to the "off" position. The switch arm cannot be moved from the "off" position unless the main switch has been closed; this eliminates the danger of the main switch being closed with the switch arm in any but the "off" position.

In order to start the motor the attendant moves the hand-wheel in an anti-clockwise direction, thus putting a powerful spring into tension. This spring operates an escapement gear which causes the starter arm to move step by step over the contacts. The starter is equipped with overload and no-voltage releases, and the motor may be stopped by short-circuiting the no-voltage coil by means of a push button in the usual way. Examples of the starter are on view at the Manchester Exhibition.

A NEW ELECTRIC HEATER

A NOVEL type of electric heater, for which great advantages are claimed over the more familiar lamp radiators and "convectors," has been recently placed on the market by Messrs. Purcell & Nobbs, of 87–89 Cleveland Street, Fitzroy Square. One form is shown in the accompanying figure. The actual resistance heated by the current is in the form of wires immersed in oil of good heat-conducting capacity contained in a sealed casing, offering a very large surface to the air. The object of thus exposing a large surface at a comparatively low temperature is to enable as large a proportion of the heat as possible to be used for direct air warming, and as little as possible to pass through the air as "radiant heat" without warming it. It is well known that the higher the temperature the greater is the proportion of heat given off as radiation. For instance, it is stated that a surface at a temperature of about 1,200° Farenheit above 60° degrees Farenheit of the surrounding air give out about 95 per cent. as radiant heat, and only about 5 per cent. will be used for direct air heating by convection. At a temperature difference of about 750°, which is the temperature employed in most so-called convectors at present on the market, the amount of radiant heat given out will still be 80 per cent. If, however, a heater is constructed to have an outside temperature of only 200° Farenheit, *i.e.*, a temperature difference of about 140° Farenheit at 60° Farenheit of the surrounding air, the amount of heat given off by radiation will only be about 30 per cent., and thus 70 per cent. of the available heat will be used for direct air warming. It is on these considerations that the company base their claim that with their apparatus the current required to heat the air in a room of given size is reduced to one quarter, so that the cost of efficient electric heating (with current at 1d. per unit) is brought into favourable comparison with other forms of heating, besides possessing all its advantages of cleanliness and controllability. We understand that, notwithstanding their considerable heat



"ELECTROYL" HEATER.

capacity, these radiators come up to their full temperature in from seven to fifteen minutes.

A special form is made for tramway and railway work, and its use obviates the difficulties found with some types of heaters in which the wires are apt to crystallise under the influence of vibration.

CATALOGUES AND PAMPHLETS RECEIVED

INSULATORS & BITUMEN SHEETING.—Two further new lists have been issued by Messrs. Johnson & Phillips during the week. One deals with a number of styles and types of porcelain insulators, together with the necessary bolts and fittings required for erecting this type of material. The other contains particulars of Paterson's bitumen damp proof sheeting which is serviceable for use in buildings where it is desirable to prevent damp from rising.

MOTOR CONTROL APPARATUS.—A handsome new catalogue of motor starters, controllers, &c., has been issued by Premier Electric Control, Ltd., a number of forms of single-lever motor starters are listed, including the pattern shown at the Manchester Exhibition on Messrs. Parmiter, Hope & Sugden's stand, and illustrated on page 33 of the supplement to our last issue. The "one-minute" pattern of rheostat is guaranteed to start a motor once in every five minutes, and the resistance is designed to carry twice the full load current of the motor for a period of one minute without undue heating. The multiple-lever starters for large motors were also described last week in connection with the exhibition. These are listed up to 200 h.p. A number of regulating starters for both series and shunt regulation are included, and further items in the catalogue comprise slow-motion attachments for ordinary starters, three-phase starters, shunt rheostats, complete motor panels, drum and lever type reversing controllers, iron-clad switches, fuses, &c., and "Schorch-Premier" high-tension oil switches. The convenience of the list is enhanced by the provision of a flap at the back by which it can easily be recognised and drawn out from among other lists, or hung up if desired. Bound in the list is a perforated post-card, with a numbered counterfoil which, when a catalogue is sent by an agent to a client, can be torn out and returned to the company as a record to be filed.

REMOTE CONTROL SWITCHES.—Messrs. A. Emanuel & Sons send us a catalogue of Blackmore's patent remote control switches, which are constructed so that they can be operated by push-buttons from any number of points. The switch itself is actuated by an electromagnet with a pivoted armature through an ingenious system of levers. The current for this can be supplied by a local battery, and the control effected through a relay, or the actuating current can be taken from the supply mains.

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THE EMERGENCY LIGHTING AT THE MANCHESTER ELECTRICAL EXHIBITION

ALTHOUGH for the greater part the sub-station at the Electrical Exhibition in Manchester has been erected on what may be termed permanent lines, it was deemed advisable to make the fullest possible provision for emergency. The hall is lighted by 54 arc lamps. Forty-four of these are magazine flame lamps, and these are divided into eleven circuits. Eight of these circuits are on the ordinary D.C. 'bus-bars, and the remaining three circuits (*i.e.*, 12 lamps) are run off "emergency" 'bus-bars on the L.T. side, which are normally connected on to a small gas-engine set on Messrs. Crossley Bros.' stand. In addition to these 12 lamps, 10 enclosed lamps are connected, two in series on a ring main, also supplied from the emergency 'bus-bars. Thus, in the event of the sub-station supply failing, 22 lamps on four circuits remain alight, and this is quite sufficient to afford a fair general illumination. In addition, along one side of the building on the exterior there are seven weather-proof fittings, each with two 25-c.p. tantalum lamps, and at two of the side exits near the main entrance there are enclosed arcs, and these are also connected to the emergency 'bus-bars.

On the emergency panel of the sub-station switchboard there is a throw-over switch by which the emergency 'bus-bars can be connected to the main sub-station 'bus-bars instead of to the Crossley set, and at the back of the board is another throw-over switch which enables the emergency 'bus-bars to be connected to the ordinary distributing network which supplies the suburb of Rusholme, and is fed from the Rusholme sub-station.

The efficiency of the arrangements was fully demonstrated on Saturday last, when the sub-station in the Exhibition was shut down at 6.45 for 8½ minutes. The lights on the stands, which have not independent supply from their own generators or cells, were, of course, extinguished, and part of the arcs in the hall and the lamps on the main entrance roadway were out, but the hall remained quite light, and there was nothing in the nature of confusion among the public; the only result was a slight crowd round the sub-station to see what had happened, and a little excitement in the tea-room, which was left in complete darkness.

The cause of the interruption was as follows:—One of the three vulcanised rubber cables connecting the induction motor-generator to its panel on the high-tension switchboard broke down beneath the switchboard and earthed one phase. This not only threw out the switch on the panel, but also blew the fuses at the Stuart Street generating station end of the feeder which was supplying the Exhibition sub-station. The supply was therefore cut off both from the A.C. and the D.C. circuits in the Exhibition with the exception of the emergency lights, which we have referred to. Stuart Street and the Exhibition sub-station, of course, got into communication at once, and the fuses were restored and the A.C. circuits switched in again. This took five minutes, however, at the end of which time the exhibitors who take A.C. current had their supply resumed. The rotary converter was next started up, and then the motor-converter—these two machines being ample for the supply—and the D.C. circuits were switched on again. For this another 3½ minutes was requisite, and at the end of 8½ minutes everything was in its normal condition. The faulty cable was replaced on Saturday night, and on Monday all three machines were running as usual.

LONDON ELECTRIC POWER BILLS

Proceedings before House of Commons Committee

A Committee of the House of Commons, presided over by Mr. Luke White, commenced consideration of the London and District Electricity Supply Bill on Monday. The other members of the Committee are Mr. James Parker, Mr. Baldwin, and Mr. Esslemont. Owing to an objection by Mr. A. C. Morton to the second reading of the London Electric Supply Bill and the London (Westminster and Kensington) Electric Supply Bill on the 19th inst., these measures have been put down for second reading in the House of Commons on Monday next. There are no less than ten motions on the paper in respect of these two Bills. Mr. Churchill will move an instruction to the Committee which will consider them that the London County Council be named as the purchasing authority; Mr. A. C. Morton has given notice of his intention to move that both Bills be rejected; a motion in the name of Mr. Claude Hay asks for the insertion in the Bills of similar linking-up powers for local authorities owning electricity works; two other motions have for their object the prevention of the companies from obtaining additional compensation in the event of purchase by reason of severance or by reason of the existence of agreements for mutual assistance; and Mr. Lough will seek to bind the companies from opposing future electrical legislation on the part of the borough councils.

With regard to the Bill now before Committee, Mr. Lough has given notice of the following motion on Monday, but it does not affect the progress of the Bill in Committee:—

That it be an instruction to the committee to modify the terms of purchase proposed in the Bill so that, within six months of twenty-eight years from the passing of the Act, and within six months after the expiration of every subsequent period of seven years, the London County Council may require the company to sell, and thereupon the company shall sell to them their undertaking upon terms of paying the then value (exclusive of any allowance for past or future profits of the undertaking or any compensation for any compulsory sale or other consideration whatsoever) of the undertaking and all lands, buildings, works, materials, and plant of the company suitable to and used by them for the purpose of their undertaking, such value to be, in case of difference, determined by an engineer or other fit person nominated as referee by the Board of Trade on the application of either party.

The following notes give quite briefly the nature of previous Bills of this character which have been promoted, together with those now before Parliament:—

In 1904, the East London and Lower Thames Electric Power Bill was before a committee of the House of Commons, but it was rejected on financial grounds. In the following year Mr. C. H. Merz came forward with a much more comprehensive scheme in the Administrative County of London and District Electric Power Bill, but after passing committees of both Houses of Parliament there was not time for it to pass the remaining stages, and the Bill lapsed. In 1906 followed the London County Council Bill, and also the Administrative County of London Bill, but only the former was read a second time and came before a committee of the House of Commons It was, however, rejected, the committee making a special report, in which they referred to the importance of the subject, and urged that it should not be allowed to drop. In 1907 another Bill was presented by the London County Council, in which it was recommended that the undertaking should be leased to a company. This, however, was not approved by Parliament, and consequently the way was clear once more for private enterprise. Accordingly, three Bills were introduced this session, and were considered by a committee of the House of Lords, presided over by Lord Cromer, the hearing lasting no less than thirty days, with the result that the House of Com-

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mons had to defer dealing with the Bills until the autumn session. Considerable alteration and amendment took place during the Lords' committee stage, and the present position in relation to these Bills is summarised below.

The London and District Electric Power Bill, the engineers to which are Mr. H. F. Parshall and Mr. Robert Hammond, proposes to incorporate a company with a capital of £4,500,000 to give a supply of electrical energy in bulk and for power purposes in an area, including the whole of the County of London and certain selected portions of the counties of Kent, Surrey, Middlesex, and Essex, having a total area of 451 square miles, of which 117 are within the County of London and 334 without. A power station will be erected at Barking, having a total capacity of 144,000 kw. of plant installed. Generation will be upon the three-phase alternating-current system at 15,000 volts and 50 cycles, there being 14 control stations connected with the main generating station by duplicate mains. These control stations will feed transformer stations, from which the actual supply to the consumer will be given. Supply may be given in bulk to authorised undertakers and to persons requiring a supply for power purposes, but a power user supplied by the company in the area of an existing supply authority may not use more than 15 per cent. of his total supply for lighting purposes. In all previous Power Bills this is 20 per cent., but Lord Cromer's committee deemed it wise to reduce the proportion in view of the greater efficiency of metal filament lamps. The company, of course, cannot supply any individual power user in the area of an existing supply authority without the authority's consent, but there is an appeal to the Board of Trade should that consent be unreasonably withheld. The power company is not restrained, however, from supplying railways, tramways, canals, docks, &c. The maximum charges in the Bill are as follows:—Untransformed alternating current, £3 per annum per kw. of maximum demand, plus 0·25d. per unit: transformed alternating current, £3 10s. per annum per kw. of maximum demand, plus 0·3d. per unit; direct current or transformed alternating current converted to any other periodicity than that of the main supply, viz., 50 cycles, £4 10s. per annum per kw. of maximum demand, plus 0·33d. per unit.

An important feature of the Bill, and one about which there will be considerable discussion in committee is the purchase clause. As matters now stand, however, the London County Council is authorised to purchase the undertaking in 1931, or subsequent periods of ten years to 1961, by giving twelve-months' notice. In 1961 the terms of purchase will be the "then value" as a going concern, but if the purchase takes place in 1931, 1941, or 1951, there is to be paid an extra sum as compensation for the loss sustained by the company by reason of such earlier sale. This sum may be agreed or determined by arbitration. To these terms, however, there is very strong objection. The Bill now contains protective clauses for practically all interests except those which object to the principle of the measure.

Although the London Electric Supply Bill, when introduced this session, asked for supply powers over a somewhat similar area to that scheduled in the previous Bill, in addition to authority for linking up the power stations of a certain number of the companies, the Bill was reduced to a very simple measure by Lord Cromer's committee. It now enables the companies named in the Bill to link up for the purposes of mutual supply, and also to give a supply of electrical energy to railways, tramways, canals, docks, &c. The companies concerned in the promotion are Charing Cross, West-End and City Electricity Supply Co., Metropolitan Electric Supply Co., London Electric Supply Corporation, Chelsea Electricity Supply Co., Brompton and Kensington Electricity Supply Co., South Metropolitan Electric Light and Power Co., London Electric Lighting Co., and the County of London Electric Supply Co.

The third Bill is on exactly the same lines, and gives similar powers to the St. James's and Pall Mall Electric Light Co., the Kensington and Knightsbride Electric Lighting Co., Westminster Electric Supply Corporation, and the Notting Hill Electric Lighting Co.

When the Committee met at noon on Monday, the attendance was somewhat smaller than has been usual in connection with these Bills. There are, as before, a very large number of petitions against the Bill, including the London Electric Lighting Companies and practically all the important borough councils, but the London County Council are not represented by counsel. The promoters have retained the same counsel as before, viz., the Hon. J. D. Fitzgerald, K.C., Mr. Talbot, K.C., Mr. Clode, and Mr. Thomas, and in his opening speech Mr. Fitzgerald gave a most detailed account of the history of these power proposals, more detailed than would appear necessary to a Committee which contained two members who have already served on earlier Committees. Two points he emphasised, viz., that the urgency of the question was undoubted in view of the reports of previous Committees, and, secondly, that all existing supply authorities had been granted their powers upon the distinct understanding, as laid down in the Electric Lighting Act of 1888, that they were not given a monopoly. Mr. Fitzgerald also made full use of the report of Mr. Luke White's Committee of 1906, which stated that the Administrative Bill was conceived on scientific lines, failing the passing of a Bill promoted by the London County Council. As the present Bill is admittedly on precisely similar lines to that of the Administrative Bill, the inference is obvious. The Chairman was also reminded of another statement in the report of his Committee of 1906, viz., that failing the promotion of a Bill by the London County Council the way should be made clear for private enterprise. Mr. Fitzgerald thus cleared the way on several important matters of principle in connection with the Bill. Another matter which Mr. Fitzgerald took an early opportunity of mentioning was the recent breakdown at Lots Road, and the letters which were sent to the Press by opponents of his Bill, pointing out the grave consequences if this supply had been to the whole of London instead of only to the railways. The answer to that, he said, was very simple. The Barking power station, which the opponents apparently did not know, would be built in sections, so that a breakdown on one section would not affect the supply from the remaining sections, and that such an event would not affect the supply to London, nor cause the least inconvenience to anyone. On the other hand, had the Barking power station been in existence at the time of the Lots Road accident, and the precaution taken to have a connection ready to be made, a supply could have been given to Lots Road from Barking in five minutes.

The general features of the London and District Electricity Bill are summarised above, but in placing them before the Committee, Mr. Fitzgerald drew attention to the small proportion which the power supply of the existing authorities represents of the whole of their output; to the possibility of railway electrification with a cheap supply of power available—thus obviating capital expenditure on power stations on the part of the railway companies—and the fact that low as the schedule of prices in the Bill is, the promoters believed and hoped they would be able to supply at still cheaper rates. On the question of competition, attention was drawn to an addition to the Kitson clause which was made at the instance of the London County Council in the House of Lords, viz., that in any arbitration proceedings at the hands of the Board of Trade, the arbitrator shall have regard to the capital expenditure, &c., upon the undertaking in whose area the promoters propose to give a supply. Complaint has been made that the price at which the power company would supply under these circumstances is not quoted in the Bill, but it was explained that owing to the wide differences in the possible demands of various consumers, it was impossible to do this. The Board of Trade arbitrator has the power to determine whether the proposed price of the power company is a sufficient and proper one, and if it were shown that the price was an unduly low one, then it could be taken that the consent of the Board of Trade to the proposed supply would not be granted.

On Clause 67, the purchase clause, Mr. Fitzgerald reminded the Committee that Lord Cross's Committee had reported against it, as a general rule, in power Bills. He did this in order to show the very different position of the promoters of this Bill as compared with the promoters of any other Bill of the same character. Dealing with the terms of the clause, Mr. Fitzgerald at once said that a concession until 1931 only, without compensation for the remaining years, as proposed, until 1961, was not one which would tempt any investor. As to the authority which shall carry out the purchase, Mr. Fitzgerald cut his remarks short in view of the instruction to the Committee by the House that the London County Council shall be named in the Bill. Similarly, with regard to Clause 77 (power to acquire undertakings), the Board of Trade will lay its views before the Committee, and here again Mr. Fitzgerald had little to say. The Board of Trade object to the clause, and Mr. Churchill has intimated that unless it is modified or withdrawn he will oppose the Bill on third reading. The promoters, however, are more or less indifferent in the matter, although they regard the clause as a useful one.

Mr. Fitzgerald's concluding remarks dealt with the petitions. Whereas in the other House there were 69 petitions against the Bill, there are now 38, of which only 19 are supported by the appearance of counsel. He first of all ridiculed a suggestion by the City of London Corporation that the whole matter should be relegated to a Royal Commission, and then drew attention to the petition of the London companies, which, he said, absolutely contradicted their attitude in the House of Lords. Then, they promoted a Bill to meet the power demand in London. That proposal was rejected, and now they said there was no demand to be met, beyond what they were already dealing with. The companies also still displayed their usual inconsistency; on the one hand, they alleged that the power company could not supply, except at a loss, at the schedule of prices in the Bill, and on the other, asserted that they themselves could supply, presumably at a profit, at lower rates. The real opposition, both on the part of the companies and local authorities, was competition.

In a discussion as to procedure, the Chairman intimated that whatever arguments were brought forward against the L.C.C. being inserted as the purchasing authority, the Committee was bound to carry out the instruction of the Committee.

Mr. H. F. Parshall, joint engineer to the scheme with Mr. Robert Hammond, gave his evidence on Monday and Tuesday, but as the facts upon which he bases the scheme, together with the engineering and other details of it, have not changed since the Bill was before the House of Lords, there is nothing new to be

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added. An outline of the details appears above, and a complete account, together with a map of the area and drawings of the proposed power-house, appeared in ELECTRICAL ENGINEERING, Vol. III., p. 721. The cross-examination has, so far, revealed no very new points, except that the authorities outside the County of London who oppose are regarding the instruction to the Committee, that the London County Council shall be the purchasing authority, as a new and additional argument for leaving them out of the area, in order to avoid municipal complications by reason of one county council having powers over an undertaking in the area of another county council. For the rest, the opponents show all their old inconsistency. Even Mr. Erskine Pollock, K.C., who appears on behalf of the Middlesex County Council, and really wants to be cut out from the Bill, complained that the promoters had not taken in enough of Middlesex. They had, he said, only scheduled that portion which was just over the London County border, and which was industrial; but when Mr. Parshall offered to take in more counsel hastily informed the Committee that the Middlesex County Council wished to be excluded. Similarly, Sir Ralph Littler, for the City of London Corporation, whilst complaining of the proposal of the company to lay mains in the City, in the next question asked if Mr. Parshall was aware that the City had special powers to regulate the laying of mains. Mr. Parshall's query as to why, then, the City Corporation was concerned on this head, remained without a satisfactory answer. Mr. Seymour Bushe, K.C., for the Westminster, Kensington, and Knightsbridge, Notting Hill, and St. James and Pall Mall companies, expressed his concern for his companies, on the one hand, and for their consumers on the other. He sought to show that the power company would endeavour to secure their customers by undue competition, yet he put it to the witness that the companies which he represents are selling power at cheaper rates than would be possible to small power users—which were all the West End companies had—under the schedule in the Bill. Obviously, if the latter is the case, the companies are protected, whilst the consumer can come to no harm in that he cannot be forced by the power company to pay a higher price for his energy than he now pays to the existing companies. And this, in effect, was Mr. Parshall's answer. Mr. Bushe pointed to a map on the wall showing the companies' area, and asked at what points it was proposed to give a bulk supply to them. He was answered by Mr. Hammond, who mounted a table, and with an umbrella, in the absence of a pointer, prodded the map indiscriminately and shouted "Wherever you want it." In reply to Mr. Balfour Browne, K.C., for the North Metropolitan Electric Power Co., Mr. Parshall refused to cut this company's area out of his scheme, because Mr. Merz had done this in 1905. Mr. Merz, he said, gave away a good deal in his dying hours.

LOCAL NOTES

ABERDEEN: *Overhead Wires.*—In connection with the lighting of the Culter district, the County Council has granted its permission for the Corporation to erect overhead wires.

ACTON: *Electric Wiring.*—The Electricity Committee recommend that in future wiring be carried out by the electricity department, where the cost is estimated not to exceed £50. Where the work was estimated to exceed that figure, the Electrical Engineer was to obtain tenders. An amendment to refer back was carried when the recommendation came before the Council.

Auditor's Surcharge Remitted.—In connection with the recent Electrical Exhibition held at Acton, a sum of £10 was granted the Electrical Engineer in respect of extra services, but this amount was surcharged by the Auditor. A communication has now been received from the Local Government Board confirming the decision of the Auditor, but exercising on this occasion its right to remit the amount.

BATH: *"Black Smoke" Nuisance.*—Mr. F. Teague, the engineer and manager of the electricity works, has written to the Sanitary Committee complaining of the remarks recently made by their officers with regard to the emission of smoke from the power house chimney. Mr. Teague complained that the trouble had been greatly exaggerated, and would be likely to do harm to the undertaking. He also mentioned that within a few days of the report of the inspector being published several offers had been received to supply them with stokers to avoid the smoke. The Sanitary Committee have, however, passed a resolution instructing the surveyor and inspector to continue to keep observations upon the electricity works chimney.

BLACKROCK: *Threatened Legal Action.*—The Council has held a meeting to consider what action shall be taken with regard to the condition of the tramway track of the Dublin United Tramways, Ltd., in Rock Road. The Council have instructed their law agent to communicate with the Tramways Company at once, and to submit the question of an action against the Tramways Co. to counsel for advice in the advent of the reply not being satisfactory.

BRAZIL: *New Submarine Cable.*—A decree has been issued authorising Messrs. Felten & Guillcaume Lahmeyerwerke, A.G., of Mulheim, to lay and work a submarine telegraph cable between the Brazilian coast and the island of Teneriffe.

BRISTOL: *Tramway Extension.*—An extension of the Bristol tramway system to Westbury has been opened, after inspection on behalf of the Board of Trade, by Colonel von Donop.

BUENOS AYRES: *Tube Railways.*—It was thought, says the *Review of the River Plate*, that before the end of the present session of Congress the question of tubes in the City of Buenos Ayres would have been settled, and that at least the concessions applied for by the Western and Amalgamated Railways would have been sanctioned. Such, however, was not to be the case, as it has been resolved by a large majority to shelve the question until next year. This is a bad look out for the city. The Corporation is not in a position to carry out the work, whilst the railway companies are, and the conditions that they offered to the Government were eminently satisfactory to the community. The Corporation will now have until next May to see what it can do in the matter, but there is no reason to hope that it will be able to do anything. Its first attempt to carry out the work by public tender was a dismal failure, only one tender having been presented, and this was not in accord with the specifications, nor was it suitable to the interests of the City.

BURSLEM: *Electricity Charges.*—At the recent Local Government Board inquiry, in connection with an application to borrow £12,000 for the purposes of the electrical undertaking, Mr. H. R. Hooper made some remarks with regard to the inadequacy of the electric light tariff. The Electricity Committee have passed a resolution saying that they see no reason why any alteration should be made in the scale of charges for electricity for lighting or power. The Chairman of the committee states that they have satisfied themselves that the electricity undertaking is in a sound position.

CLEETHORPES: *Electric Lighting.*—The Council's Electric Lighting Provisional Order will expire this month, but in order to keep the Order alive it has been decided to proceed with a scheme for laying cables along a number of roads, power being taken from the tramway generating station.

DUDLEY: *Tramway Agreement.*—A satisfactory settlement has been arrived at in connection with the terms of purchase by the Corporation of the tramways in the district, and their release to the Dudley, Stourbridge & District Tramway Co.

FOLKESTONE: *The Tramway Question.*—The new proposals of the National Electric Construction Co. in regard to the carrying out of its tramway powers, namely, that instead of the Dolter surface contact system, the conduit system be adopted in the town, and the overhead system in the outlying districts, has been rejected by ten votes to six.

GERMANY: *Munich Tramways.*—A Consular report states that the net profits of the Munich municipal tramways amounted to £21,170 in 1906-7, which works out at £441 per mile, the system being 48 miles long. The trials of heating the Munich municipal tramcars by means of electricity were unsuccessful on account of the expense.

Electrical Works.—The Bavarian electrical works report full employment for 1907; the deficiency of workmen complained of in other trades does not seem so apparent in this, the number of workmen employed by one important firm in Nuremberg alone having risen from 5,022 in 1905 to 6,345 in 1906, and to 6,700 in 1907, and this increased number of hands was obtained without difficulty.

GOVAN: *Electricity Accounts.*—The accounts of the Electricity Department for the year ended May 15th last, show a credit balance of £629. There has only been a small increase in the output and revenue, which is attributed to the bad state of trade during the twelve months covered by the accounts. Connections have been increased by 4,588 8-c.p. lamps and 1,307 h.p., but the new connections have not done much more than compensate for the decreased business with old consumers. There is an increase in the works and distribution costs, but this is almost entirely due to an increase in the price of coal, the bill for which is higher by £632. The gross revenue amounted to £16,765, and working expenses to £9,055. After meeting interest, sinking fund, &c., there is a small balance, as already stated, of £629.

GRIMSBY: *Supply for Wireless Telegraphy.*—Mr. W. A. Vignoles, the Borough Electrical Engineer, has visited Portsmouth and conferred with representatives of the Admiralty with reference to the wireless telegraph station at Humberstone. A draft agreement between the Electricity Committee and the Admiralty has been approved, and the laying of the necessary cable is to be commenced at once.

HANDSWORTH: *New Tramway Scheme.*—Negotiations are proceeding with the British Electric Traction Co., in connection with a scheme of tramways in Handsworth. A census has been taken of the district by the Company, and they hope to promote a Bill in Parliament next session.

HANWELL: *Condition of Tramway.*—At the last meeting of the District Council the matter of the complaints with regard to the tram track again came up, a letter being read from the Board of Trade stating that they had no power to compel the Tramways Co. to repair or reconstruct its lines. Sir Clifton Robinson, managing-director to the company, wrote calling attention to a report in the Press of the discussion which took

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place at the previous meeting. That was the first intimation he had received, and he would be glad to have the ground upon which the complaints were made. Sir Clifton Robinson is to be given the Council's ground of complaint.

HASTINGS.—*Sunday Tramways.*—The Tramway Company refuse to abide by the Council's resolution that as a condition for being allowed to run Sunday trams, the receipts on Sundays shall not be taken into account in the event of purchase being made, and consequently has abandoned its Sunday services. The matter does not rest there, however, as the inhabitants are strongly in favour of Sunday tramways. The Corporation have discussed the position, but no definite decision has been come to.

HERNE BAY: *Electric Lighting.*—An application is to be made to the Board of Trade for an electric lighting Provisional Order.

HERTFORDSHIRE: *Tramways.*—The Metropolitan Electric Tramways, Ltd., have paid £1,594 in settlement of interest at the rate of 4½ per cent. per annum upon the outlay of the County Council in connection with the promotion and construction of the Barnet tramways, payable under the terms of the agreement between the County Council and the company.—The plans showing the proposed method of constructing the Watford & Bushey tramway extensions have been agreed with Major Pringle, R.E., on behalf of the Board of Trade. The Light Railways Sub-Committee of the County Council has approved of an agreement with the company, granting a lease of the Bushey and Watford tramways for 42 years as from August 21st, at a fixed rent of £5 per cent. per annum upon the capital outlay incurred by the County Council in construction.

HOBART (TASMANIA): *Heavy Damages for Tramway Accident.*—An action was recently taken against the Hobart Tramway Co. for injuries alleged to have been caused to a boy fifteen years of age, through falling from a tramcar, which was stated to have been caused by the negligence of the company's servants. Damages to the extent of £2,000 were claimed, and after a lengthy hearing the jury awarded £1,200.

HUDDERSFIELD: *Tramway Receipts.*—The half-yearly statement of the tramways undertaking to September 30th shows an income of £44,111 against £44,118 last year, and a total working expenditure of £23,031 against £20,676. After allowing for depreciation at the rate of 3 per cent., there is a net surplus of £2,748, against £5,110 for the corresponding period of last year.

ITALY: *Customs Decisions.*—An Italian customs decision has recently been received at the Board of Trade, under which "carbons for electric lamps with the metallic thread in the interior, destined to facilitate the combustion of the carbon," are liable to a duty of 10 lire per 100 kilogrammes.

Proposed Electrical Exhibition.—An electrical exhibition is expected to be held in Brescia in 1909.

Telephones.—A Consular report states that in 1887 there were only about 100 persons who used the telephone in Milan. The number of telephones was 1,431 in 1895, it rose to 2,749 in 1900, to 6,112 in 1905, to 6,263 in 1906, and at present it is 7,651, with a tendency to increase.

JAPAN: *Electric Railway Statistics.*—The British Vice-Consul of Osako has forwarded some notes and statistics relating to the municipal electric railway in Osako, the second installation of which was opened to traffic on August 1st last. The railway is the first of its kind constructed and worked by a municipality in Japan. The particulars referred to may be seen at the Commercial Intelligence office of the Board of Trade.

LIVERPOOL: *Inspection of Electric Light Fittings.*—A resolution has been passed by the City Council recommending the appointment of an officer whose duty shall be to inspect the electric light fittings in the buildings under the control of the various municipal committees.

LONDON: *London County Council Tramways.*—In addition to the proposals now before the County Council for new tramways, for which a Bill is to be introduced in Parliament this session, the Highways Committee recommend the construction of a line from Streatham High Road via Mitcham Lane to Mitcham Road.

Owing to the Chelsea and Kensington Borough Councils having refused their consents to the construction of tramways from Battersea Bridge to Uxbridge Road, the Highways Committee recommend that this proposed line shall be omitted from the list submitted to the Council.

Marylebone: Consulting Engineer's Fees.—At the meeting of the Council, on October 22nd, the result of the arbitration with regard to the fees claimed by Mr. Wright, the consulting electrical engineer, was announced. The total amount now due to Mr. Wright by the Electricity Supply Committee is £342, exclusive of £85 payable by the Lighting Committee. The arbitrator has awarded that the Council shall pay the fees, amounting to £85, and the whole of the costs.

Poplar: Electricity Accounts.—The report of the Electrical Engineer for the year ended March 31st, 1908, shows a gross profit of £16,920, against £14,576 for the previous year, an increase of 16 per cent. Capital charges absorb £1,470, leaving a balance of £2,750. From this has to be deducted accrued charges on new loans, cost of raising new loans, and interest on bank overdraft, and after adding certain small items, such as income from property and income from sale of lamps, there is a net balance of £2,264. It is necessary to devote this surplus to meeting the deficit on March 31st, 1907; to writing down the original cost of six core-feeders on account of the introduction of the extra high-tension system; and various other items, which leave a balance to be carried forward of £162. Nothing is set aside for depreciation. The net revenue of the undertaking was £33,310, compared with £30,595 in the previous year. The total number of units sold was 5,296,040, at an average price of 1·6d. per unit. The cost of coal exceeded the estimate by £1,539, but as the output was 461,040 units in excess of the estimate, amounting to £701, the increased price of coal was responsible for £838 increase. The total number of public arc lamps is 344, and of 8 c.p. incandescents 575. The maximum demand during the year was 2,600 kw.

MANCHESTER: *Trolley Omnibuses.*—The Corporation will deposit a Bill in Parliament next session authorising them to use trolley omnibuses and to construct certain tramways.

MORECAMBE: *Tramway Undertaking.*—The Corporation has passed a resolution that an application be made to the Board of Trade for a Provisional Order to electrify and run the tramways, which have recently been purchased from the Morecambe Tramways Co.

OLDHAM: *"Black Smoke" Nuisance.*—At the last meeting of the Corporation, a Councillor asked if some steps could not be taken to check the emission of black smoke from the electricity generating station chimney. He urged that experiments should be made with a view to minimising the nuisance. The Chairman of the Electricity Committee stated that endeavours had been made to prevent the emission of black smoke, but he did not suppose that the Council would wish to expend hundreds of pounds by the experiments. He did not regard the trouble as a serious one. Further consideration of the matter was deferred.

POTTERIES: *Proposed New Tramways.*—The Potteries Electric Traction Co. is to be asked by the Smallthorne Urban District Council to construct a tramway from Tunstall to Brindley Ford.

QUARRY BANK: *The Light Railway Scheme.*—It is stated that there is a possibility of the light railway scheme, which has been the subject of negotiation for some time between the Quarry Bank, Brierley Hill, and Rowley Regis Councils and a company, in which Mr. C. S. Vesey Brown is interested, is likely to fall through. One of the Councils has adopted a determined attitude on the question of the security which it is proposed that the company should deposit, this being a considerable sum to remain in a bank during the forty years of the agreement. To this the company strongly object.

RHYL: *Proposed Tramway Extensions.*—The Council has decided to confer with the representatives of the Llandudno and District Light Railways Co. for the consideration of a scheme for tramways in Rhyl.

RUSSIA: *Port Lighting.*—During last year, according to a British Consular report, an electrical installation was completed at the Nicolaieff port.

Tramways.—Negotiations are proceeding for the conversion of the existing horse tramways in Nicolaieff to electric traction.

SALFORD: *New Tramways.*—A Bill is to be introduced into Parliament next session for the construction of two new tramway routes.

SHEFFIELD: *Street Lighting.*—Owing to the success of the electric lighting on the Moor, Fargate, and High Street, the Watch Committee has decided to erect electric lamps in Fitzalan Square.

TURKEY: *Smyrna: Electrical Appliances.*—A British Consular report mentions that electrical appliances, hitherto very strictly excluded, are now being gradually introduced.

WALTHAMSTOW: *Arc Lamp Hiring Scheme.*—A charge of £2 2s. per arc lamp is to be made under an arc lamp hiring scheme, such charge to cover supply of current for 800 hours burning per annum, and maintenance, all hours of burning above 800 per annum are to be charged at 2d. per lamp per hour.

WARE: *Provisional Order Revoked.*—The Board of Trade have revoked the Ware Electric Lighting Order of 1905.

WELLINGTON (N.Z.): *Electric Lighting Accounts.*—The first year's working of the municipal electric lighting department shows a net profit of £6,122 after allowing for interest, sinking fund, and depreciation.

WEST HAM: *Mutual Supply with Charing Cross Co.*—Negotiations have been in progress between the Electricity Committee and the Charing Cross Supply Co., for an interchange of supply between the Bow and Canning Town power stations. The Electrical Engineer states that the method of payment for the interchanged current presents no difficulties because it is proposed to base it entirely on the working costs of each party, the intention being that neither party supplying current shall make any profit on the actual exchange. A schedule will further vary the price according to the time of day current is taken. The two stations are about 2¼ miles apart, and the systems can be connected without any running machinery. The Engineer is to put a draft scheme shortly before the Committee, who have approved of the principle of the interchange, and have instructed him to continue his negotiations with a view to an agreement being entered into.

YORK: *Light Railways.*—The Board of Trade has confirmed the York Corporation Light Railways Order, 1908, which authorises the construction of light railways in the city of York and in the rural district of Escrick.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

CARDIFF.—Upon the recommendation of the Electrical Engineer and Manager, the Electric Lighting and Tramways Committee recommend application being made to the Local Government Board for sanction to borrow £30,000.

DUNEDIN (N.Z.).—Mr. Stark, the City Electrical Engineer, recommends the installation of a generating plant with a total capacity of 2,000 kw. He recommends steam-turbine plant in preference to any other form, at an estimated cost of £21,300.

EASTBOURNE.—The Electrical Engineer has been instructed to make inquiries in regard to obtaining a water-softening plant to deal with 1,000, 2,000, or 3,000 gallons per hour, the estimated cost of which is £200, £250, and £300 respectively. To ensure a permanent supply for the motors driving the condensing plant a spare transformer with a regulating switch is to be provided, so that the normal voltage required by the motors can be obtained should the generator voltage drop so low as 1,500. The cost will be £98.

GREENOCK.—A sum of £25,000 is to be borrowed in connection with the electricity works.

NUNEATON.—A Local Government Board inquiry was held last week into an application of the Town Council for sanction to borrow £2,500 for cable extensions.

SYDNEY.—On the recommendation of the City Electrical Engineer, the Electric Light Committee have decided to recommend that specifications be prepared for new generating plant, and that application be made for powers to borrow £250,000 for electric lighting purposes. Estimates submitted by the engineer are as follows:—Two 4,000-kw. generators at £22,000, £44,000; one 400-kw. generator, £2,750; one 400 kw. transformer, £450; switchgear (at power-house), £2,480; crane, £850; boilers with superheaters and stokers, five at £2,600, £13,000; pipework, valves, feed pumps, economisers, tanks, &c., £7,230; coal and ash conveyor, £1,900; sub-station motor generators, three at £3,200, £9,600; sub-station switchgear, £1,150; sundries and contingencies, 5 per cent., £4,170; total, £87,580. It is estimated that the buildings, chimney, &c., will cost an additional £47,000.

WATFORD.—The Electrical Engineer has been instructed to obtain tenders for certain buildings and pipe work necessary to complete the scheme of extensions for the winter's load, 1909-1910.

A Local Government Board inquiry was held last week relative to the Council's application to borrow £1,830 for improvements and extensions to their electricity undertaking. There was no opposition.

Miscellaneous

ARGENTINA.—The Government has decided to expend 50,000 pesos (about £4,375) upon the construction of telegraph lines in the province of San Juan.

AUSTRALIA.—A poll of the ratepayers of the city of Prahran (V.), in connection with the proposition to borrow £8,500 for tramway purposes, has resulted in only 665 votes against the proposal on a register of 11,171.

BRADFORD.—The Corporation invite tenders for the supply of stores for the tramways department during the year ending December 31st, 1909, including electric lamps for cars and lamp fittings.

DUNDEE.—Messrs. P. & P. Campbell are introducing electric power into their works, and have communicated with the Town Council with regard to a supply. Should the terms not be satisfactory, special plant will be put down.

GLASGOW.—Metallic filament lamps are to substituted for carbon filament lamps in the various corridors throughout the municipal buildings at a cost of £90.

LEITH.—Tenders are invited for the supply of rails, points and crossings, tie-bars, poles, bonds, and overhead fittings, for about three miles of double track. Particulars from the Borough Surveyor (fee one guinea, returnable), and tenders to the Town Clerk by November 10th.

LONDON: *London County Council.*—Tenders are invited for the supply, delivery, and erection of overhead electrical equipment for the electrification on the overhead trolley system of the Council's tramways from (1) Loughborough Junction to Norwood; (2) Hammersmith to Putney, and (3) Streatham to Norbury. Full particulars from the Clerk, fee £2 (returnable), and tenders by November 10th. (See an advertisement this week.)

NEWCASTLE EMLYN.—A number of flame arc lamps for street lighting purposes are to be purchased.

NEW ZEALAND.—It is stated that electrical machinery to the value of £75,000 will be required to complete the Waipori power scheme.

SWITZERLAND.—The Swiss Government have granted to a preliminary committee, composed of Messrs. Muller, Zeerleder & Gobat, of Zurich and Berne, and the Compagnie Electrique Alioth at Munchenstein, the concession for the construction and working of a narrow gauge (1 metre) overhead electric railway, 60 kilometres long, from Gletsch over Andermatt to Disentis (Furka-Oberalp Railway). Of the 14,000,000 francs (£560,000), the sum which it is estimated is required to carry out the work, 1,483,000 francs (£59,320) are assigned for the purchase of steel rails and like permanent-way material, 1,585,000 francs (£63,400) for rolling stock, and 1,055,000 francs (£42,200) for the erection of buildings.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Music hall, Finsbury Park. Architects, F. Matcham & Co., 9 Warwick Court, W.C.

S.W.—Additions to premises, Chelsea Art Club, 143 and 145 Church Street.

Building for Committee of Homes for Working Girls, Chelsea. Architects, Seth-Smith & Munro, 46 Lincoln's Inn Fields, W.C.

Studio at rear of 13 Kensington Square for Corporation of King's College.

W.—Re-building Harewood House, Hanover Square (£38,000). Joint architects, G. D. Martin, 3 Pall Mall East, W., and D. Blow, 9 King's Bench Walk, E.C.

PROVINCES.

ALTRINCHAM.—Isolation Hospital, Sinderland Road, Dunham Massey. Architect, Wm. Owen, Duchy Chambers, Clarence Street, Manchester.

BARKING.—Factory in River Road for London Butchers' Hide & Skin Co., Ltd., Creeksmith Road, Barking.

BOLTON-UPON-DEARNE.—Chapel (£1,129). Builder, E. E. Dickinson.

BRIGHTON.—Adaption of premises adjoining Montague Place for the Brighton, Hove & Preston United Omnibus Co., Ltd. Architects, Clayton & Black, 10 Prince Albert Street.

BRISTOL.—Additions to premises of General Accident, Fire, and Life Assurance Corporation (£1,320). Architect, W. H. Watkins, 15 Clare Street.

DONCASTER.—Schools for St. Peter's Roman Catholic Church (£3,000). Father A. Leonard.

EASTBOURNE.—Addition to Grand Hotel, Crompton Street. Builder, C. Breach, Matlock Street, Meads.

EAST CLAYDON (BUCKS).—School (130 places) and teachers' home (£1,980). Architect, C. H. Riley, Kingsbury Sub-Office, Aylesbury.

FELLING.—Workmen's Club (£2,250). Architect, H. Miller, Felling.

GLAMORGAN.—School at Hendre (£2,950); school at Abertriotwr (£5,900). County architect, D. Pugh-Jones, Cardiff.

GLASGOW.—Alterations to Hengler's Cirque. Builder, James Orr, East Kilbride.

GOSPORT.—School, Grove Road. Architect, E. J. Trench, Station Chambers, Norwich.

HARROGATE.—Re-building St. Mary's Church and mission room. Architect, A. A. Gibson, 5 Prospect Crescent, Harrogate.

HARROW.—Fifty-two houses, Rosebank and Fernbrook Avenues. Builder, C. H. E. Bridgen.

LLANDRINDOD WELLS.—Fire station. Surveyor, W. A. Millward.

MANCHESTER.—Purchase of Hulme Hall Estate, Plymouth Grove, for new school of domestic economy for Education Committee. Director, J. H. Reynolds.

MATLOCK.—Kursaal at the Fishpond (£8,000 or £10,000). Architects, J. Nuttall, Crown Square, Matlock, and F. W. Ackland Hodge, 101 Gower Street, London, W.C.

PORTSMOUTH.—Proposed nurses' home in connection with Royal Hospital. Architect, C. W. Bevis, Elm Grove Chambers, Southsea.

RUGBY.—Public baths (£4,200). Surveyor, D. G. Macdonald.

STOCKPORT.—High school for girls at Cale Green, for Stockport Corporation (£17,180). Town Clerk, R. Hyde.

WARRINGTON.—Alterations to Garven House for occupation by staff of Health Department. Borough Surveyor, Thos. Longdin, Town Hall.

Additions to works off Wilderspool Causeway. Builders, Fletcher, Russell & Co., Ltd., Palatine Works, Warrington.

New Vestry. Trustees of Holy Trinity Church.

Administrative block at the Sanitary Hospital for the Health Committee of Town Council.

WATFORD.—Additions to Paget Prize Plate Works, St. Alban's Road.

Alterations and additions at Chalk Hill and Sidney Road, for Watford Steam Laundry Co.

WEST HAM.—Additions to Spencer, Chapman & Messel's factory, Silvertown. Builders, G. Munday & Sons, Islay Wharf, Poplar.

Residence, Canning Town, for Women's Settlement (£3,640). Architect, H. Clapham Lander, Effingham House, Arundel Street, Strand, W.C.

WILLENHALL (SOUTH STAFFS.).—School (1,090 places). Secretary, Graham Balfour, County Education Offices, Stafford.

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TENDERS RECEIVED AND ACCEPTED

BELFAST.—The tender of Messrs. Ritchie, Hart & Co., for the supply of cast-iron pillars, and Messrs. Musgrave & Co., Ltd., for wrought-iron rails for the power station, have been accepted.

CARLIN HOW.—The Skinningrove Iron Co., Ltd., have placed a repeat order with Messrs. Ehrhardt & Sehmer (sole British agents, the Key Engineering Co., Ltd.) for another 700 h.p. single tandem gas engine, to be direct coupled to a 500-volt three-phase A.E.G. alternator.

HULL.—The tender of Mr. W. L. Harrison, of Hull, has been accepted for an electric light installation at the Grammar School, now being erected for the school committee.

LONDON: *London County Council.*—Owing to the Council having accepted the offer of the Charing Cross, West End, & City Electricity Supply Co., Ltd., for the supply of electricity for the lighting of the Victoria Embankment and Westminster Bridge for a period of four years, tenders have been received for purchasing the gas-driven generating plant at the Embankment power house, and that of Messrs. I. Levy & Sons, of Old Kent Road, London, at £450, has been accepted.

The following tenders have been received for six fuel economisers at the Greenwich generating station:—J. Carter & Sons, £3,360; Edwin Danks & Co. (Oldbury) (recommended), £3,378; E. Green & Sons, £3,874; Goodbrand & Co., £3,935; Roberts Bros., £3,957; A. Lowcock, £3,960; Clay Cross Co., £3,990.

The Highways Committee recommend, in connection with the joining up of the turbo-generators, boilers, feed pumps, &c., in the second portion of the Greenwich power station to the switchboard, the extension of some existing contracts to include the material now required. It is suggested that the present contracts with the Edison & Swan United Electric Light Co. for the supply of wiring material should be extended, and also an existing contract for switchgear with Messrs. Spagnoletti, Ltd. The cost is estimated at about £500 for wiring material, and £900 for the switchgear.

The Highways Committee recommend that further special trackwork in connection with the Council's tramways shall be obtained from Messrs. Hadfield's Steel Foundry, at a cost of £22,000.

The following tenders have been received for the manufacture, delivery, and erection at the Greenwich power station, of three electrically-driven boiler-feed pumps: Thwaites Bros., £1,851; Pratchett Bros., £1,865; John Cochrane (recommended), £1,892; F. Pearn & Co., £1,981; A. & P. Stevens, £2,164; Electric Construction Co., £2,220; R. Warner & Co., £2,228; Worthington Pump Co., £2,561.

ROTHERHAM.—The Council has accepted the tender of the Sheepsbridge Coal and Iron Co., Ltd., for 5,000 tons of coal for the electricity works at 5s. 4½d. per ton, also the tender of Earl Fitzwilliam for 2,000 tons at 6s. 6d. per ton. The tender of Kelvin and James White, at £181 10s. 6d., for switchboard extension has also been accepted.

SALFORD.—The Council have accepted the tender of G. Harland Bowden & Co., of Glasgow, at £437, for electric light installation at the Halton Bank School.

TWICKENHAM.—The District Council have accepted the tender of Nursey & Marr, at £1,157, for the electric lighting of the new hospital buildings. The tenders ranged from £1,549 to £1,109.

WARRINGTON.—The Council has accepted the tender of the British Westinghouse Co., Ltd., at £37 10s., for new governor gear.

WATFORD.—The Council have accepted the quotation of the National Boiler and General Insurance Co., for the insurance of new superheaters, increasing the total insurance of the boilers and superheaters from £3,600 to £5,000, at a premium of £6 17s. 6d. The tender of the Worthington Pump Co., amounting to £141 10s., has been accepted for an oil separator.

WEST HAM.—The Electric Lighting and Tramways Committee has accepted the tender of Gunn & Co. to supply 10,000 tons of north country small coal, at 9s. 8d., to be delivered between April, 1909, and December, 1909, inclusive (a considerable reduction on the present price per ton), and 10,000 tons of washed peas at 9s. 6d., to be delivered between January and December, 1909.

COMPANIES' MEETINGS AND REPORTS

VICTORIA FALLS POWER CO.—The first ordinary general meeting was held at Salisbury House, London-wall, E.C., on Friday, the Marquis of Winchester, President, in the chair. The Secretary having read the notice convening the meeting, the Chairman said that he thought those who had studied the accounts (given in our issue for October 15th) would believe that during the period which had elapsed since the company was formed they had more than fulfilled the expectations which were held out in the prospectus. Dealing first of all with the accounts, the Marquis of Winchester said that their cash capital was provided by the issue in equal amounts of shares and debentures, and there had now been issued £800,000 five per cent. first mortgage debentures. Only £175,000 of this amount had been issued, being part of the consideration paid to the Rand Central Electric Works, Limited, for the purchase of that company's plant and undertaking in South Africa. The remainder, namely, £625,000, were subscribed for and allotted in July of this year under the arrangement set forth in the prospectus, whereby subscriptions for an issue of £625,000 debentures at 95 per cent. were guaranteed conditionally upon full allotment of the issue of the £625,000 preference shares. Having dealt briefly with some of the items in the balance-sheet, the Chairman said that a most important statement which he was justified in making was that the capital estimates upon which they have worked from the outset had been proved by events to have been correct, and they now knew that upon the original programme of construction there would be a larger margin than was at first anticipated. Summing up their position, he stated that they had firmly established themselves upon the Rand, that they would shortly be delivering electrical power from two large modern plants, of which one was already earning revenue; that the estimates of cost had not been exceeded; that they had entered into satisfactory contracts in regard to coal supplies; that they had large cash balances; and that their affairs in South Africa are in most capable hands. Besides this they had the Falls in reserve. These were a most valuable asset, and in any estimate of the company's position must never be lost sight of.

With regard to the proposed formation of a company to compete with them in the supply of power on the Rand, the Chairman said their attitude was to oppose this by every means in their power. He could not believe, in spite of the positive statements which had been circulated, that either underwriters in the first place, or private investors in the second, would support a competitive scheme of this character. His own company did not propose to surrender any of the position which they had secured upon the Rand without a struggle which, if necessary, would be strenuous and protracted, and from which, if they were compelled to take part in it, he was confident they would ultimately emerge victorious. The promoters of the new project disclaimed any idea of such a struggle as that which he had indicated. They were representing themselves as quiet, peaceable folk, who were only anxious to put up plant to fulfil certain contracts which they had secured. But he could not believe that a company such as it was desired to promote could limit its operations in the manner suggested. He knew that the contracts at present secured for the proposed company had been accepted at very closely-cut prices, and they must assume that it would naturally be anxious to average these contracts with others giving a higher return. This being so, they were bound also to assume that such a company would eventually try to compete in the sale of power throughout the Witwatersrand, and that cut-throat competition must continue until one or other of the competing companies absorbed or destroyed its rival. This had been the history of competition on every other field, and it was not likely that the Witwatersrand would prove an exception. Recognising the evils of such an undesirable state of affairs, they were determined to prevent it on the Rand by every means in their power. Before any revenue could be earned by the proposed company at least two years must elapse, for, unlike themselves, they would not be able to carry on a large business during the construction period. There must be a long period during which the value of shares would probably depreciate seriously.

He proposed that the report and accounts for the year ended December 31st, 1907, be adopted.

Mr. H. Wilson Fox (Vice-President), in seconding the resolution, outlined the company's policy with regard to the development of the Victoria Falls. This, he said, did not differ from that laid down in the prospectus. They wished to turn to profitable account, on a large scale, at the earliest opportunity, that great reservoir of force; but the accomplishment of this object in point of time, and in point of fact, must depend upon circumstances. But they would not be justified in commencing the transmission works unless the profits derived from the sale of power at a distance from the Falls would exceed those which they could make by sales at the Falls themselves. Therefore, for the present they would endeavour to arrange for the establishment of metallurgical and other industries at the Falls themselves. At the same time their desire to transmit power from the Falls to Witwatersrand could not be realised until two conditions were fulfilled. The first was the grant of wayleaves by the Transvaal Government, and the second was the certainty of a continuous market for their power. With regard to the first, there had been

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much obstruction, owing to the misapprehension on the part of those concerned as to the real functions of the company. This he had been at great trouble to dispel during his visit to South Africa last year. Since then he must frankly say that the company had received nothing but the most considerate treatment at the hands of the Transvaal Government, and he thought that they might rest assured that, when in the future, having a sufficient number of customers to justify working from the Falls, they went to the Government on the basis that they could supply cheaper than by steam plant, they would receive assistance which would enable that great enterprise to be carried out. With regard to the second condition, which he had laid down, viz., the market for power, this depended on the relative cost at the Rand of steam-produced power, and water-produced power. When they first embarked upon the undertaking, it was upon the assumption that the cost of generation by steam power was higher than experience had since shown it to be. On the other hand, great advances had also been made in the transmission of electricity over long distances, and it did not appear that the limit of voltage had yet been reached, a circumstance to be set against the fact that the cost of generation by steam was not likely to be greatly reduced. Mr. Mershon, their eminent consulting engineer, was continuing to make investigations on behalf of the company, and whereas at the time of the incorporation of the company 80,000 volts was the highest pressure, he had every reason to believe that in a few years' time transmission at 150,000 volts would be possible. The importance of this statement, on the authority of Mr. Mershon, could not be over-estimated, and it was one which possible competitors on the Rand would do well to consider seriously. He need not remind them that in this era of scientific progress, projects which ignorant critics often dismissed as fantastic had a knack of being realised with almost incredible rapidity, and he felt justified in prophesying that in a comparatively short time transmission from the Falls would be possible at a less capital expenditure than it was now possible to transmit over 150 miles. By that time, possibly, a federated South Africa would have been created, and the days of parochial views would be over.

The report and accounts were then put to the meeting and carried unanimously, no questions being asked.

Mr. A. E. Hadley was re-elected a director of the company.

The auditors having been re-elected, the proceedings closed.

DRAKE & GORHAM.—At the annual meeting on Thursday the report and accounts given in our last issue were adopted. The Chairman stated that before arriving at the net profit of £5,861, liberal sums had been written off for depreciation. There was a considerable addition to stock in hand, mainly owing to the development of their tantalum and osram lamp branches. The rate at which these lamps were replacing carbon filament lamps was remarkable, and he had little doubt that their use would become almost universal, owing to the large saving in current which they effected. The Chairman then gave a long list of the various works which the company had carried out during the year.

EDISON & SWAN UNITED ELECTRIC LIGHT CO.—The report for the year ending June 30th, 1908, states that the sum of £41,312 has been brought forward from profit and loss account. Interest on debenture stocks has absorbed £16,157; £9,000 has been set aside as depreciation on freehold and leasehold property, plant, and tools, and £1,505 has been applied in writing down values of stocks. £5,000 have been added to the reserve fund. The result is a credit balance of £9,649, to which must be added the sum of £9,543, brought forward from the previous year, thus making a total of £19,193, out of which the directors recommend the payment of a dividend for the year on the A shares at the rate of two and a half per cent. (being 2s. 6d. per fully paid A share, and 1s. 6d. per part paid A share), amounting to £9,586, leaving a sum of £9,606 to be carried forward. During the year £9,930 of this company's debenture stocks have been purchased and cancelled, resulting in a profit of £1,822. This amount has been appropriated as an addition to reserve against stock depreciation. There has been expended on capital during the year ending June 30th, 1908, £8,147. The shares of the Altrincham Electric Supply, Ltd., have been taken at par as in previous years. This concern continues to show satisfactory progress, and has paid a dividend at the rate of seven per cent. on its shares for the year ended December 31st, 1907. Its indebtedness to this company has been reduced during the year by £1,219. The manufacture of metal filament lamps has been commenced during the year, and promises to yield satisfactory results. Mr. H. Wolfenden and Sir J. W. Swan, D.Sc., F.R.S., retire in rotation, and offer themselves for re-election. The meeting is to-day.

ELECTROLYTIC ALKALI.—The report for the year ended August 31st shows a net profit of £10,411, increased by the balance from last year to £17,252, after allowing debenture interest, depreciation, renewals, &c. There is three years' dividend due on the preference shares, and the directors propose to pay one year's dividend and carry forward £10,255.

MEXICO TRAMWAYS CO.—The balance-sheet of the Mexico Tramways Co. at December 31st, 1907, says the *Financial Times*, shows the following items:—Debit—issued capital, $6,000,000; five per cent. gold bonds, $7,500,000; bondholders for interest, $126,955; loans, $745,857; creditors and credit balances, $240,065; Compañia de los Ferrocarriles del Distrito Federal de Mexico $650,704; profit and loss account (credit balance), less quarterly dividend of 4 per cent. per annum paid November 1st, 1907, $151,701; total, $15,415,280. Credit—properties, securities and contracts acquired, $13,283,772; mules and horses, $21,660; stock of stores on hand and in transit, $517,608; office furniture and fixtures, $5,311; debtors and debit balances, $226,563; Mexico Electric Tramways, Ltd., $1,286,068; cash, $74,298; total, $15,415,280.

MISCELLANEOUS CITY NOTES

BATH ELECTRIC TRAMWAYS CO.—A circular has been issued owing to the fact that many shareholders are believed to be under a misapprehension with regard to the operation of the tramway system at Bath. Although there has been a falling off in the traffic receipts up to the 7th inst., this has been made up by an almost equal decrease in the working expenses. The net revenue for the forty weeks to date is only £219 less than that for the corresponding period of last year. The circular further points out that the company's application for leave to increase the fares on the Weston route has been granted by the Board of Trade, and that this should add substantially to the net receipts.

BUENOS AYRES TRAMWAYS.—A general meeting of the 6 per cent. debenture holders of the Buenos Ayres Grand National Tramways Co., will be held to-day for the purpose of considering the following resolutions: (1) To authorise the directors to increase the amount of the annual sinking fund in order to provide for the redemption of the conversion debenture stock, by a date not later than March 15th, 1958. (2) To sanction a supplemental trust deed. Similar resolutions will be submitted to a meeting of the 4 per cent. debenture holders of the Buenos Ayres New Tramways Co.

CALCUTTA ELECTRIC SUPPLY CO.—An interim dividend of 6½ per cent. per annum upon the ordinary shares has been declared.

COALFIELDS POWER SYNDICATE.—It is stated in *Commercial Intelligence* that under the prospectus of the Coalfields Power Syndicate, which has been formed by coal-mining interests in India, the capital proposed is Rs.21,00,000, divided into 140,000 shares of Rs.15 each. It is proposed to commence forthwith the erection of two power houses each, containing two 1,000-kw. steam turbo-alternators. It is also stated that tentative arrangements have been made in London to raise the capital for the complete scheme, amounting to about £1,000,000.

COMPANY TO BE STRUCK OFF REGISTER.—Notice is given in the *London Gazette* that the name of the Electrical Engineering Co. of London, Ltd., will be struck off the register in three months' time unless cause is shown to the contrary.

MEXICAN LIGHT & POWER CO.—Dr. F. S. Pearson has resigned from the Board. Dr. Pearson, as the President of the Mexican Tramways Company, was taking up negotiations for leasing the Light and Power Company to the Tramways Company, and terms had been agreed. It is now stated that the Mexican Light and Power Company has decided not to adopt the lease. The *Times* correspondent at Montreal states, on the authority of Mr. Charles Cahan, K.C., resident director and general attorney of the Mexican Light and Power Company, that the company's board of directors were unanimous in declining last Tuesday to approve the scheme for leasing the company's properties to the Mexico Tramways Company. The directors declare that under the terms proposed the interests of the Power Company's bondholders and shareholders were not safeguarded, and the lease, while irrevocable so far as the Power Company was concerned, could be terminated on six months' notice by the Tramways Company. The negotiations, according to Mr. Cahan, developed irreconcilable differences between the two companies, and if the lease had been adopted it would have diverted one-half of the surplus net earnings of the Power Company into the treasury of the Tramways Company, without any return. Mr. Cahan says that the Power Company has no difficulty in obtaining all necessary funds independently of the Tramways Company, that it will be able to pay at least 4 per cent. upon its ordinary stock, and that next year it will show surplus earnings of 8 per cent.

NEW ST. HELENS & DISTRICT TRAMWAYS.—A dividend of 1½ per cent. (1s. 6d. per share), on the preference shares, on account of arrears, has been declared, carrying forward £279.

The Junior Institution of Engineers.—At the annual meeting on Monday, October 19th, it was announced that the Durham Bursary for 1908-9 had been awarded to Mr. L. M. Jockel, of Edinburgh, for a thesis on "Electricity in Mining."

Telegraph Traffic.—The cable between Djedda and Souakim was repaired on the 25th inst. On the 23rd inst. the line between Rome and Constantinople once more gave out, and the line between Rome and Pera followed suit on the 26th inst. The Government cable between Cadiz and Teneriffe is being manufactured, and will be laid and open for traffic probably in November or December.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., quoted on Tuesday night, was £65 to £63 10s. per ton (last week, £61 10s. to £62).

G. M. BODDY & CO.—This firm inform us that they are supplying 50-c.p. 200-volt lamps with a considerably smaller bulb than hitherto. The bulb is not much larger than that of the ordinary low-voltage metal filament lamp.

"BRONSKOL" BRUSHES.—Mr. C. Conradty has purchased the business of the Aktiebolaget Bronskol Co., of Stockholm, and is now in a position to supply "Bronskol" brushes for dynamos very promptly The sole agents for Mr. C. Conradty for this country and the colonies are Sloan Electrical Co., Ltd., of 15 Fore Street Avenue, London, E.C., to whom all communications should be addressed.

THE EDISON & SWAN UNITED ELECTRIC CO., LTD.—This firm informs us that they are now in a position to supply auto-transformers, in standard ranges and voltages, from stock. These transformers have been made entirely at the Ponders End works.

FRANCO-BRITISH EXHIBITION AWARDS.—The International Jury of the Franco-British Exhibition have awarded two Gold Medals to Messrs. Hans Renold, Ltd., for their display of driving chains in the classes, (*a*) apparatus for the transmission of power, and (*b*) machine appliances and accessories.

OLIVER ARC LAMPS.—We are requested to state that the "Oriflamme" lamp is not the only type of flame lamp in use at Dundee, as stated in an advertisement recently through a misapprehension.

PERMANENT MAGNET AND MAGNET STEEL.—A correspondent desires to be placed in communication with makers of permanent magnets and magnet steel of the best quality.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The statement of affairs in the bankruptcy of Messrs. Meldrum Bros., Ltd., shows a deficiency of £114,611. There are at present large contracts in hand, which are being executed. The Official Receiver attributes the failure largely to the lock-up of capital in the Société Meldrum.

Notice of an intended dividend in the bankruptcy of G. H. Smith, electrical engineer, of 15 Ashley Road, Altrincham, is given. The last day for receiving proofs is November 7th. The name of the trustee is J. G. Gibson, Byrom Street, Manchester.

In the bankruptcy of Thomas Ward, late director of the Electrical Instrument Manufacturers, Ltd., 22 Totteridge Road, Enfield Wash, Middlesex, late Freezywater, Waltham Cross, Herts, the accounts filed show unsecured liabilities £1,161, and no assets.

Science Institute for Bombay.—According to the *Times*, Mr. J. Sassoon has offered a sum of £66,660 towards the founding of a science institute in connection with Bombay University. Sir George Clarke has accepted the offer, which, together with the gift of Sir Cowasjee Jehanghir for a like purpose, will enable a start to be made at once.

Electrification of the Bavarian Railways.—According to a British Consular Report, the cost of the electrification of the first three lines to be taken in hand, will be as follows:—Salzburg - Freilassing - Berchtesgaden - Königsee (28 miles), £259,670; Garmisch-Mittenwald-Scharnitz (15 miles), £53,174; Garmisch-Griessen (9¼ miles), £51,166; which gives a total of £364,010. The total length of the railway system south of Munich is about 350 miles, and in all some £2,375,000 will be required for its electrification.

The Journal.—The October number of the *Journal of the Institution of Electrical Engineers* concludes Vol. 41, and contains the following Papers, read at meetings of the Institution and its local sections, together with the discussions thereon:—"The Manufacture of Electrical Condensers," by G. F. Mansbridge; "Switchgear Control Apparatus and Relays for Alternating Current Circuits," by Dr. C. C. Garrard; "Recent Progress in Tungsten Metallic Filament Lamps," by H. Hirst; "Polyphase Induction Motors: The Choice of Type," by G. Stevenson; "The Design and Use of Telephone and Telegraph Cables," by F. Tremain; "The Management of Engineering Workshops," by E. Thomas. In addition to these Papers, all of which have been fully reported in our columns from time to time, the following Papers read before the students' sections are published:—"The Electrification of the Mansfeld Copper Mines," by H. R. Speyer, a Paper founded on an article by the same author, which appeared in ELECTRICAL ENGINEERING, Vol. II., pages 570, 609, &c.; "Electricity and Matter, with some account of Radiations," by L. H. H. Carr, a remarkably clear, non-mathematical *résumé* of modern theory; "The Brown-McKenzie System of Electrical Block Signalling on Railways," by A. Hamilton; "The Motor Converter," by H. W. Gregory. The annual report and the proceedings of the annual general meeting and the special meeting called to sanction the purchase of the new home of the Institution, are also included, together with obituary notices of a number of prominent deceased members.

APPOINTMENTS AND PERSONAL NOTES

The Watford Urban District Council at their last meeting received an application from Mr. W. S. Stafford, station superintendent, for an increase in his salary, which was now £120 per annum, but the Committee reported that they were unable to see their way to alter the scale of salaries at present in force. The Council, however, decided, on the recommendation of the Committee, to add £30 to Mr. Stafford's salary during November, in consideration of the services rendered by him as Acting Chief Engineer prior to the appointment of Mr. Purse.

Mr. L. G. Butler, of 28 Ennis Road, Plumstead, has been appointed by Woolwich Borough Council Junior Charge Engineer, on probation for three months, at a salary of £90 per annum. At the completion of the probation Mr. Butler's salary is to be increased to £100 per annum, rising by annual increments of £10 to £140.

Mr. J. K. North, manager of the late Rossendale Valley Tramway Co., has been engaged by the Bacup Corporation, upon the acquisition of the undertaking, until the system has been converted to electric traction.

The Darwen Town Council have decided to increase the salary of Mr. Joseph Boyce, Assistant Electrical Engineer, from 45s. to 47s. 6d. per week.

The Bristol Corporation require a charge engineer with experience of E.H.T. (three-phase) and H.T. (single-phase), and direct-current systems and large turbine units. (See an advertisement.)

NEW PUBLICATIONS

"Journal of the Institution of Electrical Engineers." October, 1908. (London: E. & F. N. Spon, Ltd.) 5s. net.

Pocket Book of Useful Formulæ and Memoranda. By Sir Guildford L., H. B., and W. Molesworth. 26th edition. (London: E. and F. N. Spon, Ltd.) 5s. net.

Fowler's Mechanics' and Machinists' Pocket Book and Diary, 1909. Edited by W. H. Fowler. (Manchester: Scientific Publishing Co.) 6d. net.

"Dynamo Electric Machinery." By C. E. Ashford, and E. W. Kempson. (Cambridge University Press.) Price 3s. net.

Oxford University: Electrical Laboratory.—The *Times* states that the offer of the Drapers' Company to build for the University a new electrical laboratory at a cost of £22,000, and to expend a further sum of £1,000 on its equipment, has been gratefully accepted by the University authorities.

TENDERS INVITED.

COUNTY OF LONDON.

LONDON COUNTY COUNCIL TRAMWAYS.

THE LONDON COUNTY COUNCIL invites tenders for the supply, delivery, and erection of overhead electrical equipment for the electrification, on the overhead trolley system of traction, of the Council's tramways from (*a*) Loughborough Junction to Norwood, (*b*) Hammersmith to Putney, and (*c*) Streatham to Norbury.

Full particulars and also information as to the conditions to be observed by tenderers will be given in the *London County Council Gazette* of 26th October, 1908, and subsequent issues. The Gazette, which is published weekly, contains particulars of all the tenders invited by the Council, and can be obtained from Messrs. P. S. King and Sons, 2 and 4, Great Smith Street, Westminster, S.W., price 1*d*., post free 1½*d*., an issue, or for the whole year a prepaid subscription of 6*s*. 6*d*.

Tenders must be upon the official forms to be obtained from the Clerk of the Council, at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council, of a sum of £2 for the specification, &c.

This fee will be returned only if a *bona fide* tender shall be submitted. No tender received after 11 a.m. on Tuesday, 10th November, 1908, will be considered.

The Council does not bind itself to accept the lowest or any tender, and it will not accept the tender of any person or firm who shall on any previous occasion have withdrawn a tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall,
Spring Gardens, S.W.
22nd October, 1908.

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Supplement to "Electrical Engineering" of Oct. 29, 1908.

THE MANCHESTER ELECTRICAL EXHIBITION OF 1908

PART V.

Published by

THE PROPRIETORS OF "ELECTRICAL ENGINEERING," 203-206 TEMPLE CHAMBERS, LONDON, E.C.

AND ALSO ON SALE AT STAND NO. 189, ELECTRICAL EXHIBITION, MANCHESTER.

PRICE ONE PENNY.

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Metal Filament Lamps.

THE "METALIK"

THE BEST 200-250 VOLT LAMP

Please write for particulars of the SPECIAL DISCOUNTS we have arranged for CORPORATIONS and the TRADE.

Messrs. G. M. BODDY & Co.,
Newington Works, LIVERPOOL. *June 23rd, 1908.*

Dear Sirs,

Answering your last letter we can tell you that the lamp No. 3 is now burning **3,170** hours and is still in good condition (sloping position, alternating current, 220 volts). As we have not made any photometric test on this lamp we cannot say exactly how many per cent. the candle power decreased, but we do not think it is much.

We remain, dear Sirs,
Yours truly,
.....*Manager, Electricity Works.*

The originals of the following letters are in the hands of the Editor of "ELECTRICAL ENGINEERING."

Messrs. G. M. Boddy & Co.,
Liverpool. *June 6th*, 1908.

Dear Sirs,

In reply to your letter of the 4th inst., we beg to inform you that we tested three "METALIK" lamps 220 volt, 50 c.p. in a sloping position burning with alternating current. These lamps were burning continually without switching in and out more than about once every 100 hours. The life of the first lamp was 970 hours, of the second 1,856 hours, while the **third lamp is already burning 2,775 hours,** and is *still in good condition.* The light of the lamps is not materially less than as they were new. The blackening of these lamps is practically so slight that we may say there is no blackening.

Electricity Offices .....
Messrs. G. M. Boddy & Co., *March 9th*, 1908.
Liverpool.

Dear Sirs,

Some time ago we had two samples 50 c.p. "METALIK" Lamps from you for testing purposes. These lamps have an average life of 1,407 hours, and would have run longer had not the filaments become shorted by twisting.

We shall be glad to have your best price for the supply and delivery carriage paid at our.....Stores of "METALIK" lamps in the 32 c.p. size suitable for series burning on a 230 volt direct current circuit.

Yours faithfully,
.....*City Electrical Engineer.*

Corporation Electricity Works,
Messrs. G. M. Boddy & Co., ..., *May 28th*, 1908.
Liverpool.

Dear Sirs,

In reply to yours of the 27th inst., so far your "METALIK" lamps have been burning very satisfactorily and shall be obliged if you will **quote me your best price for 100 lamps, as we shall probably be wanting some more before long.** Yours faithfully,
.....*City Electrical Engineer.*

Hundreds of Testimonials received from Leading Authorities.

Price H.V. 6/- L.V. 4/-

We are in the POSITION to OFFER YOU the MOST FAVOURABLE TERMS, and SATISFACTION IS GUARANTEED.

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G. M. BODDY & Co.,
ESTABLISHED 1893.
Newington Works, LIVERPOOL.
Telephone: 2558 Royal. **Telegrams: "Filament."**

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SHEFFIELD.
Telephone: 3911

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THE

MANCHESTER ELECTRICAL EXHIBITION

OF

1908

FIFTH NOTICE

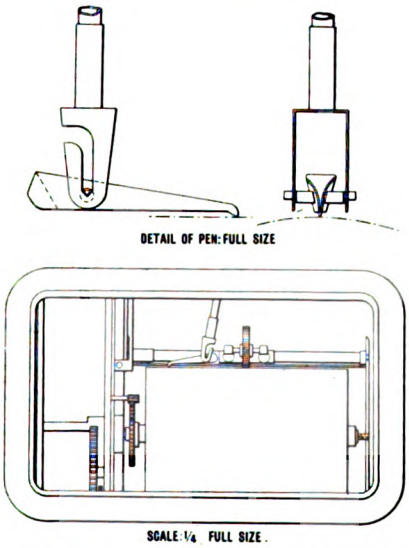
A GOOD test of the effectiveness of the emergency lighting arrangements at the Exhibition was afforded on Saturday last. At 6.45 the sub-station was suddenly switched off from a cause which is explained in a note in the body of the paper this week, but the emergency lighting circuits (supplying 22 lamps for general illumination), which are left permanently connected to a small gas-driven set on Messrs. Crossley Bros.' stand, remained alight. Although the Exhibition was very full, there was no panic of any sort and no confusion among the visitors. The sub-station was entirely switched in again in 8½ minutes and the supply restored.

We give below descriptions of a number of exhibits which have not yet been described in our previous Supplements:—

Eversheds & Vignoles, Ltd.,

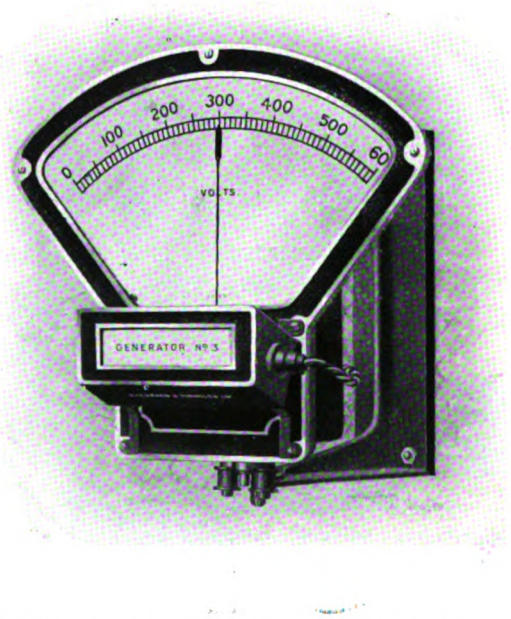
ACTON LANE WORKS, CHISWICK. (STAND NO. 226.)

Instruments.—This firm's exhibit is on the stand of Messrs. G. A. Steinthal & Boydell, Ltd., their Manchester agents. One of the new instruments on view is the Murday recording instrument, which is made either as a voltmeter or ammeter. Our illustrations show an elevation of the paper roll and pen as seen through the window, and also the detail of the pen itself, and it is seen that the interesting feature is that the pen travels on the top of the roll parallel to its axis, so that the chart has straight instead of curved lines. The Murday patent covers the construction of a form of pen which presents several novel features. Its inking mechanism is analogous to a drawing pen carried on knife edges at the extremity of the index, with an



Elevation of Paper Chart and Pen, as seen through Window.

axle perpendicular to the plane of motion. The chart, which is of the "continuous-roll" type, passes from one spool up over a driving wheel of special construction, and down to the receiving spool on which the record is wound. As already stated, the pen works on the horizontal surface of the paper formed at the summit of the driving wheel, and since its motion is in a straight line, and not an arc of a circle as usual, the time lines on the chart are also straight lines, and the record has thus rectangular co-ordinates. The pen can be slipped out in a moment, cleaned instantly in the same manner as a drawing pen, and reinserted—the whole operation being completed in a few seconds. The friction on the paper, we are informed, is uniform and very small. The contact does not depend on the level of the instrument, and cannot be disturbed by vibration; and the record is thus perfectly uniform. This movement is combined with an Evershed moving coil indicating mechanism



Evershed's Sector Moving Coil Voltmeter, showing Method of Illumination.

of peculiarly robust character, the forces being made very large by a very powerful field and large moving coil. The whole mechanism is enclosed in a cast-iron case of strong construction, easily opened, yet watertight when closed. The usual glass window allows of the inspection, both of the position of the index and the past record. Simple means are provided for the removal of the record when required; and the operation of inserting new paper rolls is very easily effected. The whole design is characterised by strength and simplicity. The shunts used with the instrument have only 0·25 volt drop, and a new construction (due to Mr. Vignoles, who has applied for a patent) renders them very small for the load they carry.

Our other illustration shows the firm's sector-shaped illuminated dial voltmeter. It is lighted from the exterior; the lamp is placed in the box in the front of the instrument, the inner surface of which reflects the light upon the scale. The window in the front of the box, bearing the name of the generator or feeder, is also illuminated by the lamp.

Ferranti, Ltd.,

HOLLINWOOD, LANCS. (STAND NOS. 80 & 102.)

Switchgear.—We have already described and illustrated in our issue of October 1st the two fine switchboards which have been supplied by Ferranti, Ltd., for the Exhibition sub-station. Adjoining the sub-station the firm has a stand on which other specimens of well-designed and equally well-finished switchgear are exhibited. Among these is a power and lighting switchboard destined for the firm's own works at Hollinwood. A switch to which much attention is given is a mechanically-operated oil switch for heavy currents. In the case of heavy mechanically-operated switches, there is always a trouble in synchronising, owing to the time necessarily taken in pulling over

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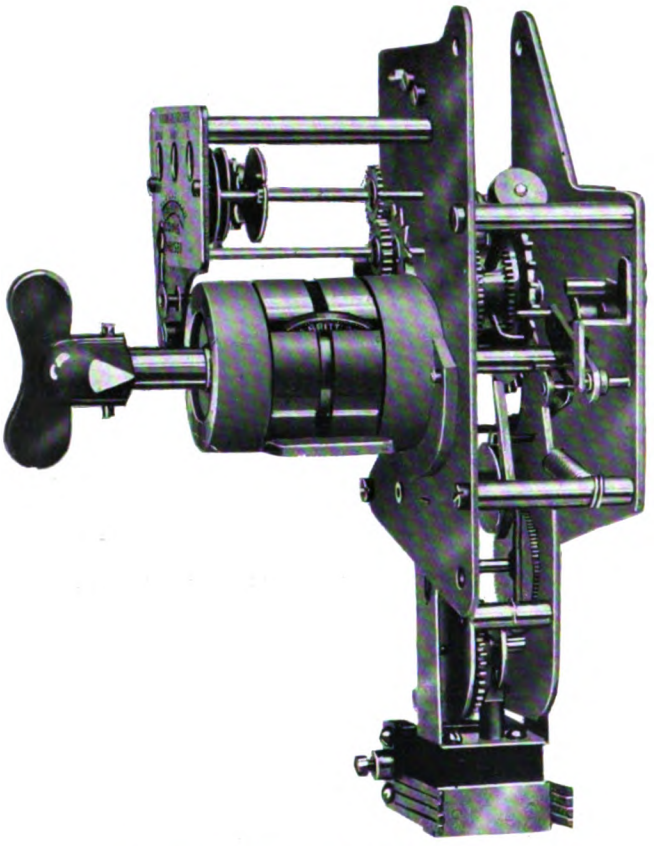
the heavily-loaded lever, and perfect synchronising is thus rendered difficult. This is overcome by giving the switch a "half-cock" position. The lever is of the railway signal-lever type, and is locked when pulled into the half-cock position. It is released to enable the switch to be pulled right over by depressing a pedal with the foot, so that the machine can only be switched in deliberately, and when switching on to the half-cock position the attendant cannot overstep the mark. Switching off is done by a tripping lever underneath the handle of the switch. In the case of the firm's electrically-operated remote control switch for synchronising, a hand-wheel is turned against a spring controller with the "make-ready" position, and is locked there by a catch. On being released by a button being pressed the spring rotates a contact drum, which closes the circuit of the operating solenoid for a definite short period (about two seconds) and then opens it. This is, therefore, the equivalent of a free-handle device, preventing the possibility of the switch being held on against a short circuit. Other exhibits are an isolating switch interlocked with the main switch, and a circuit breaker with two tripping coils, one acting instantaneously at over 500 per cent. overload, and the other working in conjunction with a time-limit relay for smaller overloads.

Meters.—Ferranti meters of all patterns are shown in sections, so that the complete method of working can be followed out. A



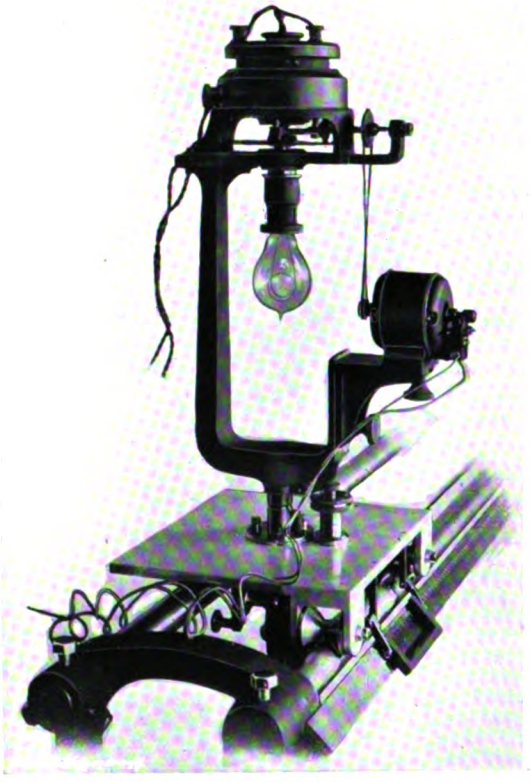
Ferranti Prepayment Meter Mechanism.

new meter is the Ferranti prepayment meter. It is one of the firm's standard type, fitted with the additional prepayment mechanism, which we illustrate. The insertion of the necessary coin in the slot enables the handle to engage with the switch lever, and, on turning the handle, current is switched on by the switch at the bottom and at the same time moves a ratchet-wheel one tooth onwards. This wheel is at one side of a differential gear, the other side of which is connected to the meter train, and on the small wheel of the differential is a weight. The weight is therefore lifted. When the weight reaches its original position again through the rotation of the meter through a predetermined amount (for the ratchet-wheel is now held and the middle wheel of the differential rotates back with the meter) it bears on a lever which releases the switch. An important point is that the switching-off puts no load on the meter, as the lever does not act directly on the catch which holds the switch on, but through gearing. Any number of pennies up to twelve may be inserted consecutively, and the weight is lifted up a corresponding number of teeth. Although difficult to describe in black and white, the action is very simple and also very certain.

Alexander Wright & Co., Ltd.,

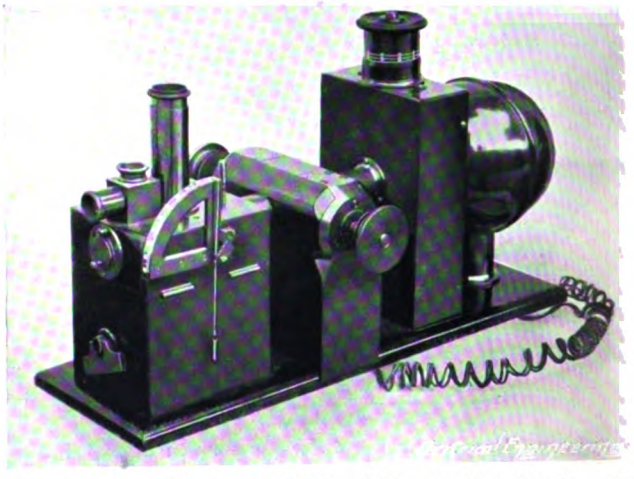
1 Westminster Palace Gardens, Artillery Row, Victoria Street, London, S.W. (Stand Nos. 199 & 202.)

CO_2 Recorders.—In the Simmance-Abady CO_2 recorder, which is exhibited in action, a charge of flue gas is drawn into a bell by a syphonic action from 15 to 25 times an hour (a period



Paterson Lamp Rotator.

which can be regulated at the will of the user). By means of an open tube which is drawn in and out of an adjustable sealing vessel, which seals a vent from the gas bell, a definite amount of gas is imprisoned. This is bubbled through a caustic potash solution which absorbs the CO_2, and causes a small moving bell to rise proportionately to the amount ab-



Direct-reading Portable "Flicker" Illumination Photometer.

sorbed. A flat brass-plate is attached to the top of this second bell, and a few seconds after it has risen, an arm attached to a pen is released by a float mechanism in connection with the syphon arrangement, and a stroke is made on a travelling strip of paper. The height of this stroke is proportional to the CO_2 absorbed. A feature of the instrument is that an interval is allowed between the raising of the bell and the movement of the pen, and this permits the heat of chemical combination

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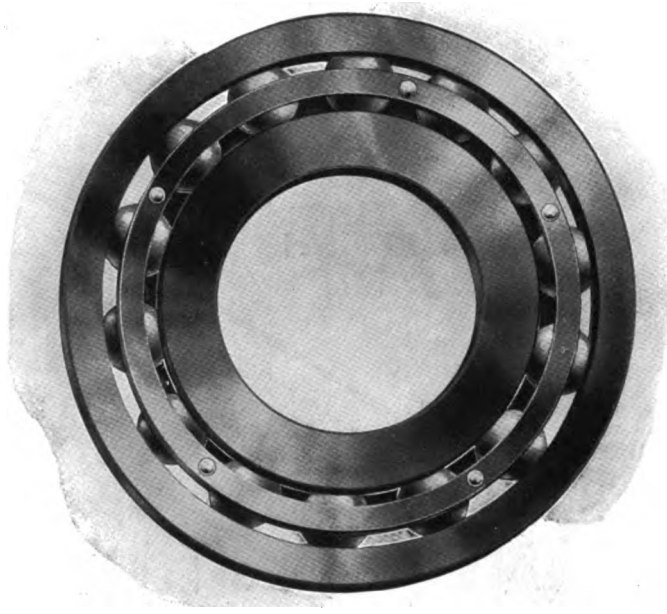
BALL BEARINGS

The Finest in the World.



Manchester Electrical Exhibition,

Stand No. 126/165

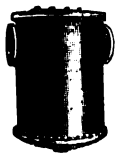
HOFFMANN MANUFACTURING CO., Ltd.,

Telegraphic Address: "Hoffmann," Chelmsford. **CHELMSFORD, ESSEX.** **Telephone: 21, Chelmsford.**

HOLDEN & BROOKE LTD.

"Parallel Flow" Oil Separators.
(Brooke's Patent.)

Highest Efficiency.
See List 127 E.

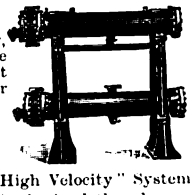


Without loss of Vacuum.

For freeing from oil or grease exhaust or other steam, as when condensing.

"High Velocity" Feed Water Heaters.
(Brooke's Patent.)

Heating Feed Water, &c., by Live or Exhaust Steam, or (as illustrated) by both.

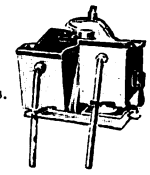


Feed Water brought up to practically *Boiler Temperature* itself.

By our "High Velocity" System far greater heat is obtained than by any other.
See List 156 E.

Leinert's Liquid Meters.
(Patent.)

Free from Complications.



Action and all parts visible.
See List 144 E.

Automatically measure and record (by actual weight) Water, Oils, and other Liquids. Accuracy not affected by changes in temperature and specific gravity of liquids dealt with.

Automatic Vacuum Dischargers.

See List 72 E.

For automatically draining and discharging water or other liquids from any Chamber under Vacuum, such as Oil Separators, Exhaust Steam Pipes, &c.

Steam Dryers.
(Brooke's Patent.)

See List 140 E.

No rivets.
No leaky seams.

The *only ones really reliable* with *high pressures* and *superheated steam*

Injectors.

See List 137 E.

For all pressures and for *Hot Water*. Started and regulated by *one movement*.

Steam Traps.
(H. & B's Improved.)

See List 126 E.

Renewable Valve Seat.
Automatic Self-Grinding Valve.

Steady working with definite intermittent discharges.

Also Manufacturers of: PUMPS, COMPRESSORS, "PROTECTED SEAT" VALVES, EXHAUST HEADS, WATER LIFTERS, EJECTOR HEATERS, SIRIUS TRAPS, INJECTORS FOR ALL PURPOSES, &c., &c.

Sirius Works, West Gorton, MANCHESTER.

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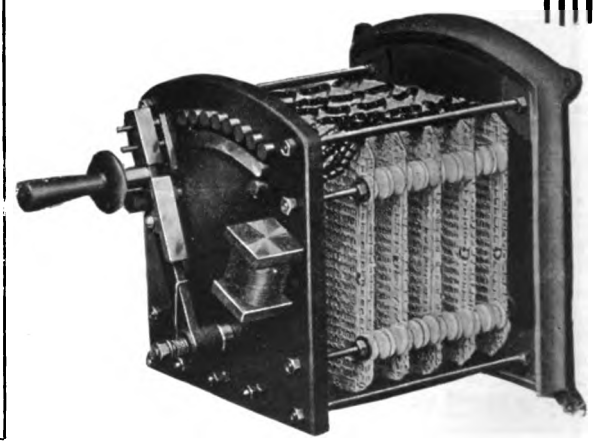
ILLUSTRATION SHOWS

MOTOR STARTER

fitted with

"SCHNIEWINDT" Resistance NETS.



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C. SCHNIEWINDT, NEUENRADE, WESTPHALIA, GERMANY.

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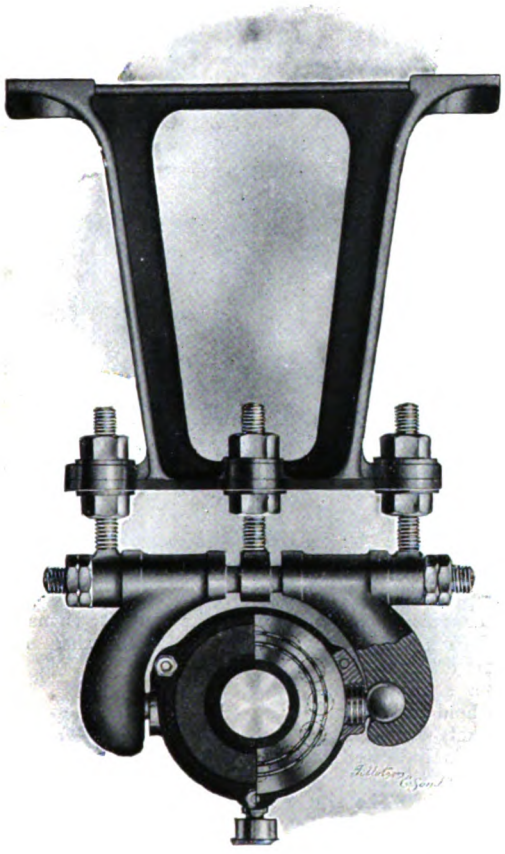
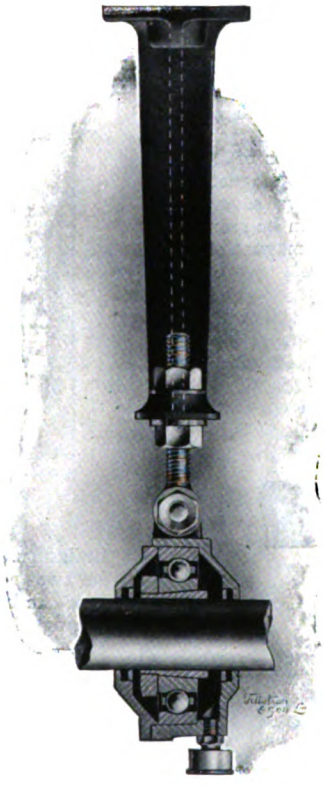
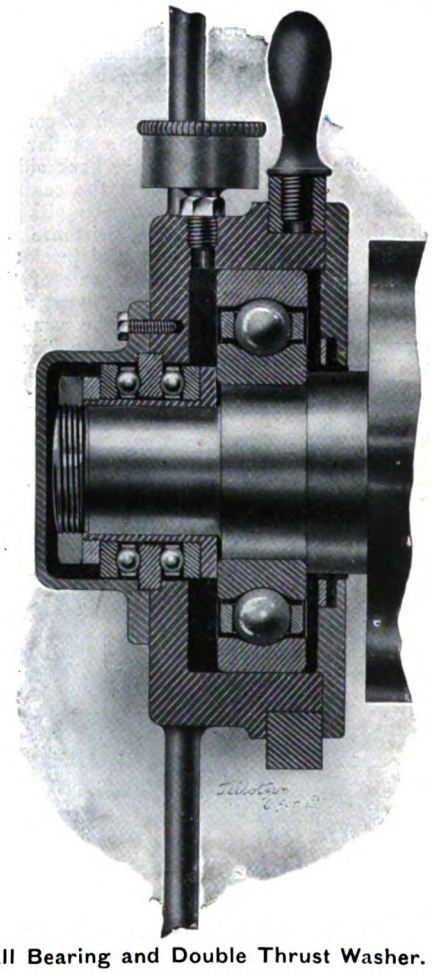
to disperse and incidentally also causes as long a contact with the caustic potash as possible. The caustic potash need only be changed six times a year. Mention should also be made of the extremely ingenious and simple continuous paper feed.

Photometers.—The largest exhibit on the stand is a facsimile of the large photometer bench supplied to the National Physical Laboratory, with a lamp rotator, designed by Mr. C. C. Paterson, of the N.P.L. The latter is of the mercury-bath type, and is designed to revolve lamps (which are suspended vertically) at a speed from 30 to 400 r.p.m. Contact is made by amalgamated copper-collecting rings revolving in a mercury cup in the casting seen at the top of the illustration. The drive from the top pulley to the lamp spindle is by friction, and the speed is adjusted by altering the position of the friction pulley. The motor can be run from cells at from four to six volts. In the direct-reading portable "flicker" photometer, illustrated, the standard is a 15 mm. square of illuminated surface coated with barium sulphate. By a mechanical micrometer movement scaled into 300 equal parts the illuminated surface can be partially obscured, so that a standard of light can be obtained varying in small steps by 0·003 of a candle foot. A small metal-filament lamp is employed to illuminate this surface, and the voltage is regulated by a rheostat, so that the light of 3-ft. candles is obtained with the screen fully opened, and by adjusting the micrometer movement until balance on the "flicker" disc is obtained, the illuminating effect in foot candles is read off direct without any calculation. The firm is also showing draught indicators, and also pressure and vacuum recorders fitted with the simple system of paper feed already referred to.



Swivelling Shafting Hanger with Ball Bearings.





Ball Bearing and Double Thrust Washer.

The Hoffmann Manufacturing Co., Ltd.

CHELMSFORD, ESSEX. (STAND NOS. 126 AND 165.)

Ball Bearings.—A very effective exhibit, illustrating the various patterns of ball bearings manufactured by this firm, and their application to different types of electrical machinery, has been arranged. Pumps, fans, polishing spindles, electrically-driven and fitted with ball bearings, are to be seen; and a length of shafting fitted with Mair's patent swivelling hanger is also exhibited. The objects and advantages of this shafting hanger, which we illustrate, were fully described in our issue of October 8th last, in connection with the installation at Messrs. W. H. Smith & Sons' bookbinding works at Letchworth Garden City. Our other illustration is that of a ball-bearing and double-thrust washer for medium-sized electric motors. The view shown is of the commutator end, as is evidenced by the brush-rocker. The double-thrust washer holds the shaft endways, and the outer races of the journal bearings are allowed to slide in their housings, so that they can arrange themselves exactly opposite the inner ball races which are fixed to the shaft. For small motors under 10 b.h.p. thrust bearings need not be provided, but then one outer race must be fixed so as to fix the shaft endways. A little grease should be occasionally forced into such bearings as these, and if this is done, it should, with the leather dust-washers shown in the illustration, prevent the access of all dust and moisture to the bearing. A very small starting effort is required when ball bearings are used; this is strikingly demonstrated by the "Stiction" apparatus shown on the stand. Three hard steel spindles are running in steel, gun-metal, and ball bearings respectively, and when a certain load is put on the spindles, it is almost impossible to rotate any spindle but that with the ball bearings. The large G.E.C. "Witton" machine at the Exhibition sub-station is fitted with Hoffmann ball bearings.

Elliott Brothers,

CENTURY WORKS, LEWISHAM, S.E. (STAND NO. 85.)

Instruments.—A very representative selection of switchboard instruments is shown under working conditions, in conjunction with the exhibit of switchgear by Messrs. Eckstein, Heap & Co., the Manchester agents of this firm. Among these are several sector and edgewise type instruments with illuminated dials. The alternating-current instruments are of the dynamometer pattern, but with two coils instead of three. In the ordinary dynamometer, the moving coil swings inside the fixed coils; but in these instruments the moving coil swings outside the fixed coil, which is in the form of a ball. The torque is increased owing to the better arrangement of the coils, and this allows of stronger controlling springs being used, with a coil of relatively low weight and inertia. Portable ammeters, with Campbell's device for compensating for temperature, and recording instruments are exhibited. These latter comprise three separate parts—the case, the clock mechanism, and the electrical

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movement—and any one part can be quickly replaced if damaged. Among the recording instruments exhibited is one fitted with a tell-tale device for ensuring that readings are taken continuously throughout a certain period, as, for instance, during the night. A new pen for marking recorder charts is also shown. Various forms of the firm's well-known testing sets are exhibited, including a mains-testing set, a fault-localising bridge, and a rail-bond testing set. The Elliott speedometer is shown working, but the action of this instrument, which indicates both speed and distance travelled, is purely mechanical.

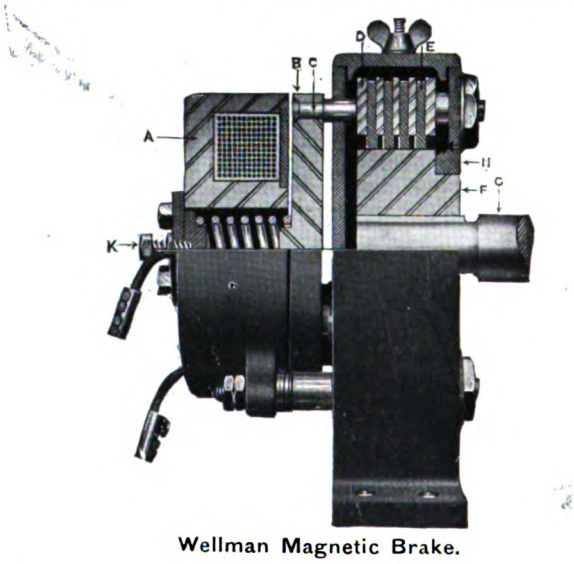
D. C. Bate,

40 Brazennose Street, Manchester. (Stand No. 284.)

Two or three firms are represented by D. C. Bate in Manchester, and exhibits of these firms' specialities are to be seen on this stand, together with a general exhibit by D. C. Bate. The exhibit of Messrs. Mawdsley's, Ltd., one of the firms mentioned, was described on page 17 of the supplement.

Motor Controllers.—A representative collection of "Dinkey" motor starters and controllers is shown by Messrs. Wellman-Seaver & Head, of 47 Victoria Street, London, S.W. The steel contact arm of this pattern of controller is provided with a series coil at its centre, and a similar steel arm is fitted to a projection of the spindle on the back side of the contact board. A strong blow-out field across the contacts is obtained in this manner. The resistances may be either of the grid or coil pattern; the latter consist of resistance wire wound on an iron tube, and embedded in a special insulating material, which is a good conductor of heat. In some of the patterns of starters the resistance coils are arranged to act as blow-out magnet coils.

Wellman Magnetic Brake.—The same firm have several examples of the "Wellman" brake on view. As can be seen from the illustration which we give, this consists of a magnet coil, *A*,



Wellman Magnetic Brake.

an armature plate, *B*, the studs, *C*, which transmit the pressure exerted by the spring to the friction plates, *D* and *E*, and a hub *F*, to which the friction plates, *E*, are keyed. The plates, *E*, are free to move longitudinally. The hub *F* is keyed to the end of the motor spindle *G*. *H* is an oil slinger, and *K* an adjusting screw. The brake works as follows:—With the motor at rest, no current passes through the coils, and the studs, *C*, press the friction plates together. On switching on the current the plate *B* is attracted to the magnet, and the friction plates are released. The revolving discs dip into oil at the bottom of the case, and keep the whole flooded with oil. This prevents jarring and sticking of the brake.

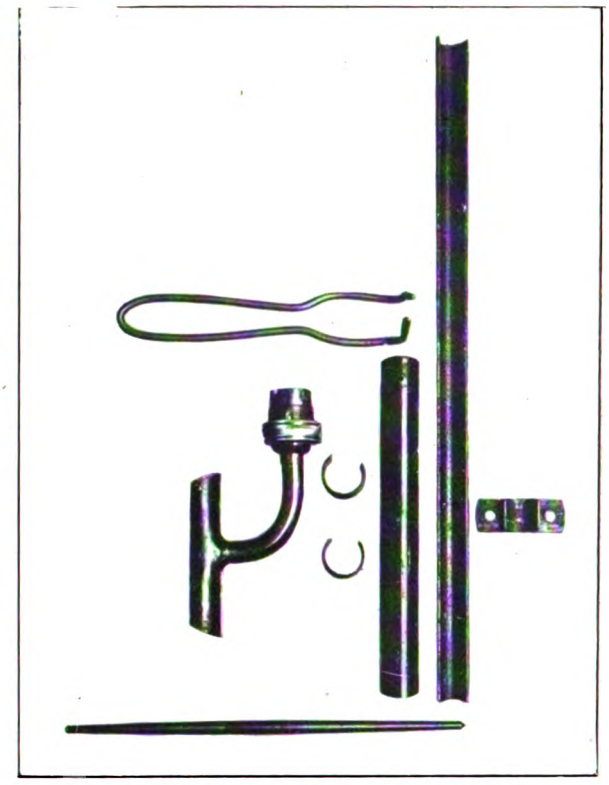
Nodon Electric Valves.—A battery of these electrolytic rectifiers is shown working, and a small continuous-current motor is being run with the rectified current from the alternating-current supply.

Schniewindt Woven Resistances.—A selection of the asbestos woven wire resistances manufactured by C. Schniewindt, of Neuenrade, Westphalia, is exhibited. Some controllers, motor starters, and other pieces of apparatus in which these woven resistances are used are shown; and bare wire-woven nets and strips for heavy currents are also exhibited.

Lift Equipment.—A complete lift equipment, with push-button control, is shown in operation; the load is obtained by means of a "Wellman" brake attached to the spindle of the lift motor, which is of the Mawdsley "Zone" pattern. The feature of the controller in use with this equipment is that the arm of the solenoid starting switch only completes relay circuits, the main current being controlled by a series of solenoid operated switches. The lift is provided with a floor contact, which renders all the push buttons inoperative when the lift is occupied.

Key Spring Conduit Demonstrations.

We referred briefly in our Exhibition Supplement of October 15th to the new "Key Spring Conduit" for surface-wiring in



Conduits and Fittings unassembled.

buildings. The conduit tube, which forms the conduit, is made in two portions, each slightly over a semicircle, so that one half can be sprung over the other. Spring clips on a similar system are employed to hold up the conduit against brackets on the wall. The arrangement is indicated in one of the two illustrations which we now publish. The two halves of the conduit are marked 3; 5 is the bracket for fixing the conduit to the walls; the springs, 2, clip the conduit to these brackets; 4 is a bracket lamp constructed to spring on the conduit; 1 is a key for removing the fittings from the conduit; and 6 a tool for removing the cover from the lower half of the conduit. To show the ease and rapidity with which the conduit can be assembled, timed demonstrations are given at the stand (No. 281) of the Key Engineering Co., Ltd. A switch, bracket lamp, three-light ceiling fitting, pendant fitting, and 20 ft. of conduit are erected in less than 2½ minutes.

Conduits and Fittings assembled.

Jas. E. Lea.

28 Deansgate, Manchester. (Stand No. 179.)

Steam or Water Recorders.—One of these recorders is shown in operation, indicating the rate of flow of a liquid, and recording the quantity which has passed during any interval of time. The recorders are used in many central stations to determine the steam consumption of generating plant by measuring either the feed-

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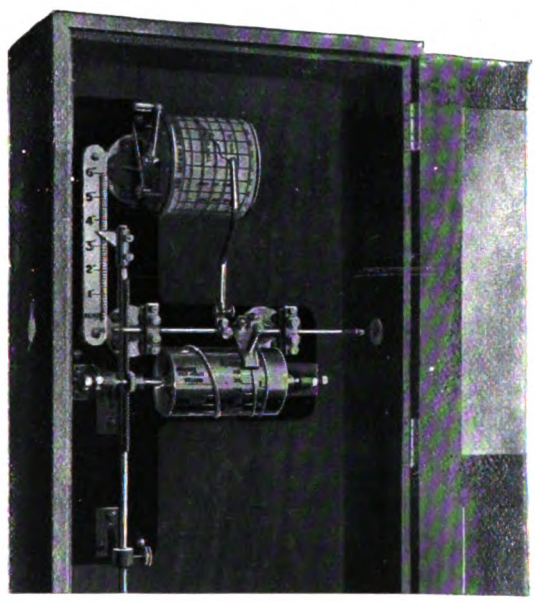
water or the condensed steam. The principle of the instrument is the fact that the rate of flow of water through a V notch can be accurately determined if the height of the water level above the apex of the notch is known. This last can be determined by a float. The accompanying illustration shows a standard 6 in. recorder. To the float is attached a spindle, which passes through the bottom of the instrument case. Upon this float spindle is a rack which gears into a small pinion upon the axis of a drum. Upon the body of this drum is a screw thread, the contour of which is the "curve of flow" for the V notch, in connection with which the instrument is used; and, just as the flow through a notch increases rapidly with the depth, so the pitch of the screw increases in the same proportion. Above this spiral drum is a horizontal slider bar, carrying an arm, at the upper end of which is a pen or pencil point, in contact with a chart paper upon a clock-driven recording drum, which, as a rule, revolves once in 24 hours. As the float rises, the spiral drum is rotated, and its motion is imparted to the slider bar and pen arm by means of a saddle arm projecting from the latter, and engaging at its lower end with the screw thread. On the body of the spiral drum is a graduated scale, adjacent to the screw thread, and marked out in pounds per hour. Thus



Standard "Lea" 6 in. Recorder.

the actual depth of water in the notch, the rate of flow in pounds per hour, or the total quantity passed, can be quickly determined. For the last measurement the area of the rate of flow diagram is measured. When applied to an electric generating plant, the steam consumption per kw. hour can be determined at once by comparing the rate of flow of condensed steam with the watt-meter reading.

Worthington Pump Co., Ltd.,

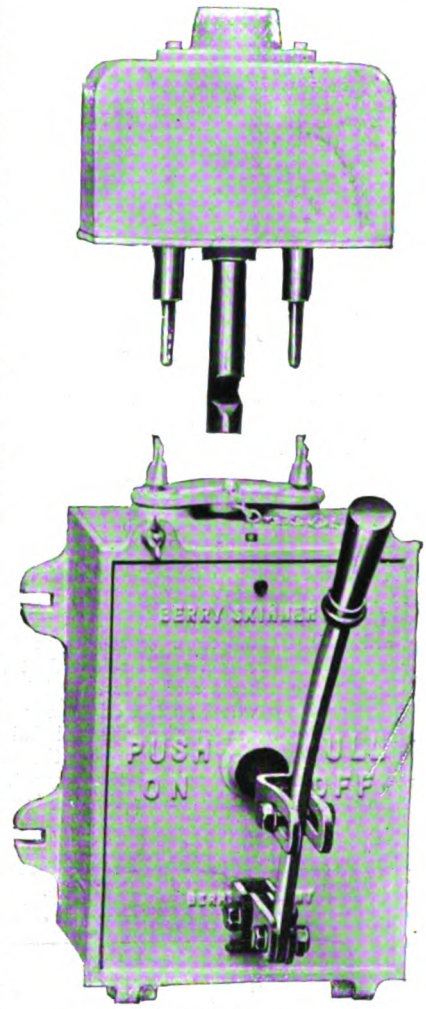
Newark-on-Trent. (Stand No. 158.)

Pumps.—The principal exhibit is a three-stage high-lift centrifugal pump, directly coupled through a flexible coupling to a Lancashire Dynamo Co. motor. The two machines are on a common bed-plate. The pump is designed to lift 600 gallons per hour against 300 ft. head, and it is shown running under actual working conditions. Its speed is 1,200 r.p.m. No special foundation has been provided, and yet the pump runs quite smoothly. The peculiarity of the design is that there are no guide vanes at all, these being rendered unnecessary by the construction of the casting. This reduction in parts is, of course, a great gain, especially for mining work, &c., and it also means economy in first cost. A small centrifugal two-stage pump for country houses, &c., is shown, coupled to a 1-h.p. motor, to lift 1,000 gallons per hour against 100 ft. head, and is intended for lifting water to a supply tank at the top of the house. The rest of the exhibits are Worthington standard low lift and medium lift pumps, and there is also a triplex single-acting pump.

Berry, Skinner & Co.,

78 Upper Thames Street, London, E.C. (Stand Nos. 188A & 216A.)

Switchgear.—Before describing this firm's exhibit, it is worthy of mention that every stand in the Exhibition is fitted with the firm's well-known pattern of push and pull fool-proof switch. In all some ten tons of this pattern of switchgear is in use in the Exhibition. Perhaps the most interesting novelty on the stand is the new patent combined switch, fuse, and detachable plug, which we illustrate below. This ingenious device conforms with the requirements of the mining regulations of the Home Office, and is especially suitable for use in mines. The plug can only be withdrawn when the switch is open, and cannot be inserted when the switch is closed. The apparatus is said to be flame-tight and water-tight. Other examples of the firm's standard switch and fuse boxes are shown. The chief feature of these push and pull switches is that both a rapid make and a rapid break are obtained, and that it is impossible to make circuit by merely closing the cover.



Combined Switch, Fuses and Detachable Plug.

Lamps and Meters.—Several examples of the new "Float" miners' and portable lamps are also shown. It will be remembered that these lamps are fitted with cells hermetically sealed, that there is no switch, and that to bring the elements into contact with the electrolyte, the cell is merely reversed. A repeater fuse-box (Denny's patent) is exhibited on this stand; this enables a circuit to be re-fused five times by merely turning a handle. The electrolytic prepayment meter manufactured by the Electrical Apparatus Co., Ltd., of Caxton House, Westminster, London, is also to be seen here. We described the working of this meter on page 140 of our issue of July 23rd last.

Ice-Making and Refrigerating Plant.—A complete ice-making plant, made by G. J. Worssom & Son, is shown working continuously. This is of the type in which liquid CO_2 is evaporated within a coil of piping surrounded by brine. The brine, which is cooled to several degrees below the freezing point of water, is used to make ice, and is also circulated by means of a small pump through pipes situated under the shelves of cold-storage rooms. The compressor for liquefying the CO_2, and the pump for circulating the brine, are driven by a small electric motor.

Taylor, Tunnicliffe, & Co., Ltd.,

Eastwood, Hanley, Staffs. (Stand No. 63.)

Insulators.—An interesting exhibit on this firm's stand is a combined pot-head and insulator for leading in telegraph wires. The lead-covered wire is brought up inside the first insulator, shown on the left of the illustration, through a hole in the top into a separate compartment, which is filled up solid with insulating material when the connection has been made. One of the wires of the pair is taken through the hole in the porcelain to the aerial wire, in the manner shown in the right-hand insulator, and the second wire is joined to another lead-covered cable, which goes up to the second insulator, and is led up in the same way. This firm also shows a specimen and drawing of the insulator used for the electrified section of the Midland Railway (Electrical Engineering, June 11th, 1908, p. 885), and a large collection of strong insulators for wireless

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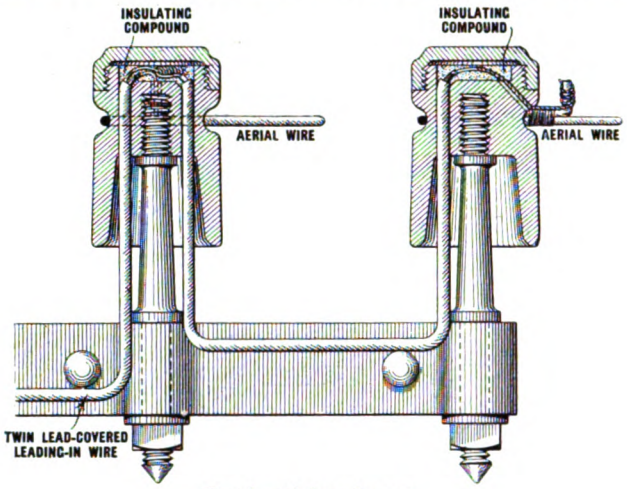
telegraphy, as well as a very large collection of porcelain holders for fuse carriers and many other purposes. Among them is one of the porcelain fuse holders used on the main



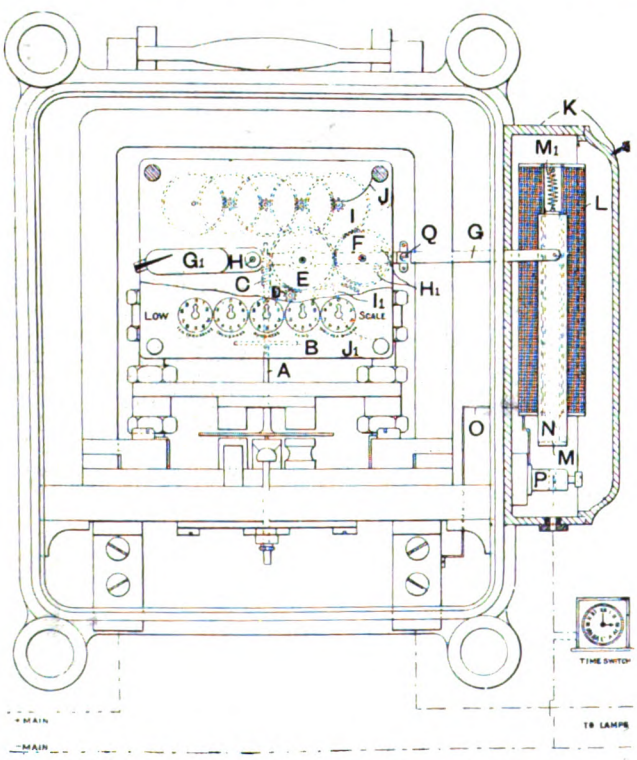
Pot-head Insulators.

distributing frames of some of the most recent Post Office exchanges; one of these was illustrated in our issue of November 14th, 1907.

Chamberlain & Hookham, Ltd.,

Solar Works, 4 New Bartholomew Street, Birmingham. (Stand Nos. 195 & 206.)

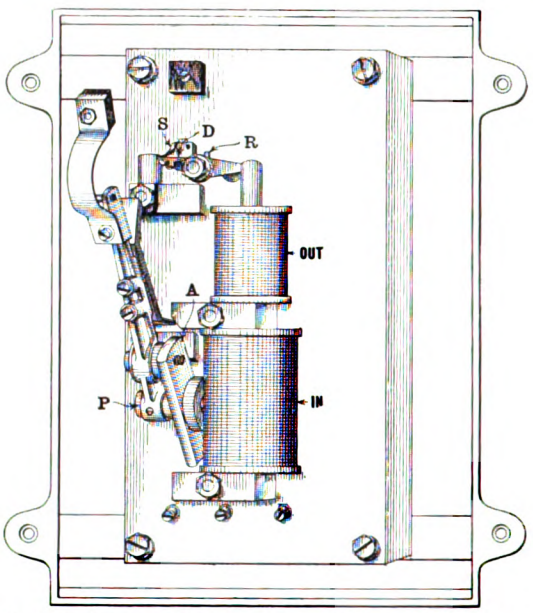
Meters and Time Switches.—Several types of meter are shown here for the first time. One of the most interesting of these is the Lackie demand meter, which is made as an attachment to an ordinary Chamberlain & Hookham meter at only a small extra cost. There is a small solenoid at the side of the meter, which lifts up a beam and puts the pinion carried by this beam into gear with a wheel on the one-hundredth unit spindle of the counter. The beam carries a small balance-weight, which is made to travel along the beam by the rotation of this pinion until it balances the pull of the magnet. The balance weight carries a pointer which marks the maximum demand in amperes



Chamberlain and Hookham Two-rate Meter.

on a scale beneath it. The most ingenious part of the device is an arrangement for giving the meter a time lag, so that the maximum currents are not recorded immediately. The usual lag is about 20 minutes, although this can be adjusted to any amount, and by this means short circuits, &c., do not prejudice the record of the maximum demand part of the meter. This is effected as follows:—Instead of the pinion gearing directly with the balance weight, it causes an endless thread to travel along the length of the beam, and on this thread is a small blob. It takes a certain time for this thread to travel round and for the blob to engage with the balance weight, and as soon as the beam balances, the thread is drawn back to its original position by a small hanging weight.

The firm's new electrolytic meter is exhibited, the action of which is as follows:—The electrolyte is shunted to a resistance in the main circuit, the drop of pressure in which at full load is 0·9 of a volt. The electrolyte of the meter is dilute sulphuric acid, which is sealed in a glass vessel together with two platinum electrodes coated with platinum black. The anode projects to some extent out of the electrolyte into an atmosphere of hydrogen, which is absorbed by the platinum black. When an electric current is passed through this vessel, the hydrogen absorbed by the anode combines with the oxygen which would otherwise be produced there, while an equal amount of hydrogen is deposited at the cathode. The deposited hydrogen rises into a vertical tube having a scale behind it, upon which its volume



Switch for working in conjunction with Venner Time-Switch.

is measured. This, of course, is proportional to the ampere-hours, and the scale is graduated to show Board of Trade units at the supply voltage. When the measuring tube has become nearly filled with hydrogen (corresponding to, say, 300 Board of Trade units), the meter reader tilts it forward, and the meter is thus again started at zero. A new "Midget" type of this meter is being placed on the market for from 1½ to 3 amperes. It is a very cheap form, and is intended for very small installations, and also for fixing at the back of radiators or other portable apparatus. On the stand is one of these small meters, through which several thousand times the normal current is passed to show that it will stand short-circuits without damage.

The Chamberlain & Hookham prepayment meter has been considerably modified, and the new design is exhibited. When a shilling is put in and the handle turned, a fairly heavy ball is raised and dropped into a beam with a V-shaped section. The weight of this ball overcomes the weight of a counterpoise and pulls the beam up, closing a switch and thus connecting up the circuit. At the same time a small star wheel which projects through a slit in the beam is put into gear with the counting train of the meter in its initial position. This wheel prevents the ball from rolling right to the end of the beam, but the wheel gradually rotates, corresponding to the shilling's-worth of energy registered by the meter, and when it has made a quarter revolution the ball passes it and drops over the end of the beam back into a trough beneath ready to be used again. Seven of these balls are provided with the meter, so that 7s. worth of electrical energy can be prepaid. The meter is also made for pennies instead of shillings.

A large proportion of Messrs. Chamberlain & Hookham meters are made with cyclometer counters instead of clock dials, and these counters can be adjusted to zero without difficulty.

A simple two-rate meter is shown connected to a Venner time-

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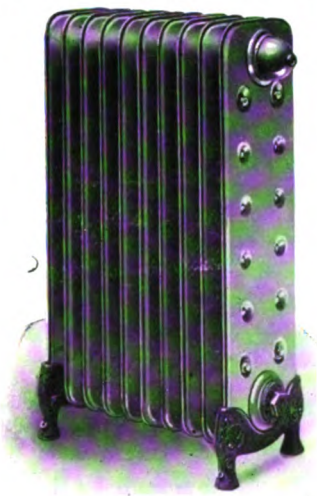

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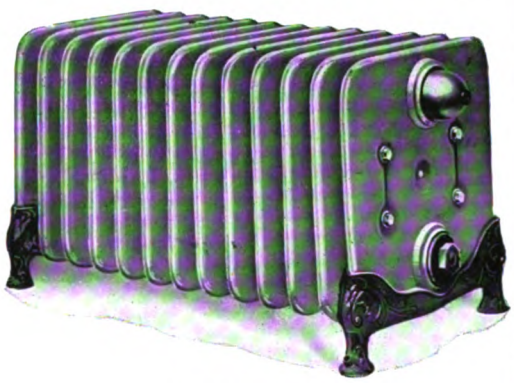

THREE COLUMN.

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MANCHESTER ELECTRICAL EXHIBITION.

STAND No. 281

(Centre of Avenue A.)

DEMONSTRATIONS

AT

4 P.M., 6 P.M., AND 8 P.M.

EACH EVENING

OF

RAPID WIRING

WITH

KEY SPRING CONDUIT

A complete installation consisting of switch, bracket lamp, 3 light ceiling fitting, pendant fitting, and twenty feet of steel conduit with right angle bend will be erected, connected up, and current switched on

IN LESS THAN 3 MINUTES FROM START TO FINISH.

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switch. When the switch acts, a beam carrying an idle wheel is lifted or lowered, so that the meter spindle is connected up by this means to one or other of its counting trains. The arrangement is clearly seen in our illustration.

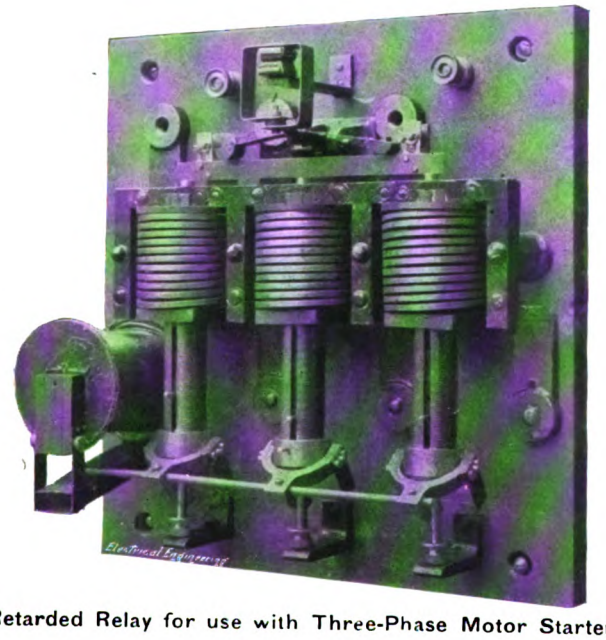
A modification of the Venner time-switch is also shown for use on arc-lighting circuits, when half the lamps have to be switched off at midnight, and the arrangement of the switch is such that a different half is switched off on alternate nights, so that all the lamps can be trimmed simultaneously. The figure opposite shows the construction of the latest type of main switch constructed to work with the Venner time-switch for similar purposes to this. The drawing represents a switch suitable for circuits from 30 to 150 amperes, and is approximately to scale. The two electromagnets "in" and "out" are connected to the circuits by the contact in the time-switch itself. When the electro-magnet marked "In" is excited, its armature *A*, which is pivoted at *P*, is rotated until it lies parallel with the axis of the bobbin. As the switch is also pivoted at *P*, this action, which is of course very rapid, throws the switch in, the latter being caught and held by detent *D*, which is controlled by spring *S*. When the "Out" solenoid is excited, the movement of its core, acting through the toggle piece pivoted at *R*, pulls up the detent and releases the switch, which is thrown out by the springs carrying the carbon contacts on which the final break is made. The switch is of the brush pattern, and is under compression when on, to ensure good contact. On the larger sizes an auxiliary copper sparking strip is fitted in addition to the carbon contact.

Credenda Conduits.—Specimens of Credenda conduit made by the Credenda Conduit Co. for house wiring are also exhibited at this stand. To show the extreme flexibility of the enamel, some half-inch conduit is shown rolled up into a coil with four turns of about 10 in. diameter, and the enamel is quite perfect and not cracked. Sharp elbows are now made of the actual tubing.

Eckstein, Heap & Co.

Salford, Manchester. (Stand No. 84.)

Switchgear.—A very substantial and effectively-arranged exhibit of continuous- and alternating-current switchgear is to be seen on this firm's stand. The chief feature of the large circuit breakers, which are of the loose handle type, is the large space allowed between the contacts when the switch is open. This



Retarded Relay for use with Three-Phase Motor Starters.

combined with the quick-break effect prevents the continuance of an arc, and a magnetic blow-out accelerates its extinction. The handle is connected to the arm by means of a toggle joint. The knuckle of the toggle joint is on its dead centre when the switch is closed. This is broken and the switch opened, when the pin of the knuckle is raised by the overload plunger. Several examples of the firm's pattern of knife switch, which has the larger half of the blade rigidly fixed to the handle, and a renewable quick-break contact piece, are exhibited. A number of large fuses, each of which consists of a number of 100 ampere unit fuses, are shown, and a representative collection of oil break switches is also to be seen. One of the most interesting items on the stand is the three-phase motor-starting switch unit, fitted with a patent retarded relay. The object of the retarded relay, an illustration of which we give, is to protect the motor at starting as well as under normal conditions. The three-series coils are put in the three phases of the stator respectively, and the plungers are set to operate at, say, 25 per cent. overload. These close a relay circuit and open the main switch in the usual manner. On the starting contacts the auxiliary magnet shown on the left is put in circuit. This rocks the lever and causes the springs to grip the buttons at the bases of the plungers. In order that the plungers may be lifted when gripped by these springs, a current of about five times the normal is required.

Aron Electricity Meter, Ltd.,

30A Salusbury Road, Kilburn, N.W. (Stand No. 131.)

Meters, Clocks, &c.—One of the chief items of this firm's exhibit is the 5,000-ampere portable meter, which has been designed and constructed to the requirements of the Manchester Corporation. As in the other patterns of portable meters, the pendulums are spring controlled, and the meter does not depend upon accurate fixing for accuracy of reading. Several examples of the firm's electrically-wound clocks are exhibited, and also their system of electrically-controlled clocks. In this system the master clock sends current impulses alternately in opposite directions. The controlled clocks have a mechanism which operates with a current in either direction, but two successive operations cannot be produced by current in the same direction. This prevents several successive movements of the minute hand due to an uncertain contact in the master clock. A self-contained double tariff meter, consisting of a single meter mechanism, two counting trains, and a clock switch, is exhibited. The clock switch changes over the counting mechanism at the beginning and the end of the high rate period. Meters are shown with an attachment for indicating the maximum demand. In order that this shall not indicate momentary demands, every few minutes a wheel is coupled to the meter mechanism for a definite time. This wheel moves round a certain angle which depends upon the average speed, and therefore the average demand during that period. The wheel carries round an index hand, which remains at the maximum position. Among the other novelties exhibited are prepayment meters for both alternating- and continuous-current circuits.

F. V. Brown & Co.,

3 Cross Street, Manchester. (Stand Nos. 34 & 35.)

T. H. & J. Daniels, Ltd., who are represented by the above firm in Manchester, exhibit a suction gas plant working with anthracite coke, and driving a 12 b.h.p. engine, to which is connected, by a belt drive, a dynamo for supplying light and power to the stand. This firm also exhibit a vertical three-throw belt-driven high-speed pump, capable of supplying 2,700 gallons of water per hour to a head of 150 ft. A horizontal sewage pump, also belt-driven, and with a capacity of 6,000 gallons per hour, is to be seen on the stand.

Sanders, Rehders & Co., Ltd., also represented by Messrs. F. V. Brown & Co., show a number of "Sarco" specialities, which include CO_2 recorders, and draught and pressure recorders. A new gas volume recorder for gas plants, for recording the actual volume of gas used by the engine, and suitable for use with hot and dusty gas, is also shown. Feed-water meters, steam meters, feed-water analysers, and calorimeters for fuel testing are also exhibited.

Arthur Ross, Hotchkiss & Co., Ltd.—The "Hotchkiss" automatic circulator for boilers is represented by a glass working model, which demonstrates the speed of circulation and the blowing out of oil, grease, and mud. Samples of mud and scale removed from boilers while at work by means of this circulator are also shown.

Cutler, Wardle & Co., Ltd., St. Peter's Square, Manchester. (Stand No. 265.)—The "Streetlite" lamp shown on this stand is a pleasing design of lantern for street lighting, intended particularly to take tantalum lamps. It consists of a heavy metal top, finished in black enamel, or alternatively oxidised, or in bright copper, and a round disc is fitted at the bottom of this covering the whole of the opening, immediately above the glass globe. A $\frac{3}{8}$-inch iron tube is screwed into the disc, and passes upwards through the top of the lantern, so that the disc takes the whole of the weight of the lamp. It also carries the holders in a vertical position, and acts as a reflector. The upper portion of the globe is opaque to a depth of three inches. This globe completely surrounds the lamp, but at the bottom there is a $1\frac{1}{2}$-inch hole, and four vents are made in the disc above referred to, corresponding to smaller vent holes in the metal top. This affords good ventilation through the lantern, and keeps it cool.

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These lamps are also in some cases fitted with a vibration absorber, consisting of a helical spring arrangement at the bottom of the iron tube above referred to. Another interesting exhibit of this firm is a collection of metal-covered porcelain ceiling roses, &c., for which we understand a patent has been applied. The porcelain has a permanent coating of metal upon it, so that the fittings have the advantage of being metal-covered without the disadvantage of the metal covers being separate.

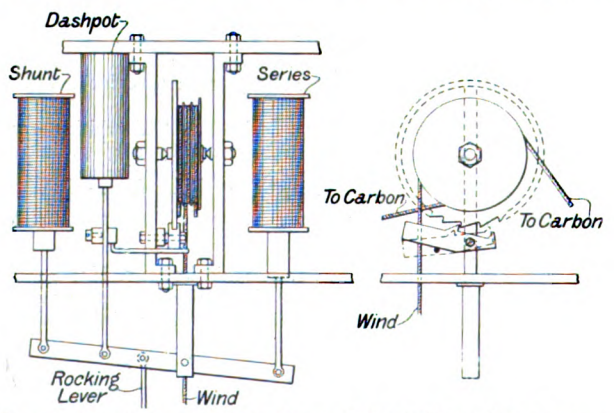
General Electric Co., Ltd., 71 Queen Victoria Street, London, E.C.—*Model Home Kitchen.*—A demonstration of the Archer system of electric cooking is being given in the kitchen attached to Messrs. Goodall's Model Home. The outfit consists of a 1,500 watt oven and auxiliary apparatus comprising saucepans, frying-pans, hot plates, kettles, &c. The oven can be heated up to a temperature hot enough for baking purposes in 20 minutes. The auxiliary utensils are connected to the oven by plugs and metal-covered flexible leads. Among the other electric kitchen fittings shown are electric irons, a boiler, a boot and silver polishing machine, and an electric knife cleaner.

Matthews & Yates, Ltd., Cyclone Works, Swinton, Manchester. (Stand No. 109.)—*Fans and Blowers.*—A large selection of electric fans for both alternating- and continuous-current are shown. The single-phase motors are of the induction type with a squirrel-cage rotor, and are provided with a special starting winding. Among the patterns of blowers exhibited is a new type especially designed for use with forges and cupolas, and similar cases where a small volume of air at a high pressure is required. A modified form of this type is used for exhausting gas in conjunction with gas-producing plants; in this form the inlet and outlet are fitted with drilled flanges to facilitate the attachment of gas pipes, and a gun-metal stuffing box is fixed to the side of the casing where the shaft passes through, so as to prevent the escape of gas. A fan of this type, directly coupled to an electric motor, is shown working on the stand. A complete pneumatic collecting plant is shown in operation. This consists of a system of piping, an electrically-driven blower, and a receiving box, and can be used for the transmission or removal of chips, shavings, dust, or grain.

Ebonestos Manufacturing Co., 127 Pomeroy Street, Old Kent Road, London, S.E. (Stand No. 197.)—A great variety of moulded "ebonestos" insulators, including switch handles, bushes, tube ends, and bases for switches, &c., are exhibited. Terminal connection pieces in which the terminals and nuts are moulded into position are also shown. These moulded parts are remarkably clean, and some fine specimens of moulded screw thread are to be seen.

John Swain & Son, Ltd., 58 Farringdon Street, London, E.C. (Stand No. 274.)—This firm's exhibit consists of a large number of photo-engravings and monochrome, two-colour, and three-colour process illustrations suitable for engineering catalogues.

The Abbey Electric Co., 17 Victoria Street, Westminster, London, S.W. (Stand No. 204.) *Flame Arc Lamps.*—Examples of the new "Abbey" flame arc lamps are exhibited. Five of these can be burnt on a 210-volt circuit, owing to the pressure across the arc having a maximum variation of only three volts.



Sketch illustrating the Working of the "Abbey" Arc Lamp.

This close regulation is obtained by a remarkably simple mechanism. The carbons are fed by gravity, and are hung by cords which pass over a drum to which is attached a large toothed wheel. As shown in the accompanying illustration, the double-toothed catch is so controlled by the shunt and series coils, that the wheel is allowed to slip one tooth at certain intervals. The rocking lever shown above is connected to the rocking carbon, and keeps the length of the arc constant. The base plate and economiser are cast in one piece of malleable iron. There is no magnetic field to control the arc.

James Howden & Co., Ltd., 105 Scotland Street, Glasgow. (Stand No. 69.)—*High Speed Engines.*—A triple expansion engine capable of developing 250 b.h.p. at 450 r.p.m. is exhibited. This engine has forced lubrication, and all the working parts are enclosed so as to prevent dirt or grit from entering the wearing surfaces. A small two-crank compound engine with cylinders side by side and a piston valve driven by a single eccentric in between is also shown. This engine develops 60 b.h.p. at a speed of 600 r.p.m.

Supplies, Ltd., Prescot, near Liverpool. (Stand No. 138.)—This firm shows a collection of radiators, each of which has a self-contained meter. In this way the radiator can be attached to any socket in the house, and the consumption charged at power rates, in cases where the supply authority agrees to accept the reading of such meters.

Premier Electric Lamp Co., Ltd.—Huyton Quarry, Near Liverpool. (Stand No. 224.) *Lamps.*—This firm exhibits 100-volt 43-watt metal filament lamps which, they inform us, have been made in England. The efficiency is 1·2 watts per British candle. The lamps are shown burning in every position.

The Howard Asphalt Troughing Co., Ltd.—Trafford Park, Manchester. (Stand No. 229.)—A number of sections of this firm's cable troughing, arranged so as to show the various stages in the work of laying mains on this system, are exhibited. These sections, made of natural rock asphalt, are supplied in lengths of 4 ft. They are welded by heating the ends and pressing them together. After the cables are laid in the troughing, bitumen is poured over them, and the trough is then filled with asphaltic concrete. The flexibility of the system is demonstrated by samples of troughing shown coiled in complete circles, and other samples passed under and over drain pipes.

Wm. Batty & Sons, Ltd.—7 & 9 Market Street, Manchester. (Stand No. 294.)—Examples of electrically-driven clocks (Perret's system) are shown. In this system the master clock is automatically wound every minute, and in the same action the current is distributed to the secondary clocks. An installation with the mechanism exposed is shown at the stand. Non-magnetic watches are also exhibited.

R. O'Brien & Co., 5 Bazennose Street, Manchester. (Stand No. 141.)—*Lamps, Dry Cells, &c.*—This firm are agents for the E.M.F. metal-filament lamp, of which they show several specimens displayed in various ways. One of the features of this lamp is a wire leading from the pip of the bulb to the bottom of the stem supporting the filaments, in order to increase the rigidity of the group of filaments and to prevent vibration. There are various sizes for voltages from 25 to 250, and the stated efficiency is one watt per candle at low voltages, and 1¼ at high voltages. Another exhibit is a dry cell made under Scek's patent, which has a very low internal resistance. The makers claim that when partially exhausted it can be repolarised by charging it with one-fifth of an ampere from the lighting mains through a lamp for one or two hours. Several small motor-driven devices are shown, including a revolving platform for shop windows or show cases, a label-pasting machine, and an electric sign.

J. & H. Grevener, Eldon Street House, London, E.C. (Stand No. 210.)—*Arc Lamps.*—Several examples of the "Arcoflame" flame arc lamps for both continuous- and alternating-current circuits are exhibited. The smallest of these is a 4½ amp. continuous lamp, which can be obtained for 10 or 16 hours' burning life. Some small enclosed arc lamps taking 3, 4, and 5 amps., and burning 25 hours on one trimming, are also shown. Other lamps with 65 and 180 hours' burning life are shown. The single burning lamps are series wound, but those for series lighting are of the differential type. A large number of accessories are shown, including a new pattern of automatic coupling, which has only recently been developed. This always finds the contacts, as by a cam arrangement the contacts are turned round to the right position as the two portions of the coupling approach one another. The mechanism is very simple, and the release certain.

The Gilbert Arc Lamp Co., Ltd.—Chingford, Essex.

The Electric Control, Ltd.—Glasgow.

The Premier Electric Control, Ltd.—Red Lion Street, Clerkenwell, London.

These three firms are exhibiting at Stand Nos. 135 and 159, with Messrs. Parmiter, Hope & Sugden, their agents for Lancashire and Yorkshire. By an oversight their exhibits were described in our last issue under the heading of Parmiter, Hope & Sugden, instead of each firm having a separate heading.

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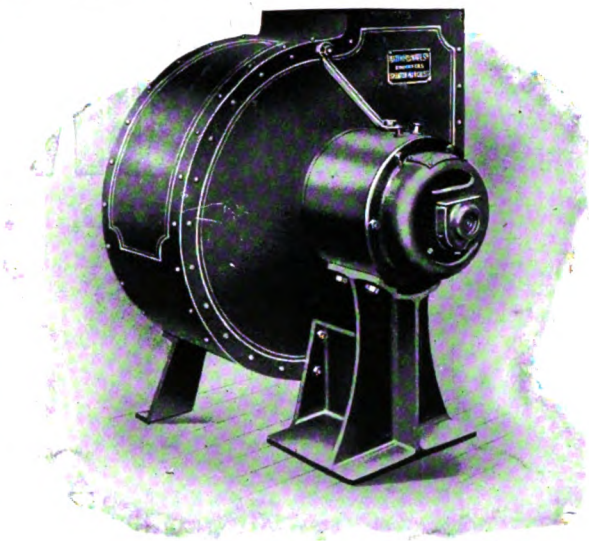

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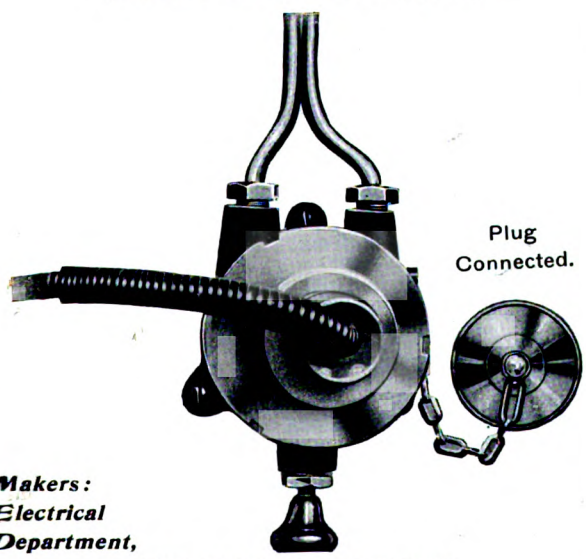

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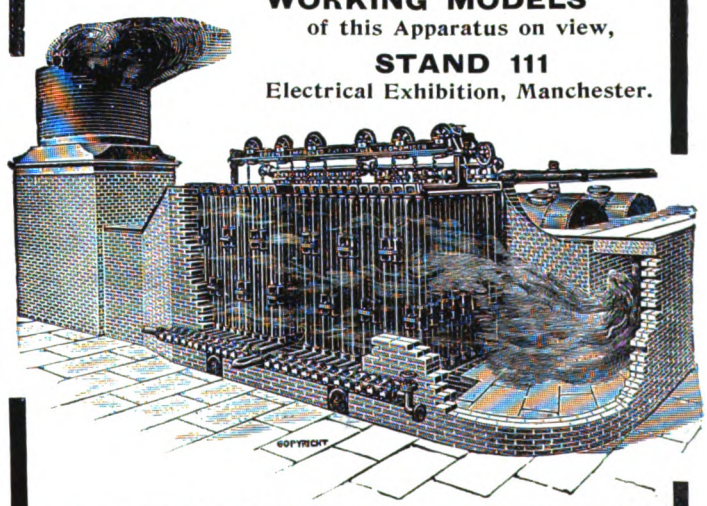

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Oct. 22nd, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

17,532, **Surface-contact Traction System.** E. A. Mitchell. In this system the pivoted switch arm is attached to an iron armature immediately under the head of the stud. This is drawn up by a magnetic skate so arranged that the flux passes in through one section of the stud and out through another. The switch opens by gravity alone, and when in the off position the arm rests against an earthed contact and earths the stud. The switch-box is filled with an oil of greater density than water, and the stud head, with all the switch parts attached thereto, can be withdrawn easily for inspection. In order to facilitate this, the connections to the live cable and the earthing conductor are made through mercury cups. Nine claims, two figures.

22,203, **Lift Control.** British Thomson-Houston Co. (*Allgemeine Elektricitats-Ges.*). In lift installations employing series- or compound-wound motors, the connections are so arranged that in the downward power positions of the controller a starting resistance and the main are connected in series to the line, and one terminal of the armature is connected to the line and field, while the other terminal is connected to varying points of the starting resistance through which the live current flows for the purpose of limiting the downward speed of the lift at starting. One claim, four figures.

24,027, **Arc Lamp.** D. Timar and K. von Dreger. This arc lamp has parallel downward pointing carbons, separated by rollers of insulating material placed sufficiently close together to allow only the conical tip of the carbons to project, so that feeding is by gravity alone. The patent does not cover any method of striking the arc. Two claims, one figure.

27,224, **Electrolytic Lightning Arrester.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). This relates to the construction of electrolytic condensers, consisting of a plurality of nested dishes with a suitable electrolyte in between them. Instead of single aluminium dishes exposed to the electrolyte on both sides, double aluminium cones are employed separated by an impenetrable insulating layer, but connected at the edges. This is in order to avoid the short-circuiting effect of the small holes which sometimes appear in the plate, due to local action. Three claims, one figure.

1908 Patents

461, **Lamp Filament Supports.** C. H. Stearn and C. F. Topham. In order to prevent a tendency for the filaments to twist laterally from the position in which they are mounted whilst allowing them to move freely in a longitudinal direction under the influence of heating and cooling, the support is made in the form of a spring flattened in a plane transverse to the length of the filament, and provided with a flat hook or loop to engage the filament. Two claims, two figures.

12,352, **Radiators.** C. N. Nobbs, C. G. Nobbs, and J. E. Rosenthal. In the radiators described in this specification, the resistance consists of bare wire interwoven with strips of asbestos or other material, and immersed in oil contained in the closed metallic body of the radiator. The wire is so arranged that parts between which there is great potential difference are kept well apart. The leading-in wires are brought through insulating bushes above the level of the oil. Five claims, two figures.

18,331, **Regenerative Braking for Single-phase Motors.** W. Cooper. In this control system, single-phase commutator motors are arranged for regenerative braking by connecting them, so that one machine acts as exciter to the other, while the armature of the second machine is connected to the main auto-transformer. The field of the exciting machine is also fed from the autotransformer. Means are provided for adjusting the phase of the regenerated current to agree with that of the E.M.F. of the supply current. Two claims, six figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

5,560, Stewart. Working of rail points, plough guides, and cable grip guides.

17,719, Chitty, Lange, & Mascord. Distribution of electromotive power.

19,612, Fett. Central alarm and telephone apparatus.

19,882, British Thomson-Houston Co. & Clough. Dynamo-electric machines.

21,861, Rosenbaum. Switchboard cable connector.

22,036, Lake (*Michaud & Delasson*). Filaments for illuminating and heating purposes.

22,311, Cowper-Coles. Electro-deposition of iron.

22,312, Cowper-Coles. Manufacture of iron articles by electro-deposition.

22,478, Martin. Composition applicable for use for the purpose of damping, transmitting, or reproducing mechanical vibrations, and, if desired, translating them into electrical variations.

22,543, Cowper-Coles. Anodes for electro-deposition.

22,871, Allgemeine Elektricitäts-Ges. Track switch and signalling systems.

24,307, Von Eltenberg & Lach. Galvanic cells having rotating electrodes.

25,305, Scherbius. Regulation of induction motors.

25,511, Banks. Electric portable photographic lamps.

25,831, Harter. Electric lamp cluster-sockets.

25,902, Phœnix Dynamo Manufacturing Co. & Pohl. Cooling of dynamo-electric machines.

25,998, Aarhus Dynamo & Electro-Motorfabrik, & Johansen. Electrically-operated winches.

26,470, Ogg. Steam Turbines.

27,131, British Thomson-Houston Co. & Wedmore. Electric distribution systems.

27,596, Mather & Platt, Ltd., Coubrough, & Frith. Dynamo-electric machines.

28,143, Midgley. Generation, control, and transmission of electric energy for automobiles.

28,281, Thomson. Collapsible trolley pole.

28,436, Gardiner. Electric signalling on railways.

1908 Patents

1,709, British Thomson-Houston Co. (*Noeggerath*). Collecting-rings for dynamo-electric machines.

1,832, Siemens Bros. Dynamo Works, Ltd., & Schenkel. Dynamo-electric machines.

2,303, Siemens Bros. Dynamo Works, Ltd., & Lydall. Single-phase commutator motors.

3,464, Andersson. Electric arc lamp.

3,492, Mahl. Variable rate meters.

3,894, Burgess. Electric railway signalling system.

4,472, Schneidau. Electric wall plugs.

4,635. Ayles. Electrically-operated horns and trumpets.

4,760, Lake (*Elektrische Gluhlampenfabrik, Watt, Scharf, Loti, & Latzko*). A conducting connection for incandescent lamps.

4,948, Howard. Alternating-current relay devices.

5,318, Swan. Incandescent lamp sockets.

5,402, Harkness. Trolleys or collectors for electricity.

5,560, Stearn & Topham. Incandescence electric lamps.

5,972, Wigh. Electric lighting for bicycles and motor-cars.

6,245, Westinghouse Metal Filament Lamp Co. Metal filament lamps.

8,206, Elektricitäts-Ges. Alioth. Electrical devices for the measurement of speeds.

8,287, Felten & Guilleaume-Lahmeyerwerke Akt.-Ges. Transporting apparatus.

8,887, Lutz. Apparatus for disinfecting telephones.

9,288, Aron. Electricity meters for use in connection with storage batteries.

9,638, Siemens-Schuckertwerke-Ges. Three-phase commutator dynamo-electric machines.

11,814, Varela. Electro-automatic sounding apparatus.

12,556, Siemens Bros. Dynamo Works, Ltd. (*Siemens Schuckertwerke-Ges.*) Metal-coated carbons for searchlights.

13,527, Firm Robert-Bosch. Ignition apparatus.

14,188, Kearney. Grooved wheels for mono-railway and tramway systems.

14,340, Aron, Induction meters for polyphase currents.

15,910, Konig. Adjustable iron insulator support.

16,852, Hall. Sparking-plugs.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

10,891, Wolfram-Lampen Akt.-Ges. Filaments for electric incandescent lamps.

12,325, Woodbridge. Electrical distribution.

19,847, Gluhlampenwerk Anker-Ges. Prevention of disintegration of incandescent filaments.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9½—10	
Do. 6% Cum. Second Pref.	10	6	6	10⅛—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	4½*	4⅜—4⅞	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	96—100	
Brompton & Kensington E. S. Co.,Ld.	5	10	5%*	7—8	
Do. 7% Cum. Pref.	5	7	7	7—8	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	3⅜—3⅝	
Do. 4½% Cum. Pref.	5	4½	4½	3¾—4⅜	
Do. 4% Deb. Red	Stock	4	4	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½	3½—3¾	-¼
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	2⅝—3⅜	
Do. 4½% Deb. Red	Stock	4½	4½	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6	9½—10¼	
Do. 6% Cum. Pref.	10	6	6	12—13	
Do. 5% Deb. Red	Stock	5	5	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4	-⅛
County of London Elect. Sup. Co. Ltd.	10	5	—	7—8	
Do. 6% Cum. Pref.	10	6	6%	10½—10¾	
Do. 4½% Deb. Red	Stock	4½	4½	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6—6¼ xd	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	90—93	
Kensington & Knightsbridge E.L.Co.	5	10	4½*	7⅜—8⅜	
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N'tng Hill E.L. Cos. Db.Rd.	Stock	4	4	96—100	
London Electric Supply Corporation	3	2½	—	⅜—1⅜	
Do. 6% Pref.	5	6	6	4½—4⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¼—4½	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—4⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	84—89	
Midland E.Corp.for P.Dist.1stMt.Db.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4⅞—5⅛	-⅛
Do. (fully paid)	4	8	2½%	3⅞—4⅛	-¼
Do. 5% Pref. Do.	5	5	2½%	5⅛—5⅜	-⅛
Do. Do.	4	5	2½%	4—4½	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅜—12⅜	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅛—6⅛	
Do. 4% Deb. Red	Stock	4	4	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	7½—8¼	
Do. 7% Non-Cum. Pref.	5	7	7	6¾—7½	+¼
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2½—2¾	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½	99—102	+1
Urban Elec. Supply Co., Ltd.	5	5	5%	4—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	7½—8½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3%*	68—70	-1
Do. 4% Preferred	Stock	4	4%	86—88	
Do. Deferred	Stock	2	—	49—52	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	85—87	
City and South London Cons.	Stock	4½	1½%	32½—33½	
Do. 4% Perp. Deb.	Stock	4	4%	100—103	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	7⅞—8½	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	½	½%	37½—38½	-1½
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	+1
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—78	
Metropolitan District	Stock	—	—	12½—13½	-½
Do. 6% Perp. Deb.	Stock	6	6%	124—127	
Do. 4% Deb.	Stock	4	4%	82—86	
Do. Perp. Extension Pref. (5%)	Stock	—	—	24—29	
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	—	50—55	
Underground Elec. Railways Co of London 5% Prior Lien Bds.				92½—93½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	—	½—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	83—88	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	¾—1¼	
Do. 6% Cum. Pref.	10	6	6%	3¾—4¼	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	76—78	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾ xd	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100 xd	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	+1
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	72—77	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	¼—⅜	+⅛
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	¼—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	½—¾	
Do. 5% Cum. Pref.	1	5	2½%	¾—⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	92—95	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜—5½	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	77—81	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅜	
Do. 6% Cum. Pref.	5	—	—	3—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	58—61 xd	
Do. 6% Pref. Crd.	Stock	6	6%*	102—103 xd	-1½
Do. Def. Ord.	Stock	1	—	16½—17	-¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	88—90	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½	13¼—13¾ xd	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—101½	
Do. do. (Mauritius Sub.)	25	4	—	101½—103½	
Eastern Ext. Australasia & China	10	7	5%	12⅝—13¼ xd	-⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	01—103	
Eastern Telegraph Co.	Stock	7	2½%*	135—138 xd	-1
Do. 3½% Pref.	Stock	3½	3½%*	84—86 xd	-1
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	29½—31½	+½
Indo-European Telegraph Co. Ltd.	25	13	—	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅞—1⅛	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	116½—117½	-1
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅜	-⅛
Do 3½% Deb. Red	Stock	3½	3½%	99½—99½	-1
Do. 4% Deb. Red.	Stock	4	4%	102—104	
Western Telegraph Co., Ltd.	10	7	6%*	13½—14	-⅛
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	7%	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	16%*	3¾—4	+⅛
Do. 6% Pref.	1	6	6%	1⅛—1⅜	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¼—6¾	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—⅞	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	0—½	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	—	9¼—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅛—1⅜	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅜—1⅝	
Do. 6% Cum. Pref.	1	6	6%	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A." £3 paid	5	2/6	—	⅝—⅞	+⅛
Do. do. (fully paid)	5	4/2	—	1½—2¼	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	1⅛—1½	
Do. 7% Cum. Pref.	2	7	—	1½—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—7⅝	-¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½—11⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16½—17½	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	⅞—1 xd	-⅛
Do. 6% Cum. Pref.	5	6	3/-	2½—2⅝	-⅛
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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ELECTROMETALLURGY AND ELECTROCHEMISTRY

E. BECK, in *Metallurgie*, 5, 504, describes alloys of magnesium which he employs to fix atmospheric nitrogen. It is well known that magnesium readily reacts with nitrogen to form a nitride. The author finds that certain alloys of magnesium can be more readily prepared than metallic magnesium itself. A suitable method to obtain an alloy of tin and magnesium is to dissolve magnesium oxide in molten carnallite, and then to electrolyse this with an anode of carbon and a molten tin cathode. When the electrolysis is finished, a current of nitrogen is blown through the molten bath through an iron pipe covered with fireclay. The magnesium dissolved in the tin is converted into nitride, the tin being unacted upon. The nitride is then treated with steam, when ammonia is produced and magnesium oxide formed; this oxide can be dissolved in molten carnallite, and used again. It is calculated that the cost of fixing atmospheric nitrogen and producing ammonia in this way is rather cheaper than the method of Frank and Caro (cyanamide process).

In the German Patent 201,665 M. Baum describes a method for coating metals with platinum. It is found that it is easy to obtain a firm deposit of platinum by, in the first place, coating the metal which it is desired to protect with nickel or cobalt. First of all, the nickel is plated upon the article, then a coating of platinum deposited, and after this the whole is heated in an atmosphere of a reducing gas, such as hydrogen. A further deposit of platinum is then plated on, and the heating process repeated. The deposition of platinum and the heating is continued until a deposit of the required thickness is obtained. Obviously copper wire, if it is first coated with nickel, can also be coated with platinum, and it is stated the wire can be bent about into all sorts of angles without the platinum springing off. Copper itself alloys with platinum at about 350°.

In *Electrochemical and Metallurgical Industry* of October some improvements in the Girod steel furnace are noted. In the arc furnace of Dr. Héroult two carbon electrodes were used upon the slag covering the steel bath. The arcs strike between the ends of the carbons and the slag, the two arcs being in series and the two carbons of opposite polarity. The current passes from one carbon into the slag and metal bath, and finally out through the other electrode. The new Girod furnace is not unlike the Héroult in external appearance, but the electrodes at the top of the baths are all of the same polarity, while the other pole is provided in the bottom of the furnace. Thus the current passes from the electrodes through the slag and into the steel bath, finally leaving through the bottom. The slag and the steel bath are thus two resistances in series, and consequently the furnace is a combined electrode and resistance furnace. With this arrangement automatic regulation is easier than with two arcs in series. The pressure is reduced to about one-half of that required with two arcs, 50 volts being found sufficient to operate one Girod furnace. The furnace is made of a sheet steel framework, which has a circular or rectangular section, and is lined with magnesia. The steel is tapped by tilting the furnace. The electrodes pass through the roof of the furnace, which is made from silicon brick surrounded by cast-iron pieces cooled by water circulation, and they are adjusted in such a manner that air cannot enter the furnace. Such an adjustment is made possible owing to the electrodes being of the same polarity; there is consequently no danger of short-circuiting. The electrodes are regulated automatically either by voltage or current regulation. If the furnace is small one top electrode only is used and voltage regulation only is employed. If it is large and energy is employed from a transformer, or if there are several electrodes in parallel, then current regulation is employed. The consumption of power per ton of steel produced is about 1,000 kw. hours. The cost of the electrodes is about 3s. 4d. For refining a liquid charge the total cost is about 1s. 8d. per ton of steel. To work the furnace a smelter, an assistant, and a boy are required.

REPORT OF THE INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS

THE following is an abstract of the report of the International Conference on Electrical Units and Standards, which concluded its meeting on Wednesday, October 21st:—

The Conference on Electrical Units and Standards, for which invitations were issued by the British Government, was opened by the President of the Board of Trade, the Right Hon. Winston S. Churchill, M.P., on Monday, October 12th, 1908, at Burlington House, London, S.W. Delegates were present from twenty-one countries, and also from Australia, Canada, India, and the Crown Colonies. The Conference elected a Technical Committee to draft specifications and to consider any matter which might be referred to the Committee and to report to the Conference.

As a result of its deliberation, the Conference adopted the resolutions and specifications attached to this report, and set out in Schedule B, and requested the delegates to lay them before their respective Governments with a view to obtaining uniformity in the legislation with regard to electrical units and standards. The Conference recommend the use of the Weston normal cell as a convenient method of measuring both electromotive force and current when set up under the conditions specified in Schedule C.

In cases in which it is not desired to set up the standards provided in the resolutions, Schedule B, the Conference recommends the following as working methods for the realisation of the international ohm, the ampere, and the volt:—

1. *For the International Ohm.*—The use of copies, constructed of suitable material and of suitable form and verified from time to time of the international ohm, its multiples, and submultiples.

2. *For the International Ampere.*—(*a*) The measurement of current by the aid of a current balance standardised by comparison with a silver voltameter; or (*b*) the use of a Weston normal cell, whose electromotive force has been determined in terms of the international ohm and international ampere, and of a resistance of known value in international ohms.

3. *For the International Volt.*—(*a*) A comparison with the difference of electrical potential between the ends of a coil of resistance of known value in international ohms, when carrying a current of known value in international amperes; or (*b*) the use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and the international ampere.

The duties of specifying more particularly the conditions under which these methods are to be applied has been assigned to the Permanent Commission, and, pending its appointment, to the Scientific Committee to be nominated by the president. The Conference has considered the methods that should be recommended to the Governments for securing uniform administration in relation to electrical units and standards, and expresses the opinion that the best method of securing uniformity for the future would be by the establishment of an international electrical laboratory with the duties of keeping and maintaining international electrical standards. This laboratory to be equipped entirely independently of any national laboratory. The Conference further recommends that action be taken in accordance with the scheme set out in Schedule D.

SCHEDULE B.—(*Resolutions.*)

I. The Conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimetre as the unit of length, the gramme as the unit of mass, and the second as the unit of time. These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0·1) in terms of the centimetre, gramme, and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gramme, and the second; (4) the watt, the unit of power which has the value 10,000,000 in terms of the centimetre, the gramme, and the second.

II. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the Conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions.

III. The ohm is the first primary unit.

IV. The international ohm is defined as the resistance of a specified column of mercury.

V. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross sectional area, and of a length of 106·300 centimetres. To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in Specification I. attached to these resolutions.

VI. The ampere is the second primary unit.

VII. The international ampere is the unvarying electric cu

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rent which, when passed through a solution of nitrate of silver in water, in accordance with the Specification II. attached to these resolutions, deposits silver at the rate of 0·00111800 of a gramme per second.

VIII. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

IX. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

SPECIFICATION I.—(*Specification Relating to Mercury Standards of Resistance.*)

The glass tubes used for mercury standards of resistance must be made of a glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimetre. The mercury must have a resistance of approximately one ohm. Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed five parts in 10,000. The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube. The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0° C. as possible. The measurements are to be corrected to 0° C. For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately four centimetres) and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the mass. The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula.

$$A = \frac{0{\cdot}80}{1063\pi}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)\text{ohm},$$

where r_1 and r_2 are the radii in millimetres of the end sections of the bore of the tube. The mean of the calculated resistances of at least five tubes shall be taken to determine the value of the unit of resistance. For the purpose of the comparison of resistances with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

SPECIFICATION II.—(*Specification Relating to the Deposition of Silver.*)

The electrolyte shall consist of a solution of from 15 to 20 parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that not more than 30 per cent. of the silver in the solution is deposited. The anode shall be of silver, and the kathode of platinum. The current density at the anode shall not exceed 1/5 ampere per square centimetre and at the kathode 1/50 ampere per square centimetre. Not less than 100 cubic centimetres of electrolyte shall be used in a voltameter. Care must be taken that no particles which may become mechanically detached from the anode shall reach the kathode. Before weighing, any traces of solution adhering to the kathode must be removed, and the kathode dried.

SCHEDULE C.—(*Weston Normal Cell.*)

The Weston normal cell may be conveniently employed as a standard of electric pressure for the measurement both of E.M.F. and of current, and when set up in accordance with the following specification, may be taken, provisionally, as having, at a temperature of 20° C., an E.M.F. of 1·0184 volts.

Specification Relating to the Weston Normal Cell.—The Weston normal cell is a voltaic cell which has a saturated aqueous solution of cadmium sulphate ($CdSO_4 8/3H_2O$) as its electrolyte. The electrolyte must be neutral to Congo red. The positive electrode of the cell is mercury. The negative electrode of the cell is cadmium amalgam consisting of 12·5 parts by weight of cadmium in 100 parts of amalgam. The depolariser, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate. The different methods of preparing the mercurous sulphate paste will be described in notes. One of the methods there specified must be carried out. For setting up the cell, the // form is the most suitable. The leads passing through the glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other. The depolariser is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed. The following formula is recommended for the E.M.F. of the cell in terms of the temperature between the limits 0° C. and 40° C.

$$E_t = E_{20} - 0{\cdot}0000406\,(t-20°) - 0{\cdot}00000095\,(t-20°)^2 + 0{\cdot}00000001\,(t-20)^3$$

SCHEDULE D.—(*Proposed Establishment of a Permanent Commission.*)

1. The Conference recommends that the various Governments interested establish a permanent International Commission for Electrical Standards.

2. Pending the appointment of the Permanent International Commission the Conference recommends that the President, Lord Rayleigh, nominate for appointment by the Conference a scientific committee of fifteen to advise as to the organisation of the Permanent Commission, to formulate a plan for and to direct such work as may be necessary in connection with the maintenance of standards, fixing of values, inter-comparison of standards, and to complete the work of the Conference. Vacancies on the committee to be filled by co-optation.*

3. That laboratories equipped with facilities for precise electrical measurements and investigations should be asked to co-operate with this committee and to carry out, if possible, such work as it may desire.

4. The committee should take the proper steps forthwith for establishing the Permanent Commission, and are empowered to arrange for the meeting of the next Conference on Electrical Units and Standards, and the time and place of such meeting should this action appear to them to be desirable.

5. The committee or the Permanent International Commission shall consider the question of enlarging the functions of the International Conference on Weights and Measures, with a view to determining if it is possible or desirable to combine future Conferences on Electrical Units and Standards with the International Conference on Weights and Measures, in place of holding in the future Conferences on Electrical Units and Standards. At the same time it is the opinion of the Conference that the Permanent Commission should be retained as a distinct body, which should meet at different places in succession.

INJURY BY TRAWLERS TO SUBMARINE CABLES

THE Interdepartmental Committee who have been considering the alleged injuries caused to submarine cables by the operations of trawlers has now issued its report. The committee consisted of Sir J. C. Lamb, C.B., C.M.G., formerly Second Secretary to the Post Office (chairman); Mr. W. R. Culley, I.S.O., Submarine Superintendent in the Engineering Department of the Post Office; Commander G. C. Frederick, R.N., Professional Member of the Harbour Department of the Board of Trade; Mr. C. E. Fryer, I.S.O., Superintending Inspector of English Fisheries; Mr. W. S. Green, C.B., Chief Inspector of Irish Fisheries; and Commander G. M. Marston, R.N., of the Hydrographic Department of the Admiralty.

The committee examined a number of witnesses and fully investigated the construction of trawling gear, and numerous photographs of typical trawls of the "otter board" and older "beam" type are included in the report. A summary of the conclusions is given below:—

The committee are of opinion that injury is sometimes caused to submarine cables by otter boards of certain types and boards out of repair, and by beam trawls with defective trawl-heads. They think that there would be little risk of injury from trawls of either kind if they were always suitably constructed and in good condition. They find that the owners of trawling vessels are generally willing, and indeed anxious, to modify their trawling gear with the view of minimising the risk. They are not prepared to recommend the proscription of any area beyond territorial limits. They recommend that all cable companies should (as certain companies and the Post Office have already done) establish friendly relations with the fishermen who frequent the waters in which their cables are laid; while the fishermen on their part should try to clear their trawls when they foul a cable, and should report the position of any contact with a cable. They recommend that a system of Government inspection of the gear of trawlers be at once instituted. They recommend that steps be taken through the diplomatic channel to invite neighbouring foreign States to adopt a similar system of inspection. They think that eventually an International Conference may be necessary to settle the terms of a Convention on the subject. They recommend that the cable companies should consider the question of substituting heavier types of cable in the areas affected.

* In accordance with § 2, Lord Rayleigh has nominated the following Committee, which has been approved by the Conference, viz.: Dr. Osuke Asano, M. R. Benoit, Dr. M. N. Egeroff, Prof. Erie Gérard, Dr. R. T. Glazebrook, Dr. H. Haga, D. L. Kusminsky, Prof. G. Lippmann, Prof. A. Roiti, Dr. E. B. Rosa, Dr. S. W. Stratton, Mr. A. P. Trotter, Prof. E. Warburg, Prof. Fr. Weber.

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ELECTRICAL ENGINEERING

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SUMMARY

WE are able to publish some extracts from a translation of the speech which Mons. P. BOUCHEROT made at the dinner of the Institution of Electrical Engineers in reply to the toast of the International Electrotechnical Commission. (Page 602.)

A LARGE number of manufacturers of machine tools were represented at the Electrical Exhibition in Manchester, and we give in this issue an article describing the more important of the machines exhibited. Some of the large machines were fitted with self-contained motor drive, and a variety of patterns of small portable electric drills and grinders were shown. Several large planers and drilling machines were exhibited, and a number of lathes, grinders, gear-cutting, and slotting machines were to be seen. Application of electrical working, other than electric driving, were also represented by some examples of magnetic chucks and drill posts. (Page 603.)

THE following books are reviewed in this issue:—"Cranes," by A. Böttcher; "Power Railway Signalling," by H. Rayner Wilson; "Laboratory and Factory Tests in Electrical Engineering," by George Sever and Fitzhugh Townsend. (Page 608.)

AN article by Mr. G. M. B. SHEPHERD describes the various uses to which condensers are put in modern telephony, both in association with the subscribers' telephone stations and in the exchange. (Page 609.)

THE Paper read by Capt. A. GARDINER before the Leeds Local Section of the Institution of Electrical Engineers on Wednesday of last week described a new proposed system of cab-signalling for railways designed to supersede entirely the usual semaphore and lamp. A working model of the apparatus was shown, and a lengthy discussion followed, in which a number of well-known railway men took part. (Page 612.)

IN a Paper read before the American Institute of Electrical Engineers at their annual summer meeting this year, three examples of a type of construction for power stations, as yet unrepresented in England, were described. The main feature of this new type is that the station is built with two floors. On the ground floor the boiler plant is situated, and the turbo-generator sets are on the floor above. With this mode of construction a very low figure for the floor space per kilowatt is obtained, and the arrangement of the steam piping is particularly easy. A special form of steel girder construction is necessary to take the weight of the generating plant, but no troubles have been experienced from vibration. A useful table, giving the approximate floor space required for different types of prime-movers, is included in the Paper. (Page 611.)

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In an appendix (which we reproduce) to a Paper on high-speed tool steel, recently read in America, curves are given which show the motor horse-power required by lathes, boring mills, planers, forging and bolt-heading machines, and fans of various capacities. Formulæ, for estimating the horse-power of the motor required in special cases, are also stated, and many examples of actual cases are included. These latter show the necessity for taking account not only of the normal capacity of the machine tool itself, but also of the work that it will be set to do. For instance, a type of lathe usually furnished with a 20 h.p. motor is mentioned. For average shop work a 10 h.p. motor would have been ample, but this same machine required in one case a 60 h.p. motor. (Page 615.)

On Tuesday the case for the promoters of the London and District Electricity Supply Bill was completed before Mr. Luke White's Committee of the House of Commons. In a report upon the Bill the Board of Trade recommend the reconsideration on the part of the Committee of several clauses, notably the purchase clause and the clause relating to the acquisition of existing undertakings by the Company. In the House of Commons on Monday, the London Electric Supply Bill and the London (Westminster and Kensington) Electric Supply Bill were read a second time after a short discussion, during which an instruction to the Committee dealing with the Bills was passed authorising the insertion of the name of the London County Council as the purchasing authority. (Page 617.)

The Highways Committee of the London County Council recommend that an application should be made for Parliamentary powers to use the trackless trolley system in the Blackwall and Rotherhithe tunnels for connecting up the northern and southern tramways systems. The Council, however, has postponed the matter pending further details of the system. (Page 619.)

A Consular report for the year 1906-7 gives details of a number of power transmission works in Italy. (Page 620.)

A motor-operated automatic battery regulating switch is described. This is controlled by a voltmeter relay, which causes the motor to be switched on and the number of cells in the circuit increased or decreased according as to whether the supply voltage has decreased or increased. The switch is worked by the motor by means of a rocking frame, which is given an oscillatory motion from a crank worked by the motor through worm gearing. (Page 620.)

We describe a system of electric lift control, known as the "Keighley" system. For control from the cage the cage switch controls a pair of solenoids acting in opposite directions on a plunger which is furnished with a rack. The rack gears into a pinion on the spindle of the main controller. An interpole motor and a compound-wound magnetic brake are employed. (Page 621.)

A new protected wall socket is described. (Page 621.)

Among the specifications published by the Patent Office on Thursday last is one by W. J. Stewart for an apparatus for enabling the rail points and plough guides of a conduit tramway system to be worked from a passing car. The British Thomson-Houston Co. and F. H. Clough have one for a special construction of the rotor field systems of turbo-generators; and a method of artificially cooling commutators by jets of air is protected by the Phœnix Dynamo Manufacturing Co. and R. Pohl. An alternator winding for avoiding large section conductors is described in a specification by Mather & Platt. The Westinghouse Metal Filament Lamp Co. has a specification for a means of suspending metal filaments, and Siemens Bros. Dynamo Works, Ltd., have protected a means of preventing the small section negative carbons used in searchlights from being consumed too rapidly. Among the expiring patents is one by La Société Anonyme pour la Transmission de la Force par l'Electricité for an asynchronous self-exciting alternator. Short abstracts of all the above specifications are given in our Patent Record. (Page 623.)

It is stated that the Premier of Victoria has recommended that the first portion of the Melbourne suburban railway system shall be converted to electric traction in accordance with Mr. C. H. Merz's report. —The accounts of the Kingston Corporation electricity undertaking for the past year show a deficit of £884, compared with a deficit of £7 for the previous year.—Street-lighting experiments with arc lamps and gas are being carried out at Leeds.—In connection with the recent criticisms concerning his report upon the Westinghouse turbines in the Lister Drive power station at Liverpool, Mr. Bromley Holmes, the consulting engineer to the Corporation, threatens legal proceedings.—The London County Council has asked the Prime Minister to receive a deputation on the question of London traffic.—The General Electric Co. has guaranteed an average life of 1,100 hours for Osram lamps which have been ordered by the Fulham Council.—It is announced that the report of Mr. W. M. Mordey upon the G.B. Surface Contact system in the Mile End Road will be placed before the next meeting of the London County Council.—A scheme of tramways is to be promoted next session connecting up several towns in the Manchester district.—The Newcastle tramways accounts show a balance of £19,477 after meeting capital charges.—Arrangements have been made between the Poplar and Stepney Borough Councils for a stand-by supply. (Pages 625-626.)

An electric lighting plant is required at the Essex County Lunatic Asylum; 800 yards of three-core cable is required by the Middleton Corporation; electrical stores by the Bradford Committee, the Dublin United Tramways Committee, and the London General Omnibus Co.; and a common battery switchboard, &c., by the Tasmanian Government. The Local Government Board has sanctioned a loan of £1,000 to the Leyton Council, and it is stated that a loan of $100,000 has been granted to the Penang Municipality for electrical purposes. An important tender in connection with the Adelaide tramways system has been placed with the Australian agents of the A.E.G. Berlin. It is announced that the whole of the first batch of tenders for the supply of wireless telegraph apparatus to the Australian Government have been rejected as not complying with the specification. (Pages 626-628.)

At the annual meeting of the Edison and Swan United Electric Light Co., last week, it was stated that the company's metal filament lamp factory is now turning out lamps of this class in larger quantities than any other factory in the country, and that this is being done without any patents having been acquired.—The accounts of the Norwich Electric Tramways Co. for the year to June 30th show a net profit of £3,830.—At the annual meeting of the Douglas Southern Electric Tramways Co., on Thursday, the report, which recommends a dividend of 5 per cent. upon the preference shares, was adopted. The total balance available was £1,658.—In a report issued by the X Accumulator Co., it is stated that the working capital originally subscribed was insufficient for the company's purposes, and that necessary steps are being taken to wind the company up. (Pages 628-629.)

Although the exhibits at Manchester were of course mainly the products of the manufacturing electrical engineer, there were many sections of the exhibition which related to the apparatus required by the manufacturer for the execution of his work. Prominent among these were machine tools, which, as indicated by a special article in this issue, were thoroughly repre-

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sentative of the latest work of some of the leading machine-tool makers in this country, and incidentally demonstrated many points in connection with electrical driving. In the earlier days, when electric driving was the exception rather than the rule, it was only natural that standard arrangements of gearing, shafting, &c., were employed, and standard constant-speed motors set to drive them. At the present time, however, the tendency is showing itself more and more widely to treat the motor and the machine tool as parts of one structure, and to design the one to meet the other. In some cases the motor is even built into the frame of the machine, or in other ways forms an integral part of it, so that belting is entirely avoided. The same idea is sometimes carried further, and the controller is also embodied in the machine itself. Another growing tendency—although with some exceptions perhaps this is not so marked as it might be in the particular exhibits under consideration—is the simplification of machines by the abolition of mechanical change-speed gearing by taking advantage of the increased range of speed regulation rendered available in shunt motors by the adoption of interpoles. Small, portable tools, drills, &c., of a class that has only been made possible by the electric motor, were also represented. Another way in which electrical working has shown its utility in machine-shop practice is in the great convenience afforded by such appliances as magnetic chucks, drilling posts, &c. The application of separate motors to the driving of single machines or small groups of machines necessitated more care being taken in proportioning the motor to the work it has to do than the case where one prime-mover covers the power requirements of a number of machines, and in this connection attention may be drawn to a Paper read recently in America by Mr. L. R. POMEROY, which contains some valuable data relating to the power absorbed in various operations in the machine-shop, and is reproduced at some length in another column.

THE case for the promoters of the London and District Electricity Supply Bill is now before Mr. LUKE WHITE'S Committee of the House of Commons, and it presents no new features compared with the position when it left the House of Lords. Despite strenuous efforts on the part of the opposition, those behind the venture express themselves still satisfied with the measure as it stands, although no opinion has yet been expressed upon the Board of Trade report on the Bill, which we give elsewhere. The most important part of this document is that relating to purchase, the period suggested being forty-two years instead of fifty-two years, as stipulated at present in the Bill, and which was agreed to by Lord CROMER'S Committee. This question, however, is left quite open to the Committee to decide. If a scheme of this character is to have a reasonable chance of being put into force within the period named in the Bill, the conditions must be such that the capital can be raised quickly and upon equitable terms. It can, however, easily happen that, if the Committee lend too willing an ear to the arguments that are being advanced for the so-called protection of public interests, the obligations will be too stringent for the promoters if they accept the Bill to be able to raise the capital required. The period of purchase is a case in point. Another is the plea now being urged on behalf of the Borough Councils, that they should be given an absolute veto as to when the power company shall supply in their areas. in other words, the abolition of the Kitson Clause. If the opposition succeed in imposing such onerous terms the Committee would be acting in direct contravention of the opinions expressed both by previous Committees and by members of the Cabinet, to the effect that there is urgent need for a supply of electricity in London on the lines laid down in the Bill. Unfortunately, political forces are still working against the Bill, and if the Bill passes the Committee, there is still the withdrawal of even that moral support of the Government which procured the second reading, to be reckoned with. For the moment, however, a good deal turns upon the closeness with which the Committee adheres to the Board of Trade report, and the evidence of the Board's representatives, which is understood to be coming, will be awaited with interest. It is for this reason that the promoters have not expressed themselves on the report, beyond the statement that clause 77 (power to take transfers of undertakings) which the report almost suggests is an insidious attempt at acquiring a monopoly, is not regarded by the promoters as a vital clause, and they are quite content to have it deleted. The Board of Trade prefer that fresh Parliamentary powers should be sought for each undertaking which the power company wishes to acquire, but this implies, in a way, a want of confidence in the Board itself, as at present, under the Electric Lighting Acts, no undertaking can be transferred without its consent. With regard to the other two Bills, these have now been read a second time, with an instruction that the London County Council shall be the purchasing authority instead of the Borough Councils. What the Borough Councils will have to say to this has not yet been indicated, but it may seem a somewhat irregular procedure to divest them, by means of a clause in a private Bill, of powers granted under a general Act of Parliament. Obviously, some co-ordination is desired, and it is possible that the method proposed is the simplest way out of a difficulty which has arisen on account of the subdivision of London into so many areas, each with its own governing body.

THE possibilities of the trackless trolley system, which have been the subject of reports to several provincial municipalities, have been discussed in connection with somewhat different circumstances by the Highways Committee of the London County Council, who have recommended its adoption in the Blackwall and Rotherhithe tunnels. Previous reports have dealt principally with problems of suburban traffic where only an infrequent service is necessary, and the main point dwelt upon has been the way in which the relative proportions of the capital outlay and the running expenses render the system suitable for work of this class. The case of the London Thames tunnels is different, the traffic is sufficient to warrant the laying of a double line of tramway track, but the ruling consideration has been the fact that, owing to the narrowness of the carriage-way, a double line of non-steerable trams would hopelessly interfere with the ordinary road traffic. The flexibility of the "trackless" vehicle entirely overcomes this difficulty, and should justify its adoption in face of the undoubtedly higher

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cost of operation for a heavy service of this character. We cannot help thinking that there are other cases of narrow roads with heavy general traffic where the laying of tramways would never have been authorised if some such system had been available. Even now it is not too late to put a stop to the losses occasioned by delays to both tramcar and ordinary traffic in certain stretches of narrow road by the running at connecting-up services of "trackless" vehicles from existing trolley lines.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 5TH.

Royal Society.

4.30 p.m. Meeting at Burlington House. Among the Papers down for reading are the following:—"On the Generation of a Luminous Glow in an Exhausted Receiver Moving near an Electrostatic Field, and the Action of a Magnetic Field on the Glow so Produced," by the Rev. F. J. Jervis-Smith; "The Effect of Pressure upon Arc Spectra, No. 2—Copper," by W. G. Duffield; "On a Method of Computing Inductance and Resistance by the Help of Two-phase Alternating Currents," by A. Campbell.

FRIDAY, NOVEMBER 6TH.

North-east Coast Institution of Engineers and Shipbuilders.

7.30 p.m. Annual meeting at the Literary and Philosophical Society, Westgate Road, Newcastle-upon-Tyne.

Rugby Engineering Society.

8 p.m. Conversazione at the Town Hall, Rugby.

SATURDAY, NOVEMBER 7TH.

The Electrical Football League.

8 p.m. First annual concert at Robertson's Electric Lamp Works, Brook Green, Hammersmith.

TUESDAY, NOVEMBER 10TH.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Meeting at the Municipal School of Technology, Whitworth Street. Paper to be read:—"Brushgear," by R. F. Blackmore.

Institution of Electrical Engineers: Glasgow Local Section.

8 p.m. Meeting at 207 Bath Street, when the Chairman, Mr. W. W. Lackie, will deliver his address.

WEDNESDAY, NOVEMBER 11TH.

Institution of Electrical Engineers: Birmingham Local Section.

7.30 p.m. Meeting at the University, Edmund Street. Paper to be read: "The Testing of Alternators," by S. P. Smith.

THURSDAY, NOVEMBER 12TH.

Institution of Electrical Engineers.

8 p.m. Opening meeting of the Session at 25 Great George Street, Westminster, London, when the premiums awarded for the session 1907-8 will be awarded. The President, Mr. W. M. Mordey, will then deliver his Inaugural Address.

Leeds Local Section of the Institution of Electrical Engineers.—Mr. H. E. Yerbury's inaugural address to the Leeds Local Section of the Institution of Electrical Engineers was devoted to a review of some of the leading features of recent electrical engineering progress, and a few speculations as to the future. In reviewing tramway work, he called attention to the way the series motor had become standardised, and pointed out the inferiority of shunt motors, notwithstanding the possibilities of the latter as regards regenerative control. He commented on the trackless trolley system, for which he thought that there was a useful and remunerative field in many districts, as the same overhead equipment could be retained if the population or requirements of a particular district justified the laying down of rails with a frequent service of cars after, say, a few years' running. The field for the single-phase motor for heavy work was also touched upon. With regard to generating plant, the problems of the large continuous-current turbo-generator were as yet not fully solved, and he thought that considerable improvements in steam turbines might be looked forward to in directions which would enable them to be so designed in future that their efficiency would not be impaired by eliminating the very fine clearances which have been the primary cause of considerable trouble in the past. The latter part of the address contained some vague remarks rather outside the range of electrical engineering, and devoted more to the metaphysical than to the physical.

THE SPEECH OF MONS. PAUL BOUCHEROT AT THE DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS

THE following are extracts from a translation of the speech of Mons. P. Boucherot at the dinner of the Institution of Electrical Engineers, when he responded to the toast of the International Electrotechnical Commission:—I am particularly honoured and fortunate in being called upon to speak on an occasion similar to that on which my revered master, Hospitalier, spoke two years ago. On that occasion, I recall, we had just decided the foundations upon which the Electrotechnical Commission should be built up, but were scarcely able to say anything as to its destiny.

The credit of the success of the movement is mainly due to Colonel Crompton, who was instrumental in calling together the preliminary meeting, and it is largely due to him that there will now be a possibility, in a new direction, of co-ordinating international ideas, of bringing uniformity into the methods of defining these ideas, and also of expressing them in concrete form.

In the pursuit of this work of higher education electricians have always taken a foremost place, although their intervention dates only from the Congress of 1881. In the demain of general education it would not be difficult to trace back the origin of instruction in the history of our race, and, moreover, one could with justice go back as far as the time of Cadmus the Phœnician, who gave the alphabet to the Greeks. This is going back a very long way, but Colonel Crompton will agree with me that that was a great work of co-ordination. Even to-day the question of symbols was discussed, and I should like to be allowed to add that, in my opinion, that is a real matter for standardisation, because it is no doubt due to the fact that the Chinese did not accept the system of Cadmus that they have remained practically stationary during so many centuries.

It has become quite a common thing to speak of progress and its causes; but nevertheless, in my estimation, there is one particular point not sufficiently insisted upon; the evolution of species is so slow that one cannot perceive any evolution in the human brain. For instance, Spencer had one of the greatest brains of the nineteenth century, and yet one could not assert that he was of superior intelligence to Aristotle. True, he lived at a later period, but that is the utmost one can say with any certainty. Until late years archæology was looked upon as comparatively a modern science. The archæological discoveries have, however, brought to light the curious fact that Nabounchid, the last King of Babylon, about 550 B.C., was himself a keen archæologist. The stones he has left behind him bear witness to the fact that, in his researches, he traced back as far as 3,200 years before his own reign, and that he rejoiced, as over a victory, at the discovery of the dedicatory cylinders to the King of the Chaldeans, Naram-sin, who lived about 6,000 years ago. Be it far from me, however, to conclude from this that the ancients had any knowledge of the second law of thermodynamics and the wonderful deductions drawn therefrom by Lord Kelvin. In conclusion, may I remind you that although in the Middle Ages there were many learned men there were no engineers, and the fact that Archimedes, Hero of Alexandria, and perhaps others, were as much engineers as savants does not alter this fact. To change the face of the earth has needed a new social element, to wit, the engineer! Engineers of all countries, be proud of your work, for however small the part played by each individual in this work, he has as much right to be proud of the great engineering achievements as the success of his own country. . . . May the work of the Commission influence the future as did the work of Cadmus influence the past.

Victoria Falls.—In answer to a question by the House of Commons last Thursday, Colonel Seely stated that the title of the Victoria Falls Power Co. to the Victoria Falls and adjoining land, is given in an agreement which provides for the lease of the Falls by the British South Africa Co. to the African Concessions Syndicate, Ltd.

Canada: Proposed Electrification of Canadian Pacific Railway.—It is stated that proposals are under consideration for the operation of about 700 miles of the Canadian Pacific Railway by electricity. The intention is to utilise water power, which is to be found in the vicinity of the line, and some of the directors of Messrs. Siemens Bros. & Co. are mentioned as being identified with the proposition.

The Affairs of the Dolter Electric Traction Co.—In the Chancery Division, on Tuesday, November 3rd, before Mr. Justice Eve, Mr. Vernon moved, in the case of Bock v. the Dolter Electric Traction Co., for judgment in default of defence in a debenture holder's action. Plaintiff is a registered holder of 175 debentures of £100 each, issued on August 2nd, 1907, which had since become due. The company, said counsel, since the issuing of the statement of claim, had gone into liquidation. His Lordship made the usual order.

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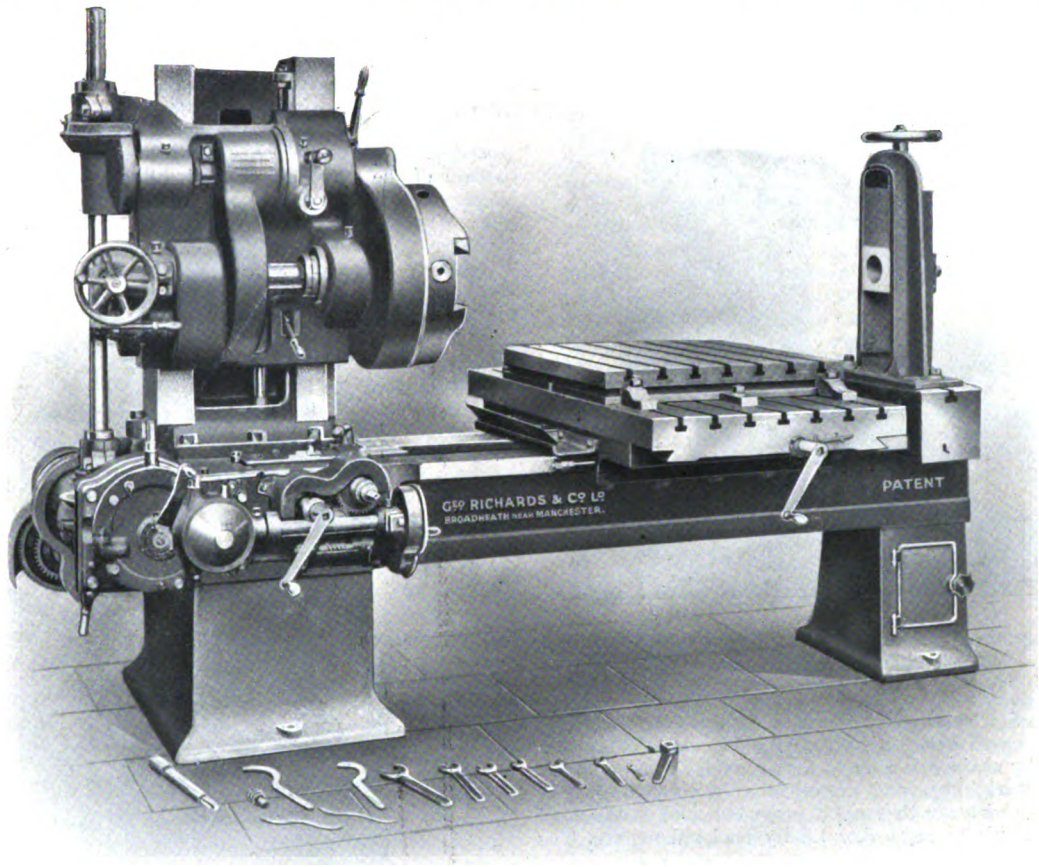
MACHINE TOOLS AT THE MANCHESTER ELECTRICAL EXHIBITION

George Richards & Co., Ltd.,

BROADHEATH, NR. MANCHESTER. (STAND NO. 52.)

The firm's latest pattern of universal facing and boring machine is seen below. All its feeds are automatic, including the cross-feed to the table and the vertical feed to the head. The spindle carrying the facing head is of exceptional strength, ground to fit its bearings, which are of phosphor bronze. The front bearing has very ample wearing surface, and its shape is designed to reduce to a minimum the friction and wear caused by taking heavy facing cuts. A tool slide, made extra long to ensure freedom from jar, is actuated by a screw. It is provided with an opening and substantial clamping bolt for securing a tool of square section, which is firmly held. A facing with a circular recess is also formed on the tool slide and is used for mounting special tool holders and milling cutters, and for securing boring bars. Provision is made for quickly centreing this appliance. The machine is fitted with a square top table revolving easily upon a strong central pin. The table may be revolved through any angle and clamped accurately, and it is particularly easy to clamp it accurately square at each quarter turn.

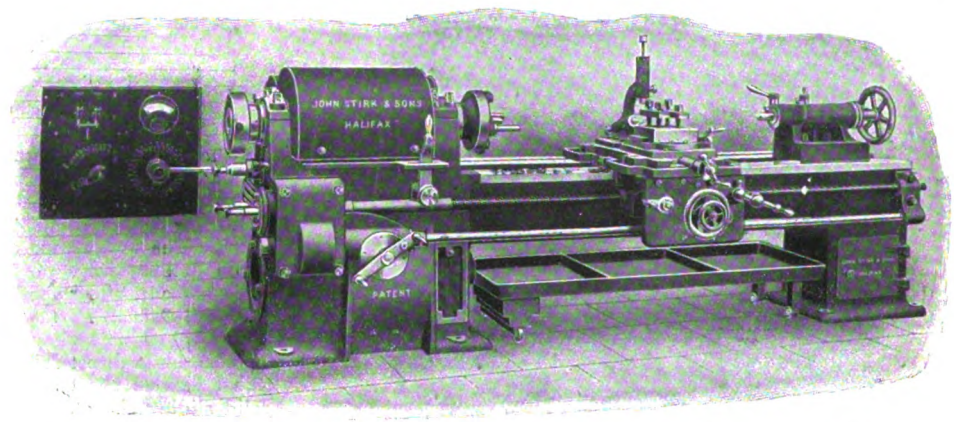


Universal Facing and Boring Machine, with facing head geared direct, with suitable speeds for drilling, and with all feeds automatic. (George Richards & Co., Ltd.)

John Stirk & Sons, Ltd.,

OVENDEN ROAD, HALIFAX. (STAND NOS. 287 & 288.)

Electrically-driven Machine Tools.—The exhibit of this firm included the six-inch slotting machine, illustrated on the next page, which is fitted with their self-contained motor drive. The motor of this machine is wound to give 1½ h.p. at any speed between 500 and 1,500 r.p.m. The frame of the motor, which is of the Lancashire Dynamo and Motor Co.'s make, is, as can be seen from the illustration, part of the body of the slotting machine. A chain transmits the power to the pinion shaft, and a further reduction is accomplished by the usual gearing at the back of the machine. A total purchase of about 18 to 1 is provided.



8-Inch High-speed Lathe with all Gear Headstock and Self-contained Motor Drive. (John Stirk & Sons, Ltd.)

and this gives a suitable number of strokes per minute. As with a six-inch machine it is not to be supposed that shorter stroke than two ins. would ever be used, the range of speed provided in the motor is all that is required. The speed regulator is so marked that the operator can see at a glance what is the correct position of the controller arm for the work the machine is engaged upon. This firm also exhibited a large high-speed lathe, and several

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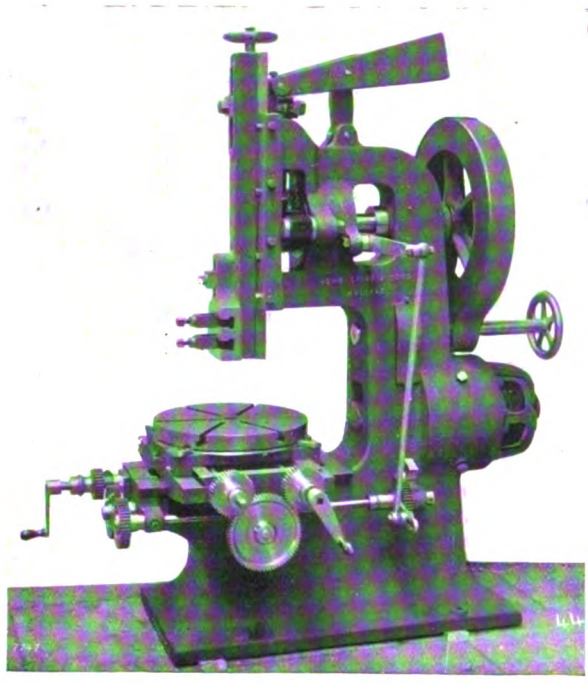
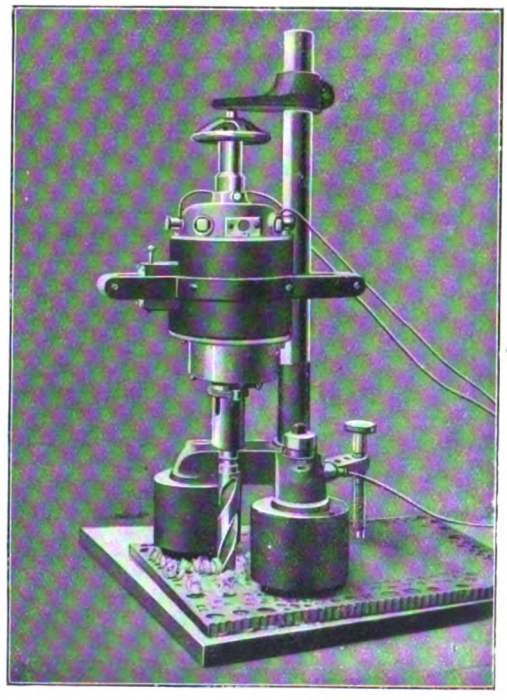
photographs of electrically-driven drills, lathes, and boring mills were shown. A fine example of an electrically-driven 8-ins. high-speed lathe is also illustrated. This is a similar lathe to that exhibited, except that it is fitted with the firm's patent motor



6-Inch Slotting Machine with Self-contained Motor Drive.
(John Stirk & Sons, Ltd.)

drive. Combined with the box end is a 7½-h.p. electric motor, running at any speed between 400 and 1,200 r.p.m. The power is transmitted by chain drive up to the spindle. This construction gives great rigidity, and accomplishes a great saving in floor space. The motor is thoroughly protected, and at the same time is as accessible as any other totally enclosed motor. The



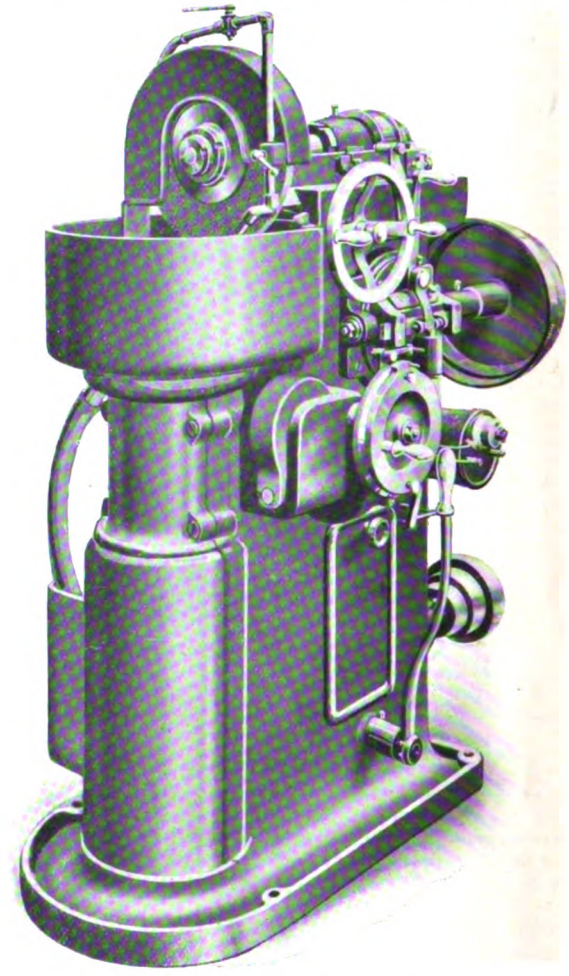
Tripod Magnetic Drill Stand and Electric Drill.
(United States Metallic Packing Co., Ltd.)

headstock gearing is designed to stand the heaviest strains the drive can put upon it. The cutting speeds are 40, 60, 80, and 120 ft. per minute; any one of these having been selected, it can be maintained on any diameter between 2½ ins. and 7½ ins.

United States Metallic Packing Co., Ltd.,

SOHO WORKS, BRADFORD, YORKS. (STAND NO. 94.)

Portable Drills and Magnetic Drill Stands.—The accompanying illustration shows a new design of magnetic drill stand which has recently been developed by this company. It will be noticed that it has three points of contact, which gives a firmness and rigidity unattainable with the usual single magnet form. Two legs of the tripod base are magnet poles, which are surrounded with the exciting coils. The latter are enclosed in strong water-tight brass cases. The third leg carries an adjusting screw, and takes the thrust of the drill-feeding screw on the arm of the drill stand. As shown in the illustration, the drill is set up centrally between the magnet poles, by which means the full pull of the magnet is obtained on the drill. A switch of the quick make and break type is provided on the base of the stand. The drill pillar and base are of steel, and



Grinder with Magnetic Chuck.
(Chas. Churchill & Co.)

are hollow. Our illustration shows a hand electric drill in use on the drill stand. This pattern of drill is made in two sizes, ¼ h.p. and ⅝ h.p. respectively, and is fitted with a series-wound motor, which is completely enclosed and suitable for outside work. The largest size of drill stand, which is suitable for use when drilling holes up to 1¾-in. diameter, takes 1 ampere at 200 volts and weighs 95 lb.

Direct-Driven Portable Electric Drill.—An example of this firm's patent portable electric drill, which, contrary to the usual custom, has a direct drive, was shown working on the stand. The usual flexible shafts, knuckle joints, &c., are superseded by a solid sliding shaft and a universal movement drill-head, which enables the machine to be worked in practically any position whilst reducing the loss of power in transmission to a minimum. The controlling switch is placed on the drill-head, which gives the operator instantaneous control. A flexible cable connects the switch to the motor. One of the new tripod drill stands was shown in use in connection with the direct-drive portable drill described above. Thus, instead of using the small drill, as shown in our illustration, a larger motor can be used with the aid of the shaft drive to run a drill supported on the tripod stand.

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Metallic Packing.—A representative exhibit of the various patterns of metallic packing manufactured by the company, including examples of block packing for use with medium and low pressures, and duplex packing for use with high pressures, was shown. A form of double cone packing, especially suitable for Corliss valve spindles, was also exhibited.

Chas. Churchill & Co., Ltd.,

OXFORD STREET, MANCHESTER. (STAND NO. 292.)

Machine Tools.—A large number of machine tools, among which were various patterns of high speed drills, Lodge & Shipley patent-head lathes, Grant rivet spinning machines, and grinding machines, were exhibited by this firm. Among the grinding machines was one which has been especially designed for grinding piston rings for automobile and gas engines, discs, saws, dies, and annular surfaces, either flat, convex, or concave. The body of this machine, which we illustrate opposite, carries a long sleeve in which runs a vertical spindle carrying a magnetic chuck. This sleeve has a micrometer vertical adjustment and power feed with automatic stop, thus allowing a large number of pieces to be ground to absolutely correct thickness, with little or no change of adjustment when using a wheel of suitable grade. The feed operates at each end of the stroke, and can be varied from 0·0001 to 0·00075 inch. The magnetic chuck is specially made to allow for wet grinding; it has six changes of speed for varying diameters of work, and can be instantly stopped without stopping the machine. The consumption of the chuck winding is from 60 to 80 watts, and it can be connected directly to the 110 or 220-volt lighting circuit if this be direct current. A fine radial finish is obtained with this machine. After a piece of work has been finished on this grinder, it retains a certain amount of magnetism according to the hardness of the steel. To get rid of this a special demagnetiser is required. This is simply a low-frequency alternating-current electromagnet, contained in a box. The laminated core and the windings are inside the box, as is also the alternating-current generator. Current for exciting the field magnets must be taken from the lighting circuit, and terminals for this purpose are provided at one side of the box. The excitation windings consume about 75 watts. In cases where no direct-current is available another form is made. This contains a generator in the body of the demagnetiser provided with both slip-rings and a commutator, and thus, besides being a self-contained demagnetiser, current can be taken from the direct-current side for supplying the magnetic chucks of the machines. All traces of magnetism are removed from any piece of work by merely passing the article over the pole faces. Demagnetising is most important in the case of cutters, as if left magnetised, they would gather a covering of chips and dust. Magnetic chucks for fixing to lathes were also shown by this firm. They are totally enclosed and watertight; the current is conveyed to the winding by contact rings on the back. The current consumption is about 40 watts. A variety of portable electric drills and grinders were also exhibited. The machines on this stand were driven by motors manufactured by Electromotors, Ltd.

William Asquith, Ltd.,

HALIFAX. (STAND NOS. 168 & 169.)

Radial Drilling Machines.—Four large drilling, boring, and tapping machines were exhibited by this firm. The most interesting of these was a 6 ft. central thrust radial drill for high speed work, with a double arm. An important feature of this machine, which is quite new, is the construction of the arm. The portion of the arm in which the spindle slide works is of the box girder section, and the spindle works midway between the two long walls of the arm, ensuring a central thrust, and entirely eliminating side twisting strains. The lifting stresses are distributed over a large area on the underside of the arm. The thrust pressure on the spindle is taken by a ball thrust bearing. This 6 ft. machine and all larger are fitted with a fine radius motion, which allows of the arm being easily and accurately adjusted from the workman's position by the slide, and which can be thrown out of gear when it is required to swing the arm rapidly round. By the use of a simple tie rod the machine can be quickly converted into a rigid vertical boring machine. Double gear is provided on the spindle slide, and the spindle is fitted with a clutch motion. These enable the spindles to be started, stopped, or reversed without using belt motion, and further when tapping, the reverse speed can be made quicker than the tapping speed. A variable self-acting feed motion is provided, and a large number of cutting speeds can be obtained. Change of speed can be effected whilst the machine is running. The other machines which were shown had the usual single arm, which carries the spindle on one side.

Bateman's Machine Tool Co., Ltd.,

PLANER WORKS, NEAR HUNSLET, LEEDS. (STAND NOS. 90 & 91.)

High Speed Planing Machine.—A fine example of the line of high-speed planers manufactured by this firm was exhibited. This size of planer has a stroke of 10 feet, and a range of 3 feet either way. The machine is driven by a Siemens' three-phase motor supported on the top of the frame, and has three cutting speeds of 20, 40, and 60 feet per min., with a constant return speed of 176 feet per min. The chief feature of the machine is the patent flywheel drive, by means of which the reversals are made promptly and acceleration is rapid. An automatic friction clutch is fitted between the fly-wheel and the fast pulley on either side; one flywheel operates the cut and the other the return. The belts are wider than the fixed pulleys, and overlap on to the fly-wheel pulleys, so that they take up much of the stored-up energy of the flywheel. In the ordinary rack-driven machines the rack is bolted direct to the table, but in this machine the rack has a short longitudinal motion in a groove on the underside of the table. Spindles are secured to a cross-head at one side of this sliding rack, and these spindles carry adjustable springs. The latter absorb all the shock of reversal, and so enable the machine to be run at a very high speed, without either shock or strain on the toothed gearing and driving belts, owing to the elastic action of the springs.

Consolidated Pneumatic Tool Co., Ltd.,

PALACE CHAMBERS, BRIDGE STREET, WESTMINSTER. (STAND NO. 225.)

Portable Tools.—This company exhibited at the stand of Messrs. Steinthal & Boydell, their Manchester agents, a large assortment of electrically-driven portable tools, including a magnetic drilling post with a circular magnet giving a very firm hold. There was a complete range of electric drills, both with single and double armatures. A portable blower for cleaning purposes is a piece of apparatus that has elicited many inquiries owing to its numerous applications. A neat, self-contained motor-grinder, and a lathe grinder for fixing on the lathes to true up the lathe centres were also exhibited.

Alfred Herbert, Ltd.,

COVENTRY. (STAND NO. 87.)

Sensitive Drilling Machine.—A 3-spindle sensitive drilling machine was shown at work to demonstrate its extreme speed which enables the best results to be obtained from high-speed drills of small diameter. A maximum spindle speed of 2,050 r.p.m. is obtained, at which a ¼ in. hole may be drilled to a depth of 1 in. in cast iron in 1 1·5 seconds. This high speed is rendered possible by the use of ball bearings throughout. "Single track" ball bearings are used. It is claimed that the bearings need only be lubricated once a year.

Hexagon Turret Lathe.—The 1908 pattern of this lathe, which embodies some improvements in detail, was shown. The roller-steady turning tool enables very rapid work to be turned out. The lathe exhibited will admit bars up to 2¼ in. diameter, and has a working stroke to the turret of 30 in. in length.

Automatic Turning Machine.—This was at work finishing small pulley castings, and an ingenious chuck was used for gripping these, obviating the necessity of adjusting an internal chuck. On the machine being started, all the operations of centreing, drilling, turning, facing, forming, &c., proceed automatically, until the piece is finished, when the machine stops. The "self-selecting" feed motion gives seven feeds for each cam, the changes of feed being made automatically by the machine. With this feed motion all the feeding cams are alike, and there is a change-feed dog for each cam having seven holes. Into any one of these holes a pin can be placed, the pin setting the feed to the required rate. To change the feed for any tool, the pin corresponding to it is simply placed in the hole relating to the feed which is required. The quick or idle motions are obtained by a constant-speed pulley on the countershaft, and the feeding motions by gearing from the headstock. The whole range of seven feeds can be raised or lowered in rate by change gears to suit the different classes of work. This feed motion renders the machine adaptable for a great variety of work, especially where quantities are not very great, and where changes in the setting of the machine are frequently required.

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Luke & Spencer, Ltd.,

BROADHEATH, NEAR MANCHESTER. (STAND NOS. 43 & 44.)

Tool Grinder.—A new patent tool grinder with some interesting features was exhibited by this firm. The wheel is of sapphire corundum, and the patent fountain tool rest fitted to the machine ensures a continuous flow of water on to the edge of the tool. The water is pumped into the tool rest itself, from which it is emitted in the form of a number of small jets which converge towards the centre of the wheel face. The inner jets impinge on the tool, and the outer jets play on to the wheel just above the tool; thus, the point of the tool is covered with water, above and below. The wheel is fitted with the firm's patent adjustable guard.

Saw Grinder.—This tool, which was shown working, is a grinder for circular wood-cutting saws, and can be adapted for grinding band saws, by attaching two extension bars with pulleys, which are supplied with the machine. A large number of other grinding tools were exhibited by this firm; these included an automatic surfacing machine, a motor-driven double emery-band polishing machine, and a commutator grinding apparatus.

Mayer & Schmidt,

OFFENBACH A MAIN, GERMANY. (STAND NOS. 8 & 55.)

Automatic Twist Drill Grinding Machine.—This was perhaps the most interesting exhibit on this firm's stand, as the machine grinds twist drills to the proper angle entirely automatically. The drill is held in a chuck and brought up to the emery wheel, given the necessary rotary and angular movement, and then turned so as to bring the opposite side of the drill to the wheel. This complex motion is obtained by a cam mechanism. Both the clearance and the cutting angle can be altered whilst the machine is running. The machine is fitted with a rotary pump to supply the water for the wheel, and a special attachment for pointing the drills.

Emery Grinder and Disc Grinding Machine.—The first of these machines is for rough grinding work, and the chief feature of interest is the method of removing the dust. The table rests are hollow, and a small fan driven from the machine sucks the dust down into the body of the machine. Here the dust is filtered from the air before it passes into the room. The accumulated dust must, of course, be removed from the filter in the body of the machine periodically. The disc grinding machine, which is suitable for rapidly grinding flat surfaces, such as commutator bars, brush holders, switch-blades, &c., is fitted with a similar dust exhauster.

Automatic Cutter Grinding Machine.—This machine is for sharpening straight, spiral, conical, or face milling cutters up to 8 in. in diameter, and 24 in. in length. The grinding wheel is provided with an automatic feed. The cutters are fixed on a mandrel between centres, and automatically ground with the greatest accuracy.

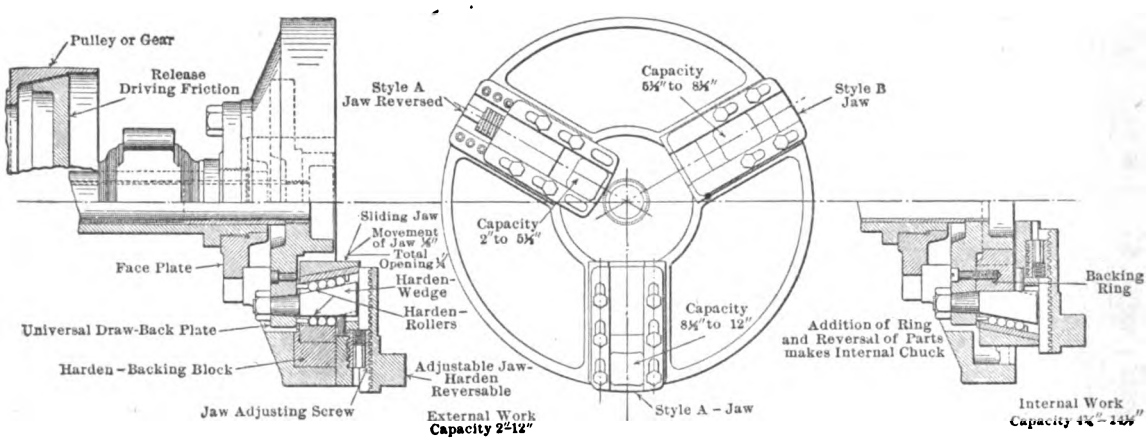
H. W. Ward & Co.,

BIRMINGHAM. (STAND NO. 156.)

Four Spindle Automatic Machine.—The feature of this machine is that all the tools operate simultaneously. The piece of work is brought round to each tool in succession, but four pieces are worked on at once. The tool support only moves longitudinally to feed the tools up to the work. The speed of the screwing spindle of the tool head can be varied by means of a cone of gears; this enables the speed of the tap or die to be increased when tapping or screwing a fine thread. The hole in the spindles will pass a 1 in. bar and the length turned is 4½ in.

Automatic Bar Chuck.—A new high-speed automatic bar chuck was also shown by this firm. The working parts of this chuck are all enclosed and are operated by means of a lever keyed on to a short shaft carrying a pinion. The pinion gears into a toothed segment of the inner sleeve of the chuck, and when this is rotated, a lateral movement is effected, by means of two spiral grooves in the sleeve, in which two stationary white metal keys engage.

G. Harland Bowden & Co., 196 DEANSGATE, MANCHESTER. (STAND NO. 92.)—*Planing Machine.*—The exhibit on this stand was to illustrate some methods of electric driving of which the firm make a speciality. The principal exhibit was a 23 b.h.p. slow speed motor arranged for driving a reversing planer, and this was shown working with automatic switchgear to secure reversal at the end of each stroke. A magnetic brake attached to the motor comes into operation directly the tappet switch is locked over into the reverse position by an arm attached to the moving planer table. As the motor slows down, the current is automatically reversed; this disengages the brake and starts the motor in the opposite direction. The total time taken in the reversal of the whole of the gearing and table from full speed in one direction to full speed in the other direction is about five seconds. The motor is fitted with interpoles and designed to give a heavy starting torque. Another motor was shown coupled direct to a special triplex reducing gear, by means of which the motor speed of 1,500 r.p.m. is reduced to 75 r.p.m. The efficiency of this reducing gear is stated to be from 94 to 96 per cent.; the high and low speed shafts are axially in line, which results in a very compact drive. This motor also was operated by automatic starting gear. Among the other exhibits were a standard three-panel switchboard and various patterns of starting gear.



Details of Garvin Automatic Chuck. (C. W. Burton, Griffiths & Co.)

C. W. Burton, Griffiths & Co., LUDGATE SQUARE, LONDON, E.C. (STAND NO. 27.)—The most interesting thing shown at this stand was a new automatic chuck. On a treadle at the base of the lathe being depressed, the lathe is stopped, and at the same time the chuck is opened automatically. When the treadle is raised again, the piece is gripped, and the machine starts. The chuck is arranged to grip eccentric or angular work, and to hold the work by the outside or inside as required. The drawing above shows its construction. The jaws are operated by hardened and ground wedges with rollers. The wedges are attached to a common disc, which is drawn back by a very powerful spring in a box overhung beyond the end bearing, and not seen in the drawing. On each sliding jaw an adjustable gripping jaw is mounted, which has a fine screw adjustment, and can be clamped in any position, and bound by six bolts. Among the other machines exhibited was a universal milling machine, driven by a single pulley. The spindle is driven by gearing inside the body of the machine, so arranged that 18 speeds can be obtained without stopping or interfering with the machine. The feed changes are twelve in number, and these can be changed without altering the spindle speed.

Cunliffe & Croom, Ltd., BROUGHTON IRON WORKS, MANCHESTER. (STAND NO. 296.)—Among the machines shown by this firm was an upright drilling machine with sliding head and 30 inch swing. A positive gear feed, giving three rates of feed ranging from 0·005 in. to 0·015 in. per revolution of the spindle is furnished with this machine, and a hand worm-wheel feed and quick

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hand-wheel return are also provided. Eight spindle speeds, ranging from 23 to 400 revs. per min. can be obtained. Another interesting machine was a 51 in. vertical turning and boring mill with a motor drive. The speed changes in this machine are obtained by means of differential gear operated by a lever. By this means, eight speeds are possible without the use of a variable speed motor. The two heads are quite independent of one another, and will swivel for angular work to an angle of thirty degrees. Eight changes of feed are obtainable at each of the eight speeds. Other machines, including a 6 ft. by 2½ ft. planer, disc grinders, and milling machines, were exhibited.

H. Luke, Ltd., 12 & 14 Brazennose Street, Manchester. (Stand No. 212.)—A boring machine, of considerable use in wiring work, was exhibited. This consists of a long steel tube, to the extremity of which a bit is fixed at right angles. A chain which passes over the toothed wheels to which the bit is geared permits of the bit being worked in positions otherwise difficult of access. Joists in flooring can be easily pierced for wiring purposes with the aid of this machine.

B. & S. Massey, Openshaw, Manchester (Stand No. 282).—*Power Hammer.*—A 3-cwt. electro-pneumatic power hammer, which was at work, attracted considerable crowds. The hammer is worked by a 7-h.p. Lancashire Dynamo & Motor Co. motor running at 850 r.p.m. This drives a pump through a single reduction spur gear with a raw-hide pinion, by means of the ordinary crank and connecting rod, and air is thus supplied directly to the cylinder of the hammer. There is thus direct pressure, both for the working stroke and the lifting stroke, and the amount of air, and thus the severity of the stroke can be regulated either by a foot pedal or by hand. It is also possible to hold on the hammer under pressure for bending, &c. In addition to this the firm exhibited a self-contained 3-cwt. friction drop stamp, driven by an electric motor, which can be regulated with extreme ease.

Oliver Machinery Co., Ltd., 201-203 Deansgate, Manchester. (Stand No. 283.)—The chief exhibit of this firm was a disc wood grinder for pattern shops. Canting rests, and a fan exhaust for the dust are fitted to this machine. The glasspaper is clamped to the steel discs by metal rings. A pattern of band saw, which was exhibited, is fitted with a spring tension device instead of the usual weight in the body of the machine. Automatic saw filers were also exhibited. The chief feature of these machines is that the file is given the same motion as it would have were a man doing the work. The machine for filing band saws was fitted with side and top brushes for cleaning the saw.

Frank Pearn & Co., Ltd., West Gorton, Manchester. (Stand Nos. 178 & 228.)—*Surfacing, Boring, and Milling Machine.*—The principal exhibit on this firm's stand was a large surfacing, boring, and milling machine. Attention should be drawn to the method of driving the spindle of this machine; the pulley, which is mounted on the spindle between the bearings, is belt driven, thus eliminating the usual bevel gearing. For heavy duty with consequently slower speed, ordinary spur back gearing is brought into requisition. The speed, feed, &c., are controlled by levers conveniently placed at the front of the machine.

John W. Perkin, Lord Street Works, Leeds. (Stand No. 234.)—This firm exhibited a representative selection of their machine tools, which include screw-cutting lathes, high-speed sensitive drilling machines, hack saws, and twist-drill grinders. A self-acting shaping machine, in which the return stroke is quicker than the working stroke, was also shown.

Pollock & Macnab, Ltd., Bredbury, near Manchester. (Stand No. 110.)—This firm exhibited lathes with single pulley drive, and with heads having self-contained gears which enable the speeds to be obtained without a countershaft. A similar device has also been used by the firm in connection with their drilling machines. Among the lathes of this type shown was a capstan lathe for chuck work up to 18 in. diameter, and capable of taking bars up to 2½ in. diameter. The sixteen spindle speeds are obtainable by moving four handles on the head. One of these has a position for putting the pulley out of gear, and all are so interlocked that it is impossible to damage the gear by endeavouring to put on two speeds at once. The machine has eight feeds forward and eight reverse, and the changes are made simply by moving a pointer to the position indicated on the part of the feed-box. These and other ingenious devices in the design of this machine and the turret lathe which was shown attracted much favourable attention at the exhibition.

C. Redman & Sons, Pioneer Iron Works, Halifax. (Stand Nos. 170 & 171.) Two large machines were exhibited by this firm. One of these was a large planing machine capable of taking a cut of ⅜ in. by $\frac{1}{2}$ in., and having a range of 6 ft. by 2½ ft. This machine is provided with a patent four-speed countershaft, giving four rates of cutting with a constant speed return. The other machine shown was a lathe with 10 in. centres and 12 ft. gap bed, specially suitable for roughing out shafts from the solid forging. A new pattern of easily adjustable feed is fitted to this lathe, and six rates of feed are obtained. The lathe was driven through belt gearing by a 30 h.p. motor.

J. Rhodes & Sons, Ltd., Grove Ironworks, Wakefield. (Stand No. 30.)—*Power Presses and Shears.*—Three examples of the power presses for use in the manufacture of sheet metal stampings and manufactured by this firm, were exhibited. The chief feature of these machines is the patent safety clutch which prevents the press from working more than once after the treadle is depressed. Before a second stroke can be obtained the treadle must be released and again depressed. This safety clutch renders the machines as safe to work as hand presses. One of the machines had a cam-actuated die-slide which automatically brings the bottom die to and from the punch. All the machines can be worked in the upright or an inclined position. The high speed shears exhibited by the firm were also fitted with the above safety clutch and although the treadle may remain depressed, another descent of the blade cannot occur.

Thomas Robinson & Sons, Ltd., Rochdale. (Stand Nos. 23 & 45.)—*Wood-working Tools.*—Perhaps the most interesting tool exhibited by this firm was a two-spindle saw bench, suitable for all kinds of accurate sawing, such as is required in pattern-making, cabinet-making, fine joinery, &c. The table is divided into two sections, the back section being fitted with an adjustable bevelling fence, and the front section with angle fences for cross-cutting and mitreing. The table can be quickly canted to any angle up to 45 degrees, and can be locked so as to be perfectly rigid in any position. The machine has two saw spindles, one to carry a saw for cutting with the grain, and the other one for cutting across the grain. Either of these saws can be quickly brought above the table for work; as the one rises, the other descends below the surface of the table and at the same time falls out of contact with the driving belt. The change-over can be accomplished when the machine is running. The machine shown was belt-driven by a motor of the Lancashire Dynamo & Motor Co.'s make. A large vertical hollow chisel mortising machine designed for heavy mortising, recessing, and tenoning, as used in railway carriage and wagon shops, was also exhibited. The sliding headstop, on which the mortising ram reciprocates, rests on roller bearings in planed ways, and these enable it to be easily moved by a cutrack and pinion. The stroke of the chisel ram is variable, and is controlled by a hand-lever. The auger, or bit, which revolves inside the square hollow chisel, is driven over turn pulleys from the back of the machine. Among the other exhibits were a 36 in. band sawing machine, a continuous roller-feed saw bench, and a tenoning machine.

Union Standard Machine Co., 165 Queen Victoria Street, London, E.C. (Stand Nos. 193 & 208.)—The principal exhibit of this firm was a number of patterns of portable wrought iron work benches. These consist of tripods on which either a bench vice, or a pipe vice, or both are fixed, together with a tray for small tools. The workman stands on a step attached to the base of the tripod, and thus uses his own weight to steady the bench. A large number of small punching and shearing machines, and other small tools were exhibited by this firm.

G. Birch & Co., Islington Tool Works, Salford. (Stand No. 15.)—*Grinding Machines, Slotting Machines, &c.*—A description of the exhibits on this stand appeared in the supplement of our issue of October 15th (p. 29).

Henry Wallwork & Co., Ltd., Roger Street, Manchester. (Stand No. 42.)—*Gear-Cutting Machines.*—A description of this firm's exhibits appeared in the supplement to our issue of October 22nd (p. 37).

The Electron.—The October number of this magazine, conducted by the employees of Messrs. Siemens Brothers' Dynamo Works, Ltd., Stafford, contains an article by Mr. C. H. N. Chamen on "High Voltage Transmission and Distribution." The series of biographical notices of prominent members of the Siemens family is continued, and a portrait of the late Carl H. von Siemens is given. The frivolous portion of the contents is represented by a delightful conversation between the well-known Mr. Dooley and another, by an author who modestly signs himself "Z." Other articles deal with the new Patent Act and Reminiscences of an Englishman's First Visit to Germany.

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REVIEWS OF BOOKS

Cranes. By Anton Böttcher. Translated by A. Tolhausen. 492 pp. 556 illustrations. 10¾ in. by 7½ in. (London: Archibald Constable and Co.) 42s.

This monumental work deals with the entire practice of crane building with an exhaustiveness which does great credit to the industry both of the author and the translator. Mr. Böttcher's portion of the book deals with cranes and appliances of German design only, and a large portion of the information he gives is the outcome of his connection with the conversion of the Stettiner-Vulcan workshops to electric driving. Mr. Tolhausen is responsible for the translation of Mr. Böttcher's work from the original German, and for a large amount of supplemental information of a general nature upon English and American practice, in addition to an introductory chapter which contains some pithy remarks anent the inroads made recently by German manufacturers upon a field of enterprise for many years looked upon by English engineers as peculiarly their own.

Perhaps nothing is more clearly illustrative of the comparatively recent growth of the German crane industry than the complexity of type and design exhibited, and whether German practice will eventually settle down to the use of a few well-marked types proved through experience to be the most satisfactory, is a question which only time can answer. There can be no doubt as to the vast amount of calculation and consideration expended over every detail, although this would appear to have complicated and lightened the structures in a manner hardly in accordance with English ideas. Possibly competition with German designers may influence English practice to some extent in their direction, and there is an equal possibility that experience may lead the Germans some way towards English ideas of solidity and simplicity of structure.

Mr. Böttcher's book offers a vast fund of information upon all aspects of continental design, and includes exhaustive tables of calculations. His chapter upon chain-driving and the figures given therein should prove extremely interesting to English engineers, and lead them to understand the predilection shown by their German competitors for this method of transmission.

The method of arranging the different sections is much to be commended; the opening section embodies the first principles of mechanics involved in the design of cranes and other lifting machinery, with illustrative diagrams and figures, and is immediately followed by a profusely illustrated chapter upon general designs of cranes. This principle is followed throughout the book, the formulæ applying to each class of mechanism are fully explained and set out, being followed by photos and descriptions of foreign cranes actually at work, with the designers' calculations fully detailed. These should prove extremely interesting to English engineers, and it is, perhaps, regrettable that the English and American examples added by Mr. Tolhausen do not embody the same amount of information for purposes of comparison. At the end of the book are supplementary tables of profiles and moments of inertia.

The book is well translated and conveniently arranged, and the illustrations are of good class. The single volume, is however, rather bulky, and might with advantage be split into two volumes of more convenient size. One thing, however, may be said, and that is, that the book is of great interest throughout, and the attractive method of arrangement never permits interest to flag.

Power Railway Signalling. By H. Rayner Wilson. 339 pp. 12 in. by 9½ in. 623 illustrations. (London: "The Railway Engineer.") Price, 18s.

Mr. Wilson's book will take rank with his work on "Mechanical Railway Signalling" as an up-to-date book of reference, indispensable to the railway signalling engineer. Portions of it are also of interest to railway men generally, and to others who like to know the technicalities and the trend of development in departments outside their own special work. Such portions are those which discuss the pros and cons of "lock and block" systems, with "track circuiting" as an alternative; the apology for the American use of the "train order" system; the discussion of automatic signals, and of interlocking power plants. These discussions show a breadth of mind and impartiality which are rare and refreshing in the writings of men like our author, who are generally and necessarily biassed by their own experiences, and are rarely able to conceal their bias. This is not to say that the author has no opinions of his own, far from it; but he can see how far differing conditions and circumstances compel or justify variation in methods and state the case with much lucidity and fairness. The non-specialist reader will also find some interesting and probably surprising figures as to the extent to which automatic signals, power operation, and track circuiting are already used in this country, but he will also perceive that the number of adaptations and combinations of systems is sufficient to prove that there is no such general consensus of opinion as to foreshadow the early general adoption of any particular one.

The chief interest of the book must be for the specialist, and lies in the description of the apparatus used and its various combinations to meet the many requirements of railway working. The inclusion of the ordinary block signalling instruments may seem a little outside the range of the title, but it is the logical and proper introduction to the subject, leading up to the modern "all-power" operation of points and signals. The conscientious reviewer finds himself in a difficulty in criticising a work like this, which is mainly concerned with detailed descriptions of highly specialised machinery, and it cannot be claimed by this one that every description has been read and checked. But from selected samples it can be affirmed that the descriptions are clear and intelligible, with a slight tendency to over much conciseness, which is rather a virtue to the specialist reader, and assisted by diagrams and figures generally excellent, but in many cases lettered in too minute a type for quite easy reading. The electrical engineer will not find electrical details very fully dealt with, and we particularly note the absence of quantitative discussion of the insulation and conducting qualities of ballast and rails, and the relation of battery power and relay windings, in reference to track circuiting. Nor is there much said about the cost and expenditure of the various forms of power, of which the use is described. These omissions, however, detract little from the value of the work to those for whom it is specially intended. The printing, illustrations, and general get-up are excellent, but we personally find the shape and size somewhat awkward.

Laboratory and Factory Tests in Electrical Engineering. By George Sever and Fitzhugh Townsend. 269 pp. 98 illustrations. 6 in. by 9¼ in. (London: Archibald Constable & Co.) 10s. 6d.

This octavo volume has 269 pages and 98 figures all of a diagrammatic character, and is creditably pro-

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duced. We read its title and noted the ground covered by the book with agreeable anticipation, because a work handling the subject ably would be of great use to students and to test-room assistants. It is, however, in some ways disappointing. One point at least we can commend which is in a measure the keynote of the book, and in all testing for whatsoever purpose its importance can scarcely be overrated. "Before commencing any experiment or test," the authors tell us on p. 1, "its description should be carefully studied in order to obtain a clear understanding of its object and the method of procedure"; nor do they allow this extremely desirable, if little recognised, phase of testing to drop out of sight at any point of their treatment of the subject. We were also glad to remark that all descriptions are easy and free from obscurity, and as far as ready accessibility is concerned the information is well presented. It is rather in matters of detail that we are disposed to differ. To put our accusation in a word, the book is not practical; its sins of omission are especially extensive, and it is difficult to avoid the impression that the authors' recent experience of testing is confined to the small machines and apparatus found in a college workshop. For example, a large amount of space is devoted to discussing the determination of characteristic curves of various types of machines, many of which are of no practical value; whereas the testing of large machines by the various varieties of the so-called Hopkinson method are not even alluded to. Again, what test-room could be called approximately complete without water-tanks or tubs for testing dynamos, and water-brake pulleys for testing motors. The only Prony brakes described, if applied for more than a few minutes to any motor of more than 10 h.p., would certainly burn up, and from the absence of any description and instructions in their management we must suppose that the most important modern development in direct-current machinery, namely, the commutation pole, is beyond the authors' ken. We do not share the authors' view that the most accurate measurement of the efficiency of a dynamo or motor is to be got by running it on light load, and we own to feeling a prejudice against a book on testing which leaves untouched the subject of how to devise a convenient and practical temperature test for a motor whose duty is intermittent. We know it may be urged that these are matters for a more advanced work, and that a student properly grounded in first principles may evolve his methods for himself. He may; but why not save him time and many a mistake by giving him a book in which the experience of practical men is properly explained?

On the other hand, we like the simplified description of the Heyland diagram for induction motors, and with the exception of one or two slips, as, for instance, on p. 116, where we find the curious inversion "$\text{Flux} = \frac{\text{Reluctance}}{\text{Magneto Motive Force}}$" the alternating-current matter is usefully presented. We do not believe, however, that the authors can have handled all the instruments described in the third and last part of the book, where the practical points about a Kelvin galvanometer, a d'Arsonval, a Secohmmeter, and a Kelvin ampere balance have been excluded in favour of a good deal of less appropriate and somewhat mathematiculistic theory.

THE CONDENSER IN TELEPHONY

By G. M. B. Shepherd

THE recent I.E.E. Paper by Mr. G. F. Mansbridge has drawn attention to the magnitude of the present demand for low-priced condensers of the foil and paper pattern, as exemplified by the statement that the factory output for the year 1907 amounted to 5 farads, or about 7,000 times the capacity of this earth, regarded as a sphere in space! Since the bulk of the condensers involved in the above huge total was in all probability absorbed by the telephone industry, it may be of general interest to give a short description of their use and applications in that branch of electrical engineering.

The functions of the telephone condenser may be classified roughly as follows:—

(1) As a convenient switchboard and instrument adjunct for differentiating between variable and continuous current.

(2) To improve transmission by the well-known quality of capacity for annulling inductance, and extending the range of current changes in speaking circuits.

(3) To absorb fluctuations in power leads, which would otherwise cause disturbances.

(4) For various purposes, such as the control of sparking at break contacts, the construction of artificial lines, and, perhaps, as a matter of scientific interest (for, except in the very early days, no commercial instrument seems to have been attempted) as a telephone receiver.

The standard unit in most modern exchange systems on the central energy principle is the 2-microfarad condenser; a variation from this figure of 10 per cent. either way when measured both by discharge deflection, and alternate current at 800 periods per sec. being allowed in the specification of the National Telephone Company. The company is at the present time making extensive use of two patterns of 2 m.f. condensers; a flat type, measuring over all 8 in. by $4\frac{11}{16}$ in. by $\frac{11}{16}$ in., and latterly a square form, $4\frac{13}{32}$ in. by $1\frac{3}{4}$ in. by $1\frac{5}{8}$ in. Both are metal-cased and conform to the same requirements in the matter of capacity, deviation, and breakdown voltage, though a somewhat lower dielectric resistance is permitted in the square pattern by reason of its smaller cubical content. Other things being equal, the advantage, of course, lies with the less bulky condenser, because of the larger number which can be accommodated in the limited space of a telephone switchboard or apparatus room. Fig. 1 is a drawing of one of the typical iron racks which are employed in common battery exchanges for mounting condensers and other apparatus. In this figure each shelf holds 350 condensers of the flat pattern, and the exchange to which the frame belongs (London Wall) makes use of a total of something like 3,300 for all purposes.

Turning now to the function and use of the 2 m.f. condenser. Probably one of the most important instances which can be quoted is that afforded by the common battery instrument of the Western Electric Company, in which the condenser forms an integral part. The principle of this instrument will no doubt be quite familiar to most people concerned with telephony, and a brief description of the action of the transmitter should therefore suffice. Referring to Fig. 2*a*, consider the microphone M to be in a state of rest with current flowing round the circuit from the + to − poles of the exchange battery. Between the points V_2 and V_1, there will be a certain P.D., and condenser will be charged as indicated by the + and − signs. If now the microphone resistance falls owing to the influence of sound waves impinging on the diaphragm, there is a drop in the P.D. $V_2 - V_1$, and consequently a

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discharge from the condenser round the local winding of the induction coil. This coil is so connected that the discharge induces a secondary E.M.F. in the line coil in the same sense as the main line current, and therefore augments it. When the microphone resistance rises again, the condenser recharges, and this time there is induced an opposing E.M.F. in the line winding which tends still further to reduce the main current. The condenser therefore widens the range of the transmitter action, and adds largely to its efficiency, a very necessary provision in a system wherein the actuating battery is removed to a distant point. If absent or faulty, there is a considerable depreciation both in volume and quality of transmission. Another important function of the condenser in this instrument is to open the bell circuit so far as continuous currents are concerned, which would otherwise lead to waste of energy and signalling difficulties. The receiver is also practically removed to a local circuit, and not exposed to possible demagnetisation from the main battery current.

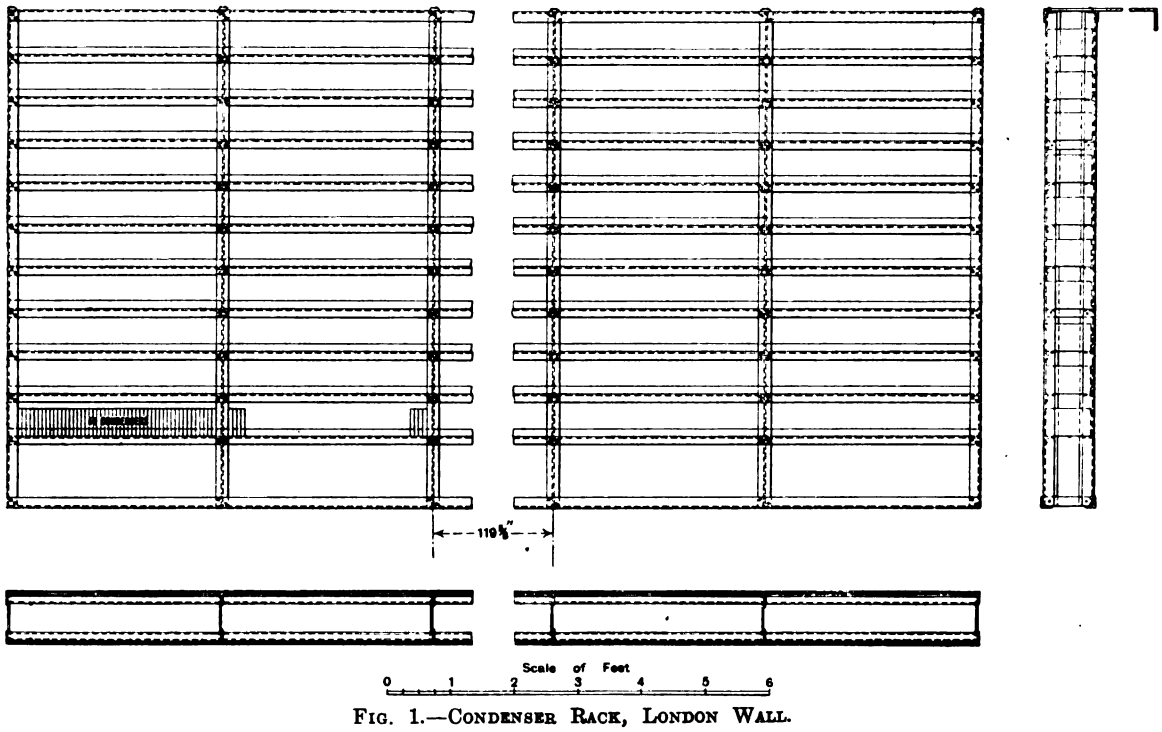

FIG. 1.—CONDENSER RACK, LONDON WALL.

Many telephone users whose exchanges have been converted from local to common battery working, will have noticed the black sandwich-box arrangement which has been fitted in or near their instruments some time prior to the change over, and possibly wondered what it meant. This is the 2 m.f. condenser that must be included in the bell circuit to enable automatic calling and clearing to take effect directly the new exchange equipment comes into operation, and thus to carry on until such time as it may be convenient to instal the complete C.B. type of telephone.

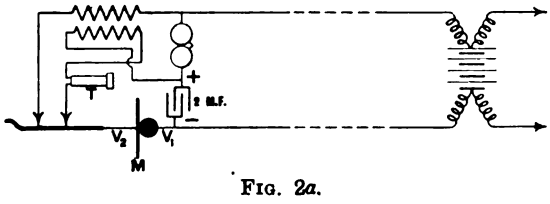

FIG. 2a.

Before leaving the subscriber's instrument, it is worth mentioning that the presence of the 2 m.f. condenser should not sensibly affect the efficiency of the 1,000 ohm magneto bell, although trouble has been experienced with certain older pattern bells actuated by 16-cycle ringing. This is easily rectified by raising the frequency to 20 or 22 cycles per second, when the ringing is, if anything, better with the condenser than without it, owing to the cancellation of inductance. This latter property is used to advantage in some of the selective calling systems introduced in the United States, but not much in favour in this country, as, for instance, the Leich party line, the signalling element of which is shown diagrammatically in Fig. 2b. There are four stations, two of which are responsive to 20 cycle, and the other two to 60 cycle ringing current; the voltages being equal in either case. The bell circuits are tuned by adjusting capacity and inductance so that each station receives maximum current at the particular frequency for which it is designed to work, but so small a current at the other frequency as to be inoperative. The method of doing this will be obvious on inspection of the diagram.

A few typical instances of the utility of condensers in switching circuits will now be dealt with. The majority of these come under heading No. (1) referred to above.

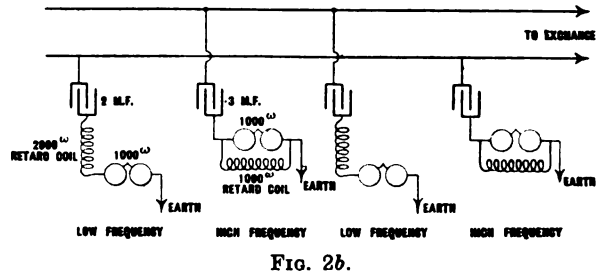

FIG. 2b.

Fig. 3a embodies the essential parts of the subscriber's cord circuit of the most commonly used form of "Stone" or impedance coil C.B. system. The currents required for the transmitters of the two parties in connection pass independently from the battery through retard coils, or relays for supervisory signals, to the two sides of the circuit, which is completed between the feeding points by 2 m.f. condensers. This arrangement ensures that each station receives a working current proportionate to its own circuit resistance,

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and obviates any trouble due to disparity between the lines connected. The condensers provide a comparatively clear path for undulatory voice currents, and at the same time divide the circuit into two mutually independent sections.

Another typical case is that outlined in Fig. 3*b*. This is a temporary junction circuit between a common battery exchange and an older magneto exchange not yet converted to C.B. The condensers are inserted in both lines to separate the two systems, and so prevent

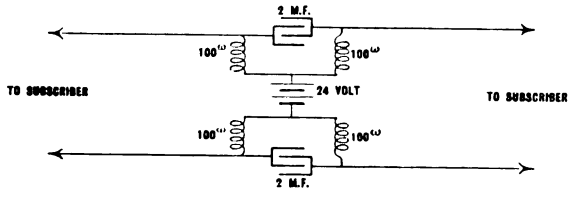


FIG. 3*a*.

complications arising from the central battery current affecting magneto apparatus. This being a ring through circuit, 4 m.f. is required in either leg, to avoid undue cutting down of the ringing, though from the point of view of transmission 2 m.f. condensers would be practically as efficient. It is, of course, a well-known fact in telephony that a very low capacity in series circuit will permit speech currents to pass; indeed, conversation is possible through two or three leaves of foil and paper, and probably only an expert could detect the presence of $\frac{1}{2}$ microfarad.

The standard subscriber's operator's equipment shown in Fig. 4 involves the use of two 2 m.f. condensers which fulfil rather different functions. The condenser in the transmitter circuit designated by *C*, is bridged across the microphone and primary of induction coil in order to provide an easy path for the varying microphone currents, which would otherwise be restricted to the circuit via 165 ohm impedance coil and battery, while that marked C_2 in series with the receiver, besides acting as a barrier to steady current when the listening key is put over, has for its special object the busy test. On tracing the connections it will be seen that normally this condenser is maintained at the potential difference of the central battery. If now the operator touches the bush contact of an engaged line with the tip of the calling plug, the condenser is discharged, and a click in the receiver notifies the condition of the line tested.

Condensers are used on all branch circuits used for electrophone distribution for the purpose of equalising the load on the common music line, and to lessen the

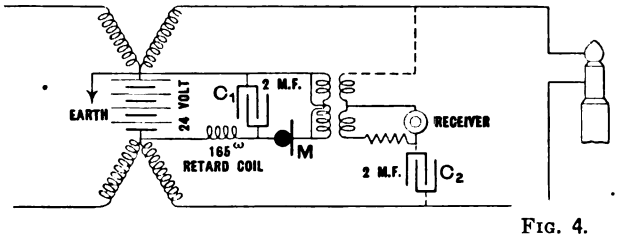


FIG. 4.

chances of breakdown, owing to a fault developing on one of the branches, and there are numerous other applications on common battery, and mixed common and local battery systems, wherein condensers are used as discriminators between steady and fluctuating currents, to enumerate all of which would be an impossible task. The foregoing should, however, give some idea of the contingencies met with in modern switchboard practice.

A very common use to which a condenser is put is that of a shunt to a relay or similar apparatus placed in the line circuit for supervisory work, which would introduce an objectionable amount of impedance to voice currents. As a general rule this device is all right and answers requirements, but it is interesting to note that cases have come to light in which the capacity shunt proved a doubtful advantage. As is

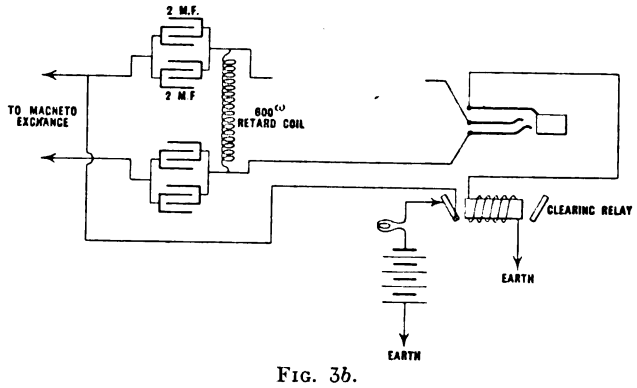
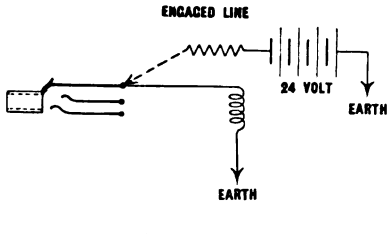


FIG. 3*b*.

well known, a pure capacity and a pure inductance in parallel will, at resonating frequency, behave like a perfect insulation to the external circuit, and although pure inductances are things which can hardly even be approximated to in the apparatus ordinarily employed in telephony, it is nevertheless possible for the combination in question, say, a relay and 2 m.f. condenser, to offer an impedance to currents of average speech frequency of perhaps several times that of the relay alone. It is well to bear this fact in mind in the design of circuits.

Referring now to the third heading, viz., the absorption of disturbances in power leads. It is usual to supply the power necessary for small private branch exchanges, over one or more pairs of line wires from the battery of a main exchange in the vicinity. Such a common lead would, from its nature, be very liable to give rise to cross talk between local sub-station circuits in use simultaneously, and this tendency is counteracted more or less completely by placing a fairly large capacity across the private exchange current 'bus-bars. A large condenser of 10 m.f. is made up especially for this purpose. Occasionally, too, it is found that the charging machine at the central office, particularly if not of the design adapted to telephonic work, introduces a serious amount of commutator disturbance when running on the accumulators feeding the switchboards. This noise can be considerably reduced, if not removed, by connecting a capacity of, say, 20 m.f. across the dynamo brushes in addition to



the choking coil, which is almost always placed between machine and battery.

In this same category one might include lines used for simultaneous telegraphy and telephony. So far as the writer is aware, not much is done in this direction in Great Britain, but a form of composite circuit used by the American Telegraph & Telephone Company is depicted in Fig. 5.*

This is a method of superposing two complete Morse telegraph systems upon a single loop telephone circuit.

* See also *American Telephone Journal*, June 24, 1905.

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The principles involved are broadly those developed by Cailbro and Van Rysselberghe. The sudden rise and fall of the sounder currents are checked and rounded off by the 6 m.f. condensers and double coil retards, R_1, R_2, &c., the latter acting differentially to slow impulses, but presenting considerable choking effect to the high frequency telephone currents. Further, any telegraph impulses which pass the 4 m.f. condensers are shunted to earth via the 30-ohm retard coils. On the other hand, speech currents are practically confined to the speaking circuit through the 2 m.f. condensers and spring jacks by reason of the strong choking of the 30-ohm and 50-ohm retardation coils. It is said that this composite circuit, when in good order, is quite satisfactory when all three components are working together, there being no appreciable mutual interference.

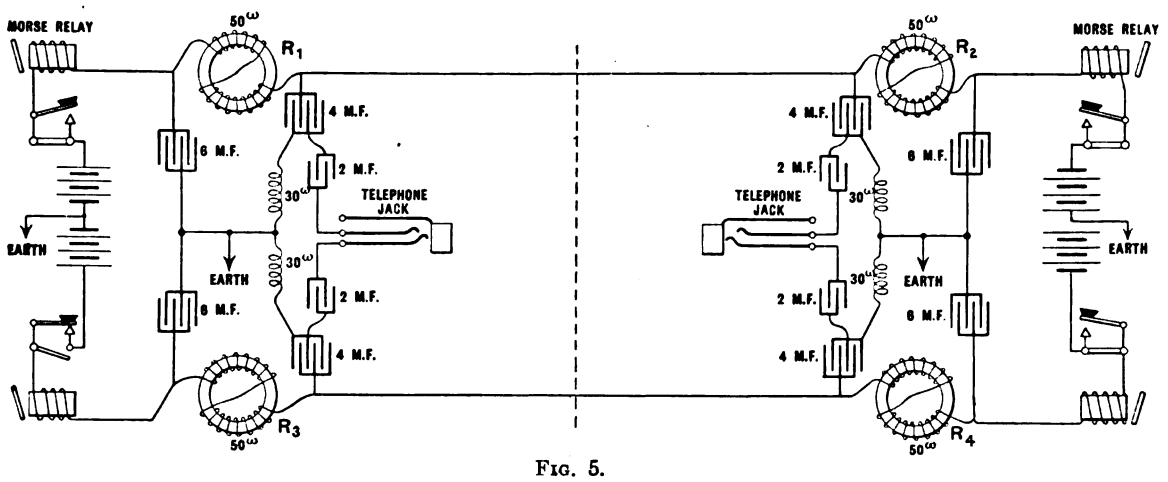

FIG. 5.

As regards miscellaneous applications, the prevention of sparking at vibrating contacts scarcely needs comment. Most exchanges possess some apparatus of the buzzer type with which one or more standard condensers are thus associated. Artificial cables, representing in particular 40 to 50 miles of 20 lb. standard dry-core cable covering the commercial limit of speech, are now becoming an indispensable item in test department equipment. It has been found that these cables can very well be constructed by arranging non-inductively wound resistance spools equal in resistance to one or even two miles of the real 20 lb. cable conductor, in series, with paper condensers of the ordinary type in bridge, having capacities approximating to one or two miles measured wire to wire, say, 0·054 m.f. or 0·108 m.f. as the case may be. Such a piece of apparatus having suitable section terminals and connectors can be built up for a very reasonable figure, and is of great value in all investigations relating to transmission.

As a conclusion to this brief account of the duties assigned to the telephone condenser, a word or two respecting the condenser receiver may be of interest. This is by no means a novelty, for early investigators succeeded in transmitting and receiving speech by utilising the electrostatic principle of varying the capacity of a system of flexible plates forming, or attached to, an acoustic diaphragm. The results obtained, however, though excellent as regards quality, were far too deficient in power to be of use commercially. This deficiency can be remedied by strongly polarising the coatings from a source of constant potential at several hundred volts, and it is surprising what an energetic and clear speaking receiver a loosely built foil condenser makes, if actuated in this manner. It seems not altogether improbable that important developments will take place in this direction in the future.

A NEW SYSTEM OF RAILWAY SIGNALLING

AN interesting Paper embodying some suggestions for removing certain defects of the railway signalling systems already in use was read before the Leeds Local Section of the Institution of Electrical Engineers by Capt. A. Gardiner, on Wednesday of last week. The author pointed out how in various cases a tendency was being shown to avoid reliance entirely on the driver's interpretation of external visual signals. As examples of this he mentioned the "train stop" of the London Underground Railways and the cab signalling system used on a branch of the Great Western Railway to replace distant signals (see ELECTRICAL ENGINEERING, Vol. I., page 431). It is pointed out, however, that a mixed system of signalling, with the "distant" in the cab and the "home" on the track, contains, moreover, a new element of danger, for the "distant" is not a final signal. Even though the "home" be off when the "distant" is passed, the signalman has the option of throwing it to "danger" before its post is reached by the train, and may thus possibly avert an accident. This danger appears to have been recognised by the North-Eastern Railway, and in their system they seek for something more than the single indication, and instal a series of signalling points, each of which confirms, or may cancel, the indication previously given (see ELECTRICAL ENGINEERING, Vol. II., p. 955).

A disadvantage of this system, however, is the use of a "gravity" safety position, as the signal is operated by a magnet that is "dead" for the safety position, and requires to be excited in order to show danger.

Another respect in which our present system of external signals breaks down is as regards reductions of speed. With signals on the cab, not only is it possible to give a "reduce speed" indication that cannot be confounded with any of the other indications, but it becomes possible also to make that signal act directly on the motive power of the engine, and so enforce compliance; and further, by providing for the automatic removal as well as the automatic exhibition of the signal, it becomes possible to obtain a record from which the actual speed over the restricted section can be indisputably established.

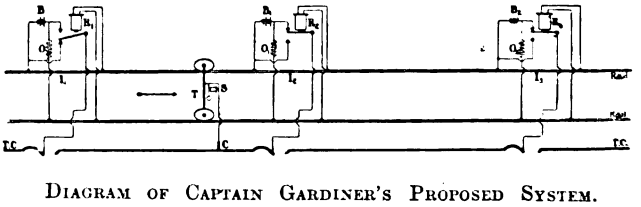

DIAGRAM OF CAPTAIN GARDINER'S PROPOSED SYSTEM.

The method proposed by the author involves the eventual entire abolition of the semaphore and its lamp. Parallel to the running rails is laid a metallic "track conductor" (T.C.).

The track is split up into track circuit sections of the desired

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length (insulated joints I_1 I_2), and the rails within the limits of these sections are bonded together on each side by one of the usual track circuit wire bonds. At one end of each section is a track relay (R_1 R_2), and at the other a track battery (B B_1) or other source of power for the track relay. The relay and the source of power are each connected to the rails in such a way that when no train is on the section the relay is excited and its armature drawn up; when a train enters the section the relay is short circuited by its wheels and axles and the armature falls away. The armature of the relay carries certain contacts which are closed when the armature is attracted, and for the purpose of this signal it carries also other contacts which will be closed when the armature falls away. A resistance (O_1 O_2) is inserted between the track battery and the track to prevent the battery itself being short circuited by the trains; and a parallel circuit is then taken from the battery positive through the contacts of the near track relay to the track conductor. The track conductor in each section is thus, when the relay controlled by the section ahead is energised, charged with the potential of the track battery above the negative track rail; but is dead when that relay is shunted. Consequently when any track circuit section is occupied, the track conductor of the track circuit section in rear is dead. As far as the first and principal indication to be given on the engine is concerned therefore, viz., "clear" and "stop," all that is required is some means of collecting current from the track conductor, and an electromagnet that will when energised show a "clear" signal, and when de-energised show a "stop" signal by the action of gravity. The action will then be as follows:—If the section (B_2 R_2) ahead of a train is clear, its relay R_2 will be energised. The battery B_1 will have part of its current shunted through the fixed resistance (O_1) and the wheels and axles of the train (T), while part of the current will pass *viâ* the track conductor and the collecting devices on the engine, and *viâ* the coils of the signal magnet (5) to the negative rail. The train will thus receive the "clear" signal. Should, on the other hand, the section ahead be occupied (as is the section B_1 R_1) the relay (R_1) being de-energised, the track conductor will be dead, and a following train will receive the "stop" signal. The lower contact of the relay is arranged to connect the track conductor directly to the negative rail of the section so that in the de-energised position of the relay it will be impossible for there to be sufficient difference of potential between them to retain the signal armature in the "clear" position.

To control the motion of the train, the armature of the signal magnet is supplied with contacts placed in a local circuit on the engine, which includes electromagnetic valves on the main steam pipe and the train brake pipe; the former to shut off steam, the latter to admit air to a vacuum equipment, or release the air from a Westinghouse one whenever the circuit is opened by the fall of the signal armature. The local circuit on the engine would also, if desired, include a whistle, bell, or buzzer, designed to operate when the signal falls, so as still further to attract the attention of the driver.

The recorder consists of a chart revolved by clock-work under a pen which is controlled by an electromagnet placed in a circuit of the local battery on the engine, and arranged so as to mark the chart when the signal magnet is in the released or "stop" position.

A train following the train "T," and approaching from the left, will be perfectly safe up to the insulated joint I_1; should it pass I_1, its collector and its signal magnet will be in parallel with the collector "C" and signal magnet "S" of train "T." To prevent this it is proposed to make use of a ramp to open the signal circuit of the following train. The track conductor is ramped in the neighbourhood of, and to the facing side of, each insulated joint. The cab signal has an additional "danger" magnet which controls three contacts, one for its own local circuit, one in series with the collector and the signal magnet, and one to operate an audible signal. Further, when de-energised it causes a shutter marked "danger" to drop by gravity in front of the signal window. The danger magnet is normally excited by the local battery on the engine, the circuit being through its coils and its own contacts in series.

One collector on each side of the engine is so arranged as to be normally insulated from this circuit, but when the collector is raised by means of a ramp it breaks the local circuit and substitutes for it another circuit from the ramp through the collector and the coils of the danger magnet to earth. If, however, the substituted circuit is dead, the armature of the danger magnet falls away on the opening of the local circuit, and in doing so breaks that circuit a second time at its own contacts. The local battery is consequently unable to resume control of the magnet after the engine has quitted the ramp. But the circuit of the signal magnet is also taken through the contacts of the danger magnet; and consequently the fact of the track conductor being alive beyond I does not result in a "clear" signal. The train would thus traverse the section I_1 I_2 (which is either occupied in some way or else unsignalled in consequence of a breakdown of its equipment, and which is therefore in either case an extremely dangerous zone) with the "danger" signal before the driver. This would be registered on the recorder, and the length of the section being known, the speed at which he traversed it would be indisputably established. If the delay had been due to the relay (R_1) being out of order, the track conductor in the section I_1 I_2 will have been alive.

Before leaving that section the engine must traverse its danger ramp, which is, however, this time a live one. The auxiliary circuit to earth which is made temporarily by one of the collecting shoes while on a ramp will now energise the danger magnet and close its contacts, enabling the local battery to resume control as the engine leaves the ramp and closing the circuit of the signal magnet. This is the normal action when quitting each "clear" section, the driver then requiring no notice whatever.

The above indications deal with the track between stations. We may now consider the approach to a station. The train may run in or through on the straight, or it may have to be turned off on to a siding or branch. In the latter case the driver should approach with reduced speed since it is not safe for him to take points for a turn-out at the same speed as for the straight. To give the warning to reduce speed, an independent ramp is placed (if the track conductor is outside) between the rails of the track. An additional magnet is supplied to the engine equipment and an additional contact device for the "reduce speed" ramp. The magnet works on the same principle as the "danger" magnet, but it is proposed that it should merely shut off steam and not affect the brake; this is, however, entirely a matter of what may be desired. The "reduce speed" magnet has a suitably worded shutter which appears by the action of gravity at a separate window placed as close as possible under that at which the "stop," "clear," and "danger" signals are shown. When the magnet is excited the "reduce speed" shutter is drawn up and the window is blank. The ramp circuit is dependent upon the points, and when these are set for the straight and all is clear, the "reduce speed" shutter will not drop; when set for a turn-out the driver will receive his warning, and with the aid of the recorder it will be possible to determine what action he took upon it.

It is, however, possibly further necessary to advise the driver of the actual route set for his train. With certain limits this can readily be done by means of bars on the track which will be normally dead, but one or other of which will be charged with current according to the setting of the points. The engine will carry a set of contact springs or other device and an indicator which will show the number of the ramp which is charged with current. The indication will not be a primary signal, and the absence of any indication can be treated as a "dead end" signal.

As regards the safety of such a system of signals as here advocated, the essential signal of the equipment is that which gives the indication "clear" and "stop." The "stop" signal is entirely a normal mechanical signal, and has to be held off continuously by a current received from the track conductor under the control of the track relay. Consequently even if the conductor be carried away altogether, the only result can be to stop the train.

As regards cost, a primary signalling equipment consisting of "clear," "stop," "danger," and "reduce speed" indicators, with the necessary contacts, &c., could probably be fitted, at a rough estimate, for about £20 per engine, which at 0·4 of an engine per mile, the figure for the Eastern Bengal State Railway, works out to £8 a mile. Fully equipped with train control as proposed in this Paper the cost would, of course, exceed this figure, but it is believed that the track work between stations with half-mile sections (instead of 1 mile as with the semaphore), need not exceed from about £140 to £160 per mile, and the engine equipments to from £40 to £50.

DISCUSSION.

Following the reading of the Paper, Captain Gardiner illustrated the working of his system by means of a complete model railway track and the actual apparatus used in a locomotive cab.

The discussion was entirely confined to experts on the subject, there being present a considerable number of representatives from the leading railway companies in the country, who had armed themselves with sheaves of written criticisms. While generally eulogising Captain Gardiner on the ingenuity and completeness of his system, there was naturally considerable technical criticism of the details which form such a radical

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departure from present-day methods. The general opinion was distinctly against the complete abolition of the semaphore, preference being given to retaining the "home" signal, but the "distant" semaphore, which is expensive to maintain, and liable to get out of order, might with advantage be replaced by a track signal with cab indication. The entire adoption of automatic track signalling would tend to make the driver a mere automaton, and the numerous electrical contacts and mechanical adjustments on the track would be difficult to maintain in efficient working order.

"DOUBLE DECK" STEAM TURBINE POWER PLANTS

IN a Paper read by Mr. J. R. Bibbins before the American Institute of Electrical Engineers at their annual summer meeting this year, a new design for electric generating stations was dealt with. There are now in service three important examples of this new type—the "double-deck" station. This type of station embodies striking originality in its departure from long-established practice, and is particularly suitable for power sites of restricted area.

At the outset it will be well briefly to review the most characteristic features of the station known as the West Point Station, before proceeding with a discussion of the double-decked type in general. The chief feature of this station is that the generating machinery is above the boilers on the second floor of the station; and the weight of the generating apparatus is supported entirely by the steel building skeleton. A section drawing of this station is given in the figure below.

The following other features are of interest:—(1) Barometric condenser hung from floor girders directly under turbine exhaust nozzle. Designed for moderate vacuum; no air pumps; adjustable cones; centrifugal type circulating pump. (2) Steam piping simple and direct with few bends, draining back from turbine throttle; no superheat; separators in each supply line to turbines. (3) All important steam header and supply lines controlled by pedestal extension valves from turbine floor; non-return valves in delivery from each boiler to prevent back-flow. (4) Header serves largely as equaliser, hence small in size (8 in.); sectioned by valves; operates practically on the unit system. (5) Designed for 200 lb. pressure, high steam velocities; largest steam pipe in plant 8 in., hung from girders. (6) All auxiliaries steam-driven for feed heating; open type heater; feed taken from condenser hot well. (7) Two-storey side addition accommodating transformers; switchgear and protective apparatus above; heaters and auxiliaries below; also serves as transmission tower. (8) Operating switchboard located in division wall, leaving a clear rectangular operating room, and separate switch room. (9) Generators air-cooled by positive blast piped from outside to reach cooler air and to avoid the possibility of steam from boiler room reaching insulation. (10) Turbine bedplate levelled on plate girders throughout its length with cast lead pad 1 in. thick. (11) Reserve exciter unit, steam-driven, exhaust to heater. (12) Transformers mounted on trucks to facilitate replacement by reserve unit provided. (13) Flue connections direct to stack; no bends. (14) Self-supporting, brick lined, steel stack.

The station was designed to serve interurban railway lines through alternating current sub-stations, and its position is reasonably near the ultimate centre of the system. It is but a short distance from some coal mines owned by the company, and the site chosen, at the foot of a hill, permits the use of the waters of two passing streams for condensing purposes. With this site, coal-handling machinery was avoided and barometric condensers used.

The Author explains his reasons for advocating this design as follows:—As compactness is perhaps the controlling feature, it is interesting to note that the problem now lies not with the generating, but with the boiler plant. Familiar Corliss engine practice of a decade ago, involving parallel engine and boiler rooms of about equal size, has been superseded by a ratio of one to three, or more, in turbine plants, especially if the boilers be double-decked, as in the large New York plants. It might, then, seem unwise to return to a station arrangement of equal area, as in the two-storey building; but it will be found that other advantages accruing in the direction of cost and simplicity render this arrangement most effective, especially as the extra space in the turbine floor is usually occupied by direct-current converting apparatus serving near-by sections of line. For several years there has been a continual reduction in the bulk and cost of the turbine unit. To what extent, can best be appreciated by comparison with Corliss practice.

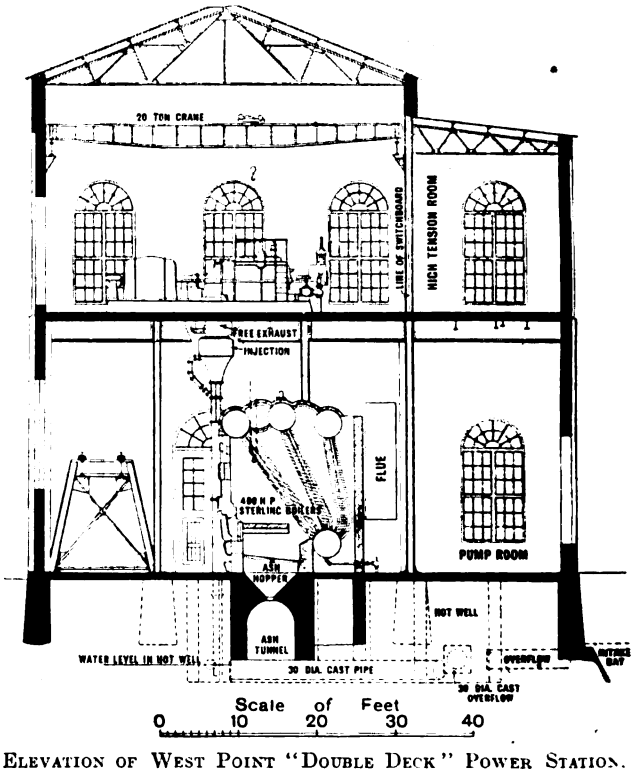
Type of prime mover.	Over-all floor space, square feet per electrical horse-power.
Horizontal Corliss, 500 to 1,500 e.h.p.	0·7 to 1
Vertical Corliss, 1,000 to 3,500 e.h.p.	0·35 to 0·4
Horizontal vertical compound Corliss, 7,000 e.h.p.	0·46
Vertical 3-cyl. Corliss 5,000 e.h.p.	0·2
Single-flow turbine, 1,000 to 5,000 e.h.p.	0·17 to 0·75
Double-flow turbine, 15,000 e.h.p.	0·05

Thus, in large sizes, the turbine has reduced floor areas to about 20 per cent. of that required by the modern vertical Corliss engine, and to about 10 per cent. of the horizontal vertical type. A detailed comparison between single-flow and double-flow types follows:—

Unit size. kw.	Type.	Floor space required in sq. ft. per kw.	per e.h.p.
1,000	Single-flow	0·200	0·149
1,500	,,	0·165	0·123
2,000	,,	0·141	0·105
3,000	,,	0·101	0·075
5,000	Double-flow	0·092	0·068
10,000	,,	0·063	0·047

Similarly in weight per kilowatt capacity. Data are not at hand for comparison with complete reciprocating units, but without generators, large vertical Corliss engines, including fly-wheel, weigh from 320 to 500 lb. per kilowatt, the weight increasing with the size, whereas the large turbine unit complete weighs but a fraction, 15 to 20 per cent. of the above, and, moreover, the weight decreases with the size. Considering in addition that the horizontal turbine permits the installation of auxiliaries beneath, this extreme compactness practically eliminates it in the study of reduced floor area. The West Point station covers a floor area of two square feet per kilowatt. Considering the small size, this represents a high degree of compactness, relatively better than in some large turbine stations. The Ft. Wayne double-deck station covers 1·42 square feet per kilowatt, ground floor plan, the second New York Edison Waterside 0·818, and the Boston Edison 2·64; and these latter have twenty to twenty-five times the capacity.

The Paper continues:—In spite of the relatively high speed, the construction of turbine machinery has been brought to such a state of perfection that structural foundations are permissible



ELEVATION OF WEST POINT "DOUBLE DECK" POWER STATION.

in certain types, which at once open up an extensive field for originality in the arrangement of units and auxiliaries. For example, 1,000-kw. units in a power house at Piedmont, W. Va., are supported entirely upon 8-in. cast iron pipe columns with units spaced 10-ft. centres, and all auxiliaries beneath. In a power house in Philadelphia, reinforced concrete posts tied into the concrete floor structure carry the entire weight of the generating plant. As the height of these columns is 20 feet or

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more, it is but a step further to employ standard column sections and elevate the machines to a height sufficient to place the boilers beneath. This has been done in the three stations already referred to. At Fort Wayne the turbine floor stands 28·5 ft., and at West Point 33 ft. above the boiler room on ground floor, by no means an excessive height. Here seems to be one of the most advantageous features of the horizontal type turbine—foundation loadings sufficiently distributed to permit of a light foundation structure involving preferably, but two principal points of support. It might, of course, be possible to provide a supporting column under each of the three bearings; but with the possibility of unequal settling at the footings and temperature changes resulting from the proximity to boiler settings, it is evidently a much simpler solution of the problem to employ two points of support. At West Point only 12-in. box columns are required. Of course, it is impossible entirely to concentrate the weight of the unit on these columns. A certain proportion must be carried by the building walls. It is therefore desirable to employ a steel skeleton building, carrying the machine crane and roof truss loadings independently of the brick wall. This evidently simplifies to a large degree the problem of maintaining proper turbine alignment. Although strictly necessary only for the turbine supporting structure, the steel work may be extended upward to relieve the wall loading, with little, if any, increase in cost over that of heavier building wall otherwise necessary. At West Point, the longitudinal members between the turbines are tied together into a continuous floor structure from wall to wall, with the sole object of reinforcement, resulting in an exceedingly rigid structure integral with the building skeleton, which has proved to be entirely devoid of any vibration. This applies also to the steel supporting columns, which show no evidences of vibration.

The West Point station is an excellent example of the possibilities of a compact condensing plant. The barometric condensers are attached directly to the turbine exhaust. Here the condensers are arranged in line with the boiler fronts, but with a passage of over 6 ft. between boiler settings, it is quite evident that the condenser may be placed wherever most convenient, irrespective of the position of the batteries, and with a discharge tunnel conveniently located.

In the double-deck station it is important to draw ventilating air from the outside to avoid not only the heat above the boilers, but also the possibility of escaping steam reaching the generator insulation. Some little difficulty here arises in avoiding structural work, but hardly to any greater degree than in the ordinary station. At West Point one vertical and one horizontal offset to the ventilating ducts suffice to clear both columns and girders. At Fort Wayne a rectangular steel duct extends from one end of the building to the other in front of the boilers, drawing air from either end, according to the prevailing winds. Each generator then draws from this air header through comparatively short and direct connections. An auxiliary steam-driven blower in the adjoining area way has also been installed to assist in delivering more air to the generators during very hot weather and peak loads. With this provision against excessive temperature rises in the generators, even under the worst conditions of atmosphere and load, there follows the maximum security against interruptions and the possibility of tiding over emergencies.

The avoidance of long runs and bends in steam piping is, of course, fully as important, if not more so, than in exhaust piping, and with boilers beneath turbines a most simple and desirable arrangement is possible. In the Fort Wayne station the steam has but 30 to 35 ft. to travel between any turbine throttle and the boilers supplying this particular machine, and with only two long-sweep bends intervening. Moreover, piping may be most readily drained—a point of value, even with superheat. At Fort Wayne, there is a continuous slope to the boilers. At West Point, where no superheaters are used, the header is drained by steam traps, separators being provided in each turbine line as an additional precaution. Under normal working conditions, therefore, the plant operates almost entirely on the unit system, with the interconnected header properly sectioned to isolate trouble in emergencies. In both stations each turbine line connects to the header close to the feeders from the boilers supplying it, so that the header operates simply as an equaliser between the various points of demand.

There is an excellent building arrangement at West Point to provide for switch room and auxiliaries. An addition to the rear of the main building accommodates the electrical apparatus above, and the feed pumps, circulating pumps, and heater below. This addition provides a rectangular engine and boiler room of minimum proportions, with centralised auxiliary and electrical control plants, permitting the installation of the switchboard in a most convenient position between the building columns, with all the high-tension apparatus in the rear, including high-tension bus-bars, circuit-breakers, and protective apparatus with transmission line outlets near the roof. In the 33 ft. between floors, there is space for a mezzanine floor or gallery for some of the small auxiliaries, but this has not been made use of at West Point.

THE POWER REQUIREMENTS OF MACHINE TOOLS FOR RAILWAY SHOPS

AN abstract of an appendix to a Paper on "High-Speed Tool Steel" read by Mr. L. R. Pomeroy before the Central Railway Club of Buffalo, U.S.A., is given in a recent issue of the *Railway Gazette*. This abstract, which deals with the horse-power required to drive the various machine tools in railway shops, is of considerable interest, and is reproduced in full below.

Generally speaking, for railroad repair shops, the generator capacity approximately equals 15 kw. per locomotive pit, or space in erecting shop occupied by one locomotive. This comprehends requirements for tools, cranes, heating, blower and exhaust fans, and thus provides for all power required except lighting. The tools alone require about 9 to 10 kw. per pit; heating, blower and exhaust fans 5 kw. per pit, while 3 kw. per pit will suffice for the ordinary shop and adjacent yard lighting.

The following curves, Figs. 1 to 8, are submitted to cover the general horse-power requirements of machine tools ordinarily found in railroad repair shops. Occasionally certain tools are selected with the purpose of performing extra heavy service, to utilise the full capacity of the new rapid cutting tool steel, as is now done in manufacturing shops; in such cases the power to drive must be figured on the basis of service required of the machine. As these cases are few and exceptional the curves meet the majority of conditions, but the exceptions can be taken care of by the following formula :—

Horse-power to drive equals $F \times D \times S \times 12 \times N \times C$., where

F = Feed in inches.
D = Depth of cut in inches.
S = Feet per minute.
N = Number of tools cutting.
C = A constant depending on the class of material, with the following values :

For cast iron	0·35 to 0·5
Soft steel or wrought iron	0·45 to 0·7
Loc. driving-wheel tires	0·70 to 1·00
Crucible steel driving-wheel tires	1·00 to 1·10.

This formula is based on Prof. Flather's dynamometer tests, which compare favourably with actual motor tests, and is, therefore, submitted with confidence. For example : The aggregate horse-power of 45 tests, with various tools, by test was 247·7, while the calculated aggregate horse-power by formula equalled 247·2. The extensive tests made by Dr. Nicolson, of the Manchester Technical School, confirm the foregoing, and form a very interesting contribution to the subject. A careful analysis of the results of these experiments shows the average horse-power required at the motor, per pound of metal removed per minute to be as follows :—

Medium or soft steel or wrought iron	2·4 h.p.
Hard steel	2·65 h.p.
Cast iron, soft or medium	1·00 h.p.
Cast iron, hard	1·36 h.p.

Using the symbols of the previous formula, the horse-power becomes : $F \times D \times S \times 12 \times N \times W \times$ constants above, where W equals the weight of a cubic inch of metal removed and is as follows : For cast iron 0·258; wrought iron 0·278; for steel 0·284.

The following examples illustrate the more or less heavy cuts to which reference has been made; the larger powers given

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are exceptional, while the average requirements are far below these, and all are submitted as actual cases which have come under the writer's observation :—

(*a*)—100 in. driving wheel lathe—(material steel d.w. tires).
$\frac{5}{16}$ in. feed ($\frac{5}{16}$ in. cut) at 18·5 ft.p.m. (two tools cutting).
$\frac{5}{16}$ in. × $\frac{5}{16}$ in. × 18·5 ft. × 12 × 2 × C. = 40 h.p.
Same lathe $\frac{3}{16}$ in. feed ($\frac{1}{4}$ in. cut) at 16 ft.p.m. (two tools cutting).
$\frac{3}{16}$ in. × $\frac{1}{4}$ in. × 16 ft. × 12 × 2 × C. = 16 h.p.

(*b*)—Old 76 in. driving wheel lathe (material d.w. tires).
$\frac{1}{16}$ in. × $\frac{1}{4}$ in. × 16 ft. × 12 × 2 × C. = 5 h.p.

Average feed 0·4625 in. × depth 0·423 at 12·2 ft. p.m. (two tools cutting).

The foregoing figures are the averages of 37 tests and represent 40 h.p. The maximum horse-power developed was about 65. The machine is equipped with a 40 h.p., d.c. motor with a 2 to 1 speed variation.

The lathe in question is a "special," extra heavy, and about double the capacity and cost of the standard driving wheel lathe of equivalent size. On average work the same investment in two lathes will turn out more work in a year than this special machine.

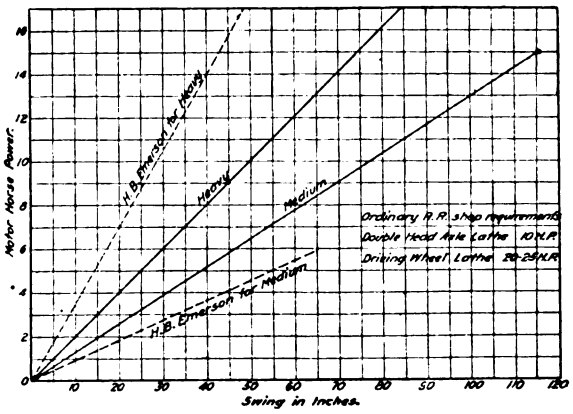

Fig. 1.—*Lathe Motors.*

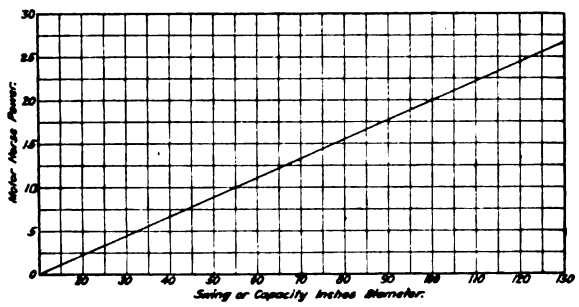

Fig. 5.—*Boring Mills.*

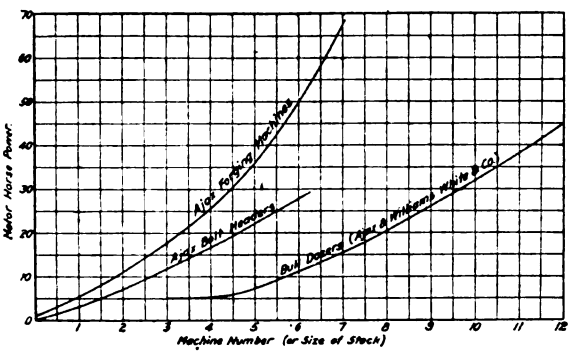

Fig. 7.—*Forging and Bolt Heading Machines.*

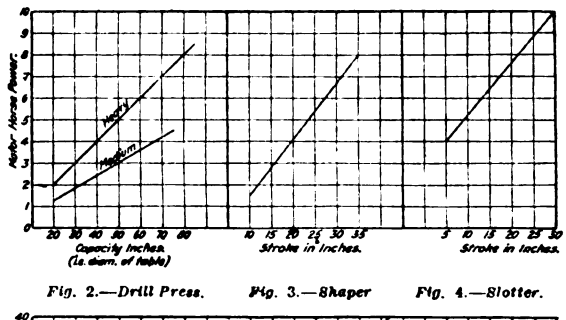

Fig. 2.—*Drill Press.* Fig. 3.—*Shaper* Fig. 4.—*Slotter.*

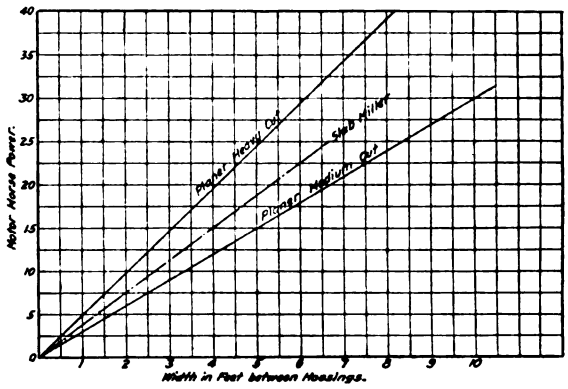

Fig. 6.—*Planers.*

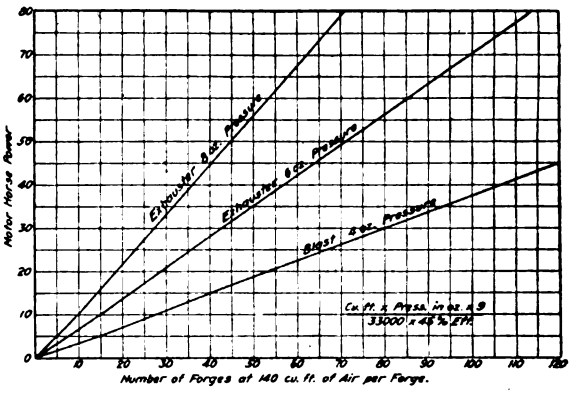

Fig. 8.—*Fans.*

FIGS. 1–8.—HORSE-POWER OF MOTORS REQUIRED BY VARIOUS MACHINE TOOLS.

(*c*)—Steel tired wheel lathe (engine truck wheels).
$\frac{1}{4}$ in. × $\frac{5}{16}$ in. × 16 ft. × 12 × 2 × C. = 17 h.p.

(*d*)—Planer (material cast iron).
$\frac{5}{32}$ in. × $\frac{3}{8}$ in. × 16 ft. × 12 × 0·35 (one tool cutting) = 4·5 h.p. (two tools cutting) = 9 h.p.

(*e*)—Planer (wrought iron engine frame).
$\frac{5}{32}$ in. × $\frac{1}{2}$ in. × 16 ft. × 12 × 2 × 0·5 (two tools cutting) = 15 h.p.

(*f*)—76 in. boring mill (on cast steel d.w. centres).
$\frac{1}{8}$ in. × $\frac{3}{4}$ in. × 30 ft. × 12 × 3 × 45 (two tools cutting) = 45 h.p.
Same machine boring driving wheel tire.
$\frac{1}{8}$ in. × $\frac{5}{16}$ in. × 28 ft. × 12 × 2 × 1 (two tools cutting) = 15 h.p.

(*g*)—84 in. boring mill (on 62 in. cast iron wheel centres).
$\frac{1}{8}$ in. × $\frac{1}{16}$ in. × 30 ft. × 12 × 3 × 0·35 (three tools cutting = 4·7 h.p.
Same mill boring 44 in. steel tire.
$\frac{1}{4}$ in. × $\frac{3}{32}$ in. × 26 ft. × 12 × 2 × 1 (two tools cutting) = 14·5 h.p.

(h)—A special test on an extra heavy driving wheel lathe, giving results representing unusual conditions, where the operator was given a heavy bonus to develop the ultimate capacity of the machine, is as follows :

For rapid estimates, where the foregoing data is not available, the horse-power required can be obtained by the following formulæ :—

$$(a) \quad \text{Single belt} \quad \text{h.p.} = \frac{d \text{ in.} \times f \times R}{12 \times 400},$$

where d = diameter of smaller pulley in inches; f = face of pulley in inches, and R = revolutions per minute.

$$(b) \quad \text{Double belt} \quad \text{h.p.} = \frac{d \text{ in.} \times f \times R}{12 \times 400 \times 0{\cdot}7}$$

This formula is very conservative, and provides for about as much overload capacity for belts as is ordinarily assumed for motors; it includes a liberal allowance for the influence of centrifugal force and diminishing arc of contact of the pulley figured, driven from a larger one. It is especially useful in figuring the power required for wood-working machines, and was arrived at largely from experience with such machines.

The tool builders do not always discriminate between the requirements of manufacturing plants and railroad repair shops, and for this reason motors are often recommended that are

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larger than necessary. For example: the finished product of the axle department of a large concern becomes the raw material for railroad shops. In the former case, the forging is turned out from the hammer without much regard to finished dimensions, as it is much cheaper to rough out to size on special rapid reduction lathes than to attempt to reduce the size under the hammer.

For such machinery high power is required, but for the same lathes in railroad shops, where the work performed is finishing on journals and wheel seats, mainly finishing cuts, a smaller and cheaper motor can be selected. As an example of extreme requirements, the case of a Bement-Niles lathe furnished to a large axle works may be cited. The capacity of this machine is two cuts, each $\frac{3}{8}$ in. by $\frac{1}{8}$ in. at 60 ft. per minute, and at this rate of cutting it requires a 60-h.p. motor. Another machine, built for the same work, but used largely in axle shops and in many railroad shops, is capable of taking two cuts of $\frac{3}{4}$ in. by 1/12 in. at 24 ft. per minute with only 18 h.p., but is usually furnished with a 20 h.p. motor. While this power motor is quite suitable for the full capacity of the machine, a 10 h.p. motor will usually cover the requirements of the same tool on average railroad shop work.

LONDON ELECTRIC POWER BILLS

Proceedings before House of Commons Committee

THE case for the promoters of the London and District Electricity Supply Bill is still being heard by Mr. Luke White's Committee in the House of Commons. In our last issue we dealt with the evidence and cross-examination of Mr. Parshall, joint engineer to the scheme. Mr. Parshall was followed by Mr. Robert Hammond, whose evidence and cross-examination occupied a portion of Wednesday, the whole of Thursday, and a portion of Friday.

On Thursday, a deputation of London and other Liberal members waited upon the Prime Minister in order to call his attention to the resolution passed by the London Liberal Federation last week, to the effect that that body viewed "with profound alarm" the London and District Electricity Supply Bill, and regretted that the Government should have given facilities to it. Among the members of the deputation, which, says *The Times*, was introduced by Mr. Lough (West Islington), were the Rev. G. Hooper, Mr. G. Lambert, Mr. Pickersgill (South Melton, Devon), Mr. T. Davies (Fulham), and Mr. A. J. Mundella. Mr. Asquith was accompanied by Mr. Churchill, Sir Hudson Kearley, Mr. McKinnon Wood, and Mr. J. A. Pease. It is stated that Mr. Churchill pointed out that the Government were not pledged to the principle of this Bill, and that their action hitherto had been guided by the desire that the Bill should be referred to a committee so that it might have fair play. The Board of Trade had no desire to take one side or the other during the later stages of the Bill. In reply to Mr. Pickersgill, Mr. Asquith is understood to have stated that the Government whips would not tell in any divisions that might be taken in the House during the final stages of the Bill, after it has passed the Committee. On Friday last the Board of Trade issued a report recommending reconsideration of certain clauses of the Bill. We give this report in full on p. 618.

London and District Electricity Supply Bill

Mr. ROBERT HAMMOND, who has been responsible for the large mass of statistical information which has been prepared in connection with the Bill, explained the various tables much in the same way, and practically in the same words, that he did before the House of Lords Committee. These statistics, it should be pointed out, were compiled from the accounts for the year ended December 31st, 1906, in the case of the companies, and March 31st, 1907, in the case of the local authorities. The general effect of them is that, in comparison with the maximum prices in the Bill, the quantity of energy which, as shown in these accounts, cost £1,387,989 to produce on the part of all the authorised distributors in the area, could be given by the power company for £747,917, thus showing an annual saving of £640,072. This is on the assumption, of course, that all the existing plant would be scrapped, which, in the words of Mr. Hammond, is not regarded by the promoters as practical politics. It is contended, however, that it would be unsound to perpetuate the present uneconomical state of things by adding to the generating plant in the various generating stations, and that all future supplies could be more economically drawn from a central generating works such as that proposed under the Bill. Following out this line of reasoning, Mr. Hammond has prepared tables showing the advantages to the present authorised distributors if, instead of extending their works, they in future took a bulk supply from the power company. In the case of local authorities an aggregate saving of £112,569 per annum is shown under these conditions, and in the case of the companies £112,027, making a total of £224,596. This, briefly, is the case for the Bill, and Mr. Hammond was put into the witness-box for the purpose of formally proving his figures and then to undergo cross-examination upon them.

Mr. Hammond is always an entertaining witness, and his cross-examination at times was of an enlivening character, owing to the fighting attitude which he assumes in his answers in preference to confining himself to stereotyped answers of "Yes" or "No." In fact, this propensity of Mr. Hammond's on one or two occasions called forth a gentle remonstrance from the Chairman. At the same time, he did not come under the ban of the Chairman for irrelevant answers quite so often as did the opposing counsel for putting irrelevant questions or putting matters of argument to the witness which he was left in a quandary as to whether an answer was expected of him or not. For instance, Mr. Vesey Knox, for a number of authorities outside London, asked if Mr. Hammond had made any calculation as to the probable purchase price in 1931. "No," said Mr. Hammond. "Do you know," continued counsel, "that, taking your estimated balance sheet, and taking 17½, which is the usual multiplier for 30 years' purchase on the 4 per cent. basis, that the purchase price will be £6,382,000?" "No," replied Mr. Hammond. In the same way, Mr. Meyer, for the Battersea Borough Council, asked if witness was aware that the whole saving shown by his tables, in the case of local authorities, would amount to less than a farthing rate." Again the reply was "No." Many other questions of a similar character were put, to which the obvious answer was "No," and when, apparently tired of the continual "No," Mr. Hammond varied the monotony by innocently answering "It is marvellous how these things work out," there was a good deal of laughter. Mr. Morten, for West Ham Corporation, adopted the well-worn argument that the Corporation was supplying at cheaper rates than the power company was proposing, and therefore what benefit could be conferred upon that district; but Mr. Hammond had a ready answer which was appreciated by those who remember the recent Local Government Board proceedings. "Some people," he said, "say you are charging too low prices." Mr. Morten, by the way, was repeatedly pulled up by the Chairman for pursuing the point that if every district in London was as well supplied as West Ham, the power scheme could never come into existence, and therefore the Bill should not be passed. The Chairman said that the committee quite understood, and the witnesses had already agreed to that extent, that if no one took power the company could not supply it. Mr. Morten did not appreciate the interruption, and replied that he would prefer to put his point to the witness if he were allowed time. Some questions more to the point were put by Mr. Vesey Knox on behalf of Southwark. Here the Borough Council, which is supplying on the direct-current system, is in competition with the London Electric Supply Corporation, which supplies alternating current. Under the schedule of prices in the Bill, alternating-current supply is cheaper than direct-current supply; therefore, argued Mr. Vesey Knox, it would be possible for the power company to enter into an agreement with the London Electric Supply Corporation to give a supply of cheap alternating current, and thus competition with the Council could be made more effective. Of course, the argument leaves out of account the fact that the power company would be able to supply both parties, whilst Mr. Hammond's reply on the question of competition was that as the Newington Vestry many years ago permitted the supply company to obtain an order for their district, that was a mistake, the consequences of which the present Council must suffer for. Mr. Vesey Knox also wished Mr. Hammond to bind his proposed company to give a supply to Southwark for a certain amount, but when the Chairman asked if the Council would bind itself to take the supply, counsel replied that that was another question, and the matter immediately dropped. Some amusement was caused when Mr. Meyer, for the Battersea

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Council, expressed his conviction that he would convert Mr. Hammond from believing that his figures, so far as Battersea was concerned, were right. The Chairman, somewhat incredulously, invited him to try. At the same time, it must be admitted that counsel met with a degree of success not common with the other opposing counsel as a general rule, for he showed that the accounts of the Battersea Council for the year ended March 31st, 1907, included interest and sinking-fund charges until the following September, viz., eighteen months, and Mr. Hammond had dealt with the accounts as for twelve months. As, however, the accounts themselves did not indicate this fact, no blame attaches to the promoters.

During Mr. Hammond's evidence the promoters, by permission, interpolated the evidence of Mr. Oliver Bury, the general manager of the Great Northern Railway Co., who repeated his evidence in the other House as to the company's desire to convert their suburban lines to electric traction, but that they had been deterred owing to the necessity for erecting their own power station, the cost of which represented about 35 per cent. of the total cost of the scheme. Very careful estimates, he said, had been made, and if a supply of power was available from an outside source, this would hasten the decision of the directors very considerably. Mr. Bury also retorted upon counsel during cross-examination that although, when giving evidence in the House of Lords, he had invited any of the existing companies to take the matter up with him, when he would be prepared to go into it carefully, not one of them had approached him.

After Mr. Hammond's re-examination was concluded on Friday, Mr. J. H. Rider, the Chief Electrical Engineer to the London County Council, was called in support of the scheme. When the Bill was in the last House the London County Council objected to Mr. Rider giving evidence and on this occasion the promoters secured his attendance by the aid of the Speaker's order. Mr. Rider was generally in favour of the scheme, which, he said, was practically identical with that of the London County Council.

Financial evidence was then taken. As has already been mentioned the capital of the company is £4,500,000, with one-third borrowing powers, making a total of £6,000,000. Clause 79 stipulates that "Unless the company shall within twelve months from the passing of this Act obtain a certificate from the Board of Trade that not less than six hundred thousand pounds of the share capital of the company by this Act authorised has been *bona fide* subscribed, and that not less than two hundred and forty thousand pounds of such share capital has been paid up, and unless within two years from the passing of this Act the company shall have substantially commenced their works for the purpose of carrying out their powers under this Act, the Board of Trade, after considering any representations which the London County Council may desire (and are hereby authorised) to make, may order that the powers of the company under this Act shall cease as a whole or any part of the area of supply, and on any such order being made those powers shall cease accordingly."

The promoters named in the Bill are Sir Hugh Bell, Bart., Mr. R. W. Blackwell, Mr. R. S. Guinness, Mr. R. Miller, Mr. G. D. Rowe, Mr. Owen H. Smith, Mr. William D. Ward, Mr. Vincent W. Yorke, and Mr. John Young, and in the last House Sir Hugh Bell and Mr. Owen Smith gave evidence with regard to finance. The effect of their evidence was that Sir Hugh Bell made himself personally responsible for the raising of the £600,000 mentioned in clause 79, and Mr. Owen Smith stated that the other gentlemen mentioned were all prepared to take a substantial interest in the undertaking. Both witnesses, however, made the reservation that the subscription of money would depend upon the form in which the Bill passed, and Sir Hugh Bell, who was called on Friday, repeated this evidence with the addition that he was still satisfied with the Bill, although there had been several modifications in the House of Lords. Mr. Vesey Knox, who appears for a number of authorities outside the London area, asked for a list of names of the other persons associated with those mentioned in the Bill, but Sir Hugh Bell declined, on the ground that the information already given was considered sufficient by the promoters. An appeal to the Committee by counsel met with no success, the Chairman stating that the Committee were unanimously of the opinion that Sir Hugh Bell need not give the information required. The rest of the cross-examination was directed to inducing Sir Hugh Bell to admit that the Bill was not now so satisfactory to the promoters as it had been in its original form, but this completely failed, Sir Hugh emphatically asserting that he was prepared to stand by the whole of his evidence given in support of the Bill in the House of Lords.

BOARD OF TRADE REPORT ON THE BILL.

During the course of Friday the report which the Board of Trade has issued upon the Bill was handed in to the Committee. We give it in full below :—

Clause 53 (Conditions affecting supply). This clause provides for the supply of energy by the promoters, in certain events, to persons requiring a supply of power in the areas of authorised distributors in competition with those distributors. The clause contains provisions such as are usual in Electric Power Acts for protecting authorised distributors from unreasonable competition, together with an additional provision that in considering whether the consent of an authorised distributor is unreasonably withheld the Board of Trade shall "regard all the circumstances of the case including the capital expenditure incurred in connection with the undertaking of such distributor and all charges in respect thereof and the financial position of such distributor." The Board suggest that in the special circumstances of Greater London, it is a matter for consideration by the Committee whether further protection against competition could not properly be given to those distributors who can show that they are exercising their powers with due regard to the interests of the public in respect of the supply of energy for power purposes.

Clause 67 (Liability of undertaking to compulsory purchase). The Board of Trade call attention to the fact that the period of 52 years after which the undertaking will be liable to purchase without payment of compensation in respect of goodwill, &c., exceeds that prescribed by the Electric Lighting Act, 1888, viz. :—42 years. They suggest for the Committee's consideration whether there is any sufficient reason for the more extended period. With regard to the terms of purchase at an earlier date, it appears to the Board that under the clause the purchasing authority might be involved in a liability to pay as compensation in respect of the loss sustained by the company by reason of earlier purchase an uncertain amount in respect of prospective profits, and that on giving notice to purchase the purchasing authority would have no means of gauging, even approximately, what that amount might be. The Board recognise that if the purchase takes place before the expiration of 42 years, terms must be provided for compensating the company for loss sustained by them by reason of the earlier purchase but they consider that those terms, while being of such a character as not unduly to hamper the company in raising the capital necessary for the undertaking, should, at the same time, be such as would enable the purchasing authority to calculate what the compensation would be and as would not involve them in paying an extravagant sum. For instance, the Committee might consider whether the sum payable as compensation for the unexpired period of the 42 years might not be calculated on some such basis as the following :—the average profits properly earned during a certain period immediately preceding the purchase (say five or seven years) to be ascertained and the present value of annual profits at this rate for the unexpired period to be the sum payable in compensation. No doubt other methods of calculating the amount of compensation will be placed before the Committee. The instruction of the House on the 19th October provides that purchasing powers shall be conferred on the London County Council. The Board suggest that provision should be made by the clause not only for compulsory purchase at certain dates, but also for enabling the London County Council to purchase the undertaking at any time on terms to be agreed by them with the company. The Board also suggest for the consideration of the Committee that it would be desirable to empower the London County Council to discharge the sum payable in respect of the purchase of the undertaking, whether by compulsion or by agreement, by the issue of stock or annuities.

Clause 69 (Inspectors, &c.). The Board suggest that on the purchase of the undertaking by the London County Council, the provisions of this clause in so far as they relate to the appointment of Electric Inspectors by the London County Council should cease to operate. It may be a matter for consideration also, whether on the London County Council acquiring the undertaking to be authorised by this Bill, they should not cease to exercise the various administrative duties in regard to the appointment of Electric Inspectors, approval of works, and other matters which are imposed upon them by the Acts and Orders which have been or may be granted relating to the supply of electricity in the Administrative County of London.

Clause 77 (Transfer of Undertakings of Local Authorities and others to Company). The Board do not consider it desirable that the company should be empowered to acquire the undertakings of other bodies without further recourse to Parliament. The Bill does not confer on the company a monopoly in the supply of energy, but the acquisition by them of undertakings under the provisions of this clause might result in the creation of a *quasi* monopoly. In areas where there are two bodies supplying in competition the company might acquire the undertaking of the one body and with the advantages conferred on them by their Act be in a position to subject the other body to an unfair and ruinous competition. Moreover, after a transfer under the clause it would be impossible to say as regards power supply, whether the company were acting as undertakers under the present Act or under the Provisional Order authorising the undertaking transferred to the company, and if such undertaking were that of another company, great confusion may arise when the time arrives under the Provisional Order for the purchase of the transferred undertaking by a Local Authority. It will be difficult if not impossible to determine whether a particular work was authorised by the Act or by the Order and therefore whether it is purchasable under the Order or not. Any transferred works which would be purchasable under the existing purchase clause would if transferred to the company and used by them for supplying other parts of their area cease to be subject to the existing purchase clause. Of course the

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Board of Trade would never sanction a transfer under the clause without giving objectors the fullest opportunity of being heard, and if the opposition were serious the Board would probably refuse their consent. The Board, however, do not consider that they should have placed upon them the responsibility of deciding such important and controversial questions as might be likely to arise under the clause. They have usually objected to similar clauses in Bills and Provisional Orders, and they are of opinion that the clause ought to be struck out of the Bill. [This would involve a consequential amendment in the first proviso to Clause 55 (Conditions affecting supply).]

Clause 79 (Cesser of powers). The Board suggest that the word "or" should be substituted for the word "and" in the sixth line of the clause, otherwise it might be doubtful whether **the power of the Board to make an Order** under the clause would arise until after the expiration of the second period mentioned in the clause.

On Monday, November 2nd, evidence of a general character was given. Mr. J. F. S. Gooday, General Manager of the Great Eastern Railway Co., and Mr. A. L. Stride, of the London, Tilbury & Southend Railway Co., spoke as to the desirability of a cheap supply; and Mr. Vincent Raven, Chief Assistant Mechanical Engineer of the North-Eastern Railway Co., referred to the effect which electrification had had upon their lines in the Newcastle district. Mr. W. Woodhouse, Engineer of the Yorkshire Electric Power Co., followed, after which evidence was taken from representatives of a number of firms in the area of supply, who supported the scheme in view of the possibility of getting a cheaper supply of electricity than is now possible.

The case for the promoters was concluded on Tuesday, after Mr. Owen H. Smith had concurred in the financial evidence given by Sir Hugh Bell. There were also some further general witnesses.

It has been arranged that the opposition shall take the following order:—Borough Councils, Middlesex County Council, City of London Corporation, Companies.

London Electric Supply Bill and London (Westminster and Kensington) Electric Supply Bill

In the House of Commons last Monday the President of the Board of Trade moved that it be an instruction to the Committee considering these Bills to insert a provision constituting the London County Council the purchasing authority. After a short discussion the instruction was agreed to.

An instruction was then moved by Mr. T. Davies (Fulham) to the effect that the companies shall not be entitled, in the event of purchase of the undertaking, to any additional compensation by reason of the existence of agreements for mutual assistance or association, or for any loss occasioned by severance.

Mr. Churchill stated that he would not recommend the House to adopt this instruction, as the terms of purchase of electric lighting did not raise the question of profits, dividends, prospective advantages, or goodwill.

The amendment was then withdrawn.

A proposal of Mr. Hay (Shoreditch) that powers should be inserted in this Bill conferring linking-up powers upon the local authorities of London was altered to read that the Committee has power to deal with this. It thus did not take the form of an instruction, and was agreed to.

The second reading of the London Electric Supply Bill having been carried, the President of the Board of Trade moved an instruction to the committee that purchase powers on the part of the London County Council should be inserted in the London (Westminster & Kensington) Electric Supply Bill.

This was agreed to.

Mr. T. Lough then moved that a clause should be inserted in the Bill binding the companies not to offer opposition to any future proposals on the part of Borough Councils for mutual assistance, &c.

This was agreed to, and the Bill read a second time.

A similar motion in regard to the London Electric Supply Bill is now on the paper.

Strengthening of Corroded Tramway Poles with Reinforced Concrete.—A recent issue of the *Electric Railway Journal* contains an account of a method adopted by a tramway company in America for strengthening corroded tubular tramway poles by filling them with reinforced concrete. The cap at the top of the pole is first removed, and a suitable cage of twisted steel bars is dropped in. The lower ends of these rods are set in a concrete-iron base, but at the top a hooked cap temporarily confines the upper ends of the rods to allow the cage to pass through the narrower upper section of the pole. Upon the withdrawal of this cap from above the rods flare out towards the sides of the pole. A grouting is then forced in through a hose inserted at the top of the pole, from a tank in connection with a portable motor-driven air compressor, taking current from the trolley wire. These operations have been carried out in the case of a large number of poles by the New York Pole Company who originated the system.

THE TRACKLESS TROLLEY SYSTEM IN LONDON

IN a report by the Highways Committee of the London County Council reference is made to linking up the northern and southern tramway systems *via* the Blackwall and Rotherhithe tunnels.

In 1904 a scheme was promoted for the construction of tramways from Trafalgar Road, Greenwich, *via* Blackwall Lane and Blackwall Tunnel to East India Dock Road. Parliament, however, only sanctioned the tramways along Blackwall Lane, the portion of the scheme affecting the tunnel being struck out. At the time the matter was discussed, considerable stress was laid on the difficulty of taking two lines of fixed traffic through the tunnel owing to the large amount of general traffic, and the probable congestion that would result if tramways were made. Since this date the tramways north and south of the river at Blackwall have been electrified, while the new tunnel at Rotherhithe, which connects with the Council's tramways at either end, has been opened. The Highways Committee now think it right to again consider arrangements for linking up the northern and southern systems. The Committee's attention has been called to the trackless trolley system of electric traction which has been installed in certain places on the Continent. An exhaustive inquiry into the working of this system has been carried out by the Manchester Corporation Tramways Committee and, as the result, the Corporation proposes to seek Parliamentary authority to equip certain routes on this system in the suburbs of Manchester where tramway construction would not be justified on the ground of expense. The question of promoting legislation on this subject is also before the Liverpool Corporation.

The advantages of the system briefly stated are the avoidance of track expenses, and, in some cases, of the necessity for street widenings, and the greater adaptability of the vehicles used to the general traffic conditions. At the same time the disadvantage of carrying accumulators which obtains in the case of electric omnibuses is obviated. The Committee state that it would, in any case, be impossible to construct conduit tramways through the tunnels as there would not be sufficient depth for the necessary excavation, and the previous proposals for the construction of lines in Blackwall Tunnel have provided for the use of overhead traction. As the electric tramways on both sides of the river have been reconstructed for conduit traction, it would in any case be difficult to provide any other than a shuttle service of cars in the tunnel, and the size and mode of construction of the cars need not, therefore, conform to the Council's standard rolling stock. From the information obtainable, it appears that the estimated expenditure on capital account would be £7,925 in the case of Blackwall Tunnel, and £9,335 in the case of Rotherhithe Tunnel. The estimated financial results of the proposed services, taking into account the traffic which will be induced on the Council's existing tramways, are thought likely to be favourable, and the Committee are strongly of opinion that Parliamentary authority should be sought in the session of 1909, to enable the Council to provide and work a service of cars on this system through both the tunnels, and to carry out any incidental works.

In a report upon the matter the Finance Committee state that the question whether, having regard to the amount of information at present available as to the working of systems of trackless trolley cars, the Council would be well advised to inaugurate such a system, is one for the consideration of the Council upon the report of the Highways Committee. From a financial point of view they do not offer any observations upon the proposal to obtain Parliamentary powers. It will, however, be obvious that before the Council actually inaugurates such a system, in the event of the necessary powers being obtained, it will be desirable that further information should be obtained, both as to the practical working of the system, and as to the estimated financial results.

At the meeting of the County Council on Tuesday an amendment was passed, postponing action in the matter until further information is available.

Institution of Civil Engineers.—The only Paper of electrical interest which has received a medal during the past session is Mr. W. Barclay Parson's Paper on the "New York Rapid-Transit Subway," for which the author has been awarded a Telford Gold Medal.

Royal Society.—The following is a list of the Fellows recommended by the President and Council of the Royal Society for election into the Council for the year 1908-9:—President—Sir Archibald Geikie, K.C.B., D.C.L., Sc.D., LL.D. Treasurer—Alfred Bray Kempe, M.A., D.C.L. Secretaries—Professor Joseph Larmor, D.Sc., D.C.L., LL.D., and Professor John Rose Bradford, M.D., D.Sc. Foreign Secretary—Sir William Crookes, D.Sc. Other Members of Council—Sir George Howard Darwin, K.C.B., Professor James Cossar Ewart, M.D., Sir David Gill, K.C.B., John Scott Haldane, M.D., Charles Thomas Heycock, M.A., Professor Horace Lamb, D.Sc., Professor Hector Munro Macdonald, M.A., Frederick Walker Mott, M.D., the Hon. Charles Algernon Parsons, C.B., Professor William Henry Perkin, Ph.D., Professor Edward Bagnall Poulton, D.Sc., Lieutenant-Colonel David Prain, C.I.E., Sir Arthur William Rücker, D.Sc., the Right Hon. Sir James Stirling, LL.D., Professor Frederick Thomas Trouton, Sc.D., and William Whitaker, B.A.

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ELECTRIC POWER TRANSMISSION WORKS IN ITALY

IN a report upon the trade and commerce of Venice for the year 1906-07, Mr. Consul de Zuccato makes many references to electrical works in the Venetian provinces. He states that since his last report the development of hydro-electric plants for the supply and transmission of power for lighting, industrial, and traction purposes has continued on a vast scale and in all directions. There appears to be evidence that hydro-electric power is destined in future to produce extraordinary results, and it may in the long run cause a great diminution in coal imports, although so far nothing of the kind has occurred.

Water Power Scheme at Verona.—Under the auspices of the Verona Bank a company is said to have been constituted for the distribution of electric power for illuminating and industrial purposes in the provinces of Verona and Vicenza, in connection with the Milani Canal.

Water Power Plant at Ponte della Serra.—Works are proceeding for constructing a water power plant near Feltre, on the River Cismon, which rises in the Tyrol Mountains and flows into the Brenta in the Valsugana Valley. Through the efforts of Engineer Fortis, of Milan, the Edison and Adriatic companies have provided the funds for this plant, which is being built about 200 metres distant from Ponte della Serra. It is said that the energy to be derived therefrom will be from 6,000 to 9,000 horse-power, to be distributed in the provinces of Padua and Vicenza. The construction of the workshops began in 1906, while the works for the perforation of the rocks commenced in February, 1907. The river was deviated and readmitted into its course through a right angled gallery about 100 metres long, and a bar is to be raised on caissons filled with concrete which will produce a fall about 35 metres (115 feet) high. There will be a large water reserve basin, which will extend as far as the Austro-Hungarian frontier near the Ponte delle Muline. Two plants will subsequently be built lower down the river.

Cellina Works.—On January 1st, 1908, the Italian Company for the utilisation and distribution of electrical power in Venetia, invited an increase of capital and issued 32,000 new shares of 175 lire (£7) each, giving the preference in subscribing for half of the amount to the old shareholders. The total capital of the company, which was formerly 4,200,000 lire (£168,000) has now been brought to £9,800,000 lire (£392,000).

Garda Electric Railway.—A well-attended meeting of the principal notabilities of the provinces of Verona, Mantua, Roveredo, and Trent has recently been held at Torri del Benaco to discuss the purchase of the waterfall called "Vajo delle Pissotte," in the Baldo Valley, or another fall offered by the Commune of Roveredo, to produce the energy required for the projected Garda electric railway. There were loud protestations, as it was stated that a preliminary arrangement had already been made with an Anglo-Italian company for the building and working of this line, when the War Ministry in Rome objected to its construction, on military grounds. The line would run from Verona to Lazise on the lake, and then go on to Benaco and Riva on the Austrian frontier, through a gallery to be bored under Mount Altissimo. From Lazise a small branch would turn towards Peschiera to form a junction with the Venice-Milan line and with the one in construction, Peschiera-Mantua. The line is to be double track of normal gauge. This line, which would place the whole Trent district in direct communication with Verona, Brescia and Milan, would, it is estimated, cost about 13,000,000 lire (£520,000), of which about 2,000,000 lire (£80,000) would be contributed by the provinces and the communes concerned, and the remainder would be provided by the subsidy of 6,000 lire (£240) per kilom., for which the committee have asked the Italian and Austro-Hungarian Governments. The committee are in hopes soon to obtain the concession from the Italian Government, on the ground of public utility, as they state there would be a great development of trade and industry and a large tourist traffic on the Veronese shore of the lake.

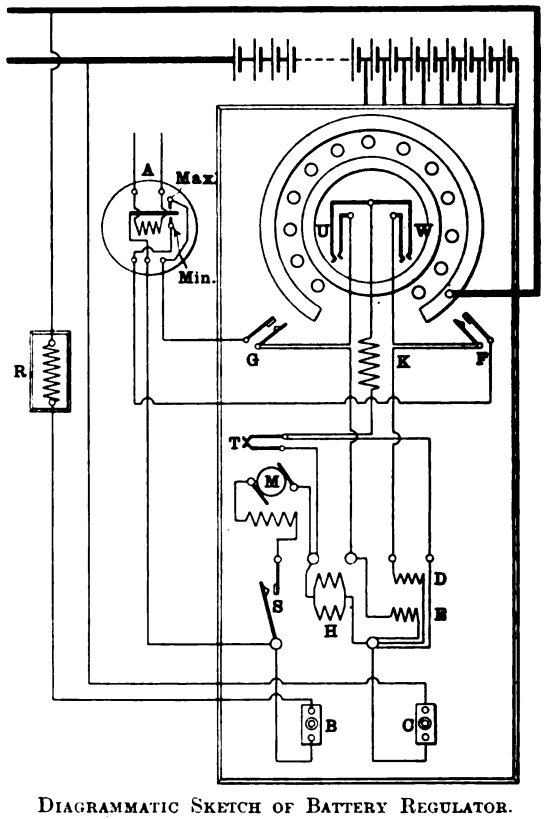
Verona Tramway.—The horse tram in the town of Verona has been transformed into an electric one. This service is carried on by an Italo-Belgian company. The electrical equipment has been supplied by the firm Siemens, of Brussels, and the cars by the Thomson-Houston Co.

Electric Tramway, Padua Vigodarzere.—An electric tramway, which is subsequently to be extended, was opened to the public on April 16th, 1908, between Padua and Vigodarzere, stopping for the present at the bridge of Vigodarzere on the road leading to Torre.

National Telephone Company's Employees.—At a meeting of the National Society of Telephone Employees at the Holborn Town Hall, last week, to protest against the dismissal of workmen by the National Telephone Co. in view of the acquisition of the company's business by the Post Office in 1911, Mr. B. S. Straus stated that the Postmaster-General had come to an arrangement with the company by which the discharges would be stopped.

MOTOR-OPERATED AUTOMATIC BATTERY REGULATING SWITCH

AMONG the exhibits of the Union Electric Co. at the Manchester Exhibition was a 22-way battery regulating switch, with a lever arm for regulating on the charging side, and an automatically-operated lever for the discharge side. The latter lever is also provided with a hand-wheel for hand regulation if required. The operating gear, a diagrammatic sketch of which is given below, consists of a frame to which is imparted an oscillatory or rocking motion by a small motor driving a crank through worm gearing. The rocking frame carries a pawl or detent, which engages with a toothed wheel fixed to the discharge lever shaft. The action of this detent is governed by a solenoid K, and the circuit is completed in this coil by spring contacts U and W alternately. In addition to these, limit contacts G and F are fitted to automatically break the motor circuit when the discharge regulator arm reaches either the maximum or minimum limits. These are protective devices only, and have no other function in the apparatus. The device works as follows:—In the event of the pressure falling in the supply circuit in which the magnetising coil of the contact voltmeter A is connected, contact is made on the lower or minimum terminal of the



DIAGRAMMATIC SKETCH OF BATTERY REGULATOR.

voltmeter. There is then a circuit from fuse B to the centre terminal of the voltmeter, through the minimum contact, through the limit contact F, through the relay coil D and fuse C to the main supply. As the contact relay is energised, the motor circuit is completed through relay S, which is controlled by the electromagnet H. The solenoid controlling the pawl or detent is energised through contacts U and W, the movement of the rocking frame alternately closing and opening the circuits through these contacts, alternately engaging and disengaging the detent with the toothed wheel on the discharge lever, and transmitting the motion of the rocking frame to the latter. By this action a sufficient number of cells are brought into circuit to bring the pressure to its normal value.

The same operation is carried out in the event of the pressure rising above normal, owing to the load on the battery being reduced, or the battery pressure increasing during charging. In this case the voltmeter makes contact on the maximum or upper terminal. The circuit will then be from fuse B to the centre contact of the voltmeter, thence to the maximum contact through the limit contact G, through relay coil E, through fuse C to the main supply. The motor circuit is completed in exactly the same manner as in the first case, the motor rotating in the same direction, but the movement of the discharge lever is reversed owing to the pawl or detent engaging with the toothed wheel on the reverse stroke of the rocking frame.

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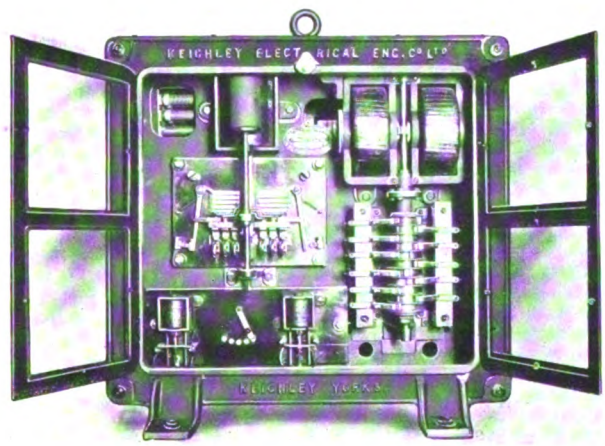
At the normal pressure, the circuit through the motor remains open by the action of the spring contact T, which shunts the coils of the relay magnet H, thereby breaking relay contact S. The contact voltmeter may be regulated to operate within ± 3 per cent. of normal pressure by adjusting a sliding weight upon the horizontal arm of the lever, and increasing or decreasing the distance between the maximum and minimum contact discs. These discs and the moving element are provided with platinum contacts, and by turning them slightly a new point of contact is always available. Further, they may be removed for cleaning without interfering with the setting of the instrument. In order to prevent hunting or undue oscillation of the horizontal lever, a damping device is fitted, consisting of a small metal cylinder filled with oil, and a light baffle plate rigidly attached to the contact arm.

THE KEIGHLEY SYSTEM OF ELECTRIC LIFT CONTROL

AN interesting lift control gear manufactured by the Keighley Electrical Engineering Co., Ltd., was shown at the Manchester Exhibition by Messrs. John Collier & Co., who hold the sole rights of sale for the Lancashire district. The apparatus exhibited was that which is used for operating a high speed passenger lift, for which an interpole motor rated at $7\frac{1}{2}$ b.h.p. for intermittent use is employed. The normal speed of the motor on the maximum field excitation is 400 r.p.m., corresponding to a travel of the cage at the rate of 100 feet per minute, and the maximum speed 800 r.p.m., equal to a cage



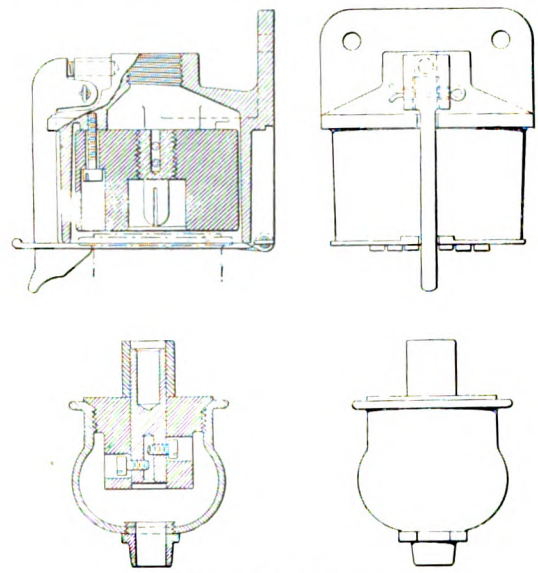
LIFT CONTROLLER FOR CAGE SWITCH CONTROL.

travel of 200 feet per minute. The brake blocks are pulled on to the brake pulley by powerful duplicate springs, and are released by means of ironclad electromagnets, the windings of which are in series with the compound field winding of the motor.

The system of control (Hindle's patent) may be adapted for either hand rope, cage switch, or push-button control; the controller illustrated above is for cage switch control. The direction of travel is determined by means of a controller of the tramway type, actuated by a double solenoid, the magnetic core of which is furnished with a rack, gearing into a pinion on the controller spindle, and rotating the latter in either direction as desired through an angle of about 90 degrees. The main circuit is actually closed, after the operation of the reverser, by a multiple contact starting switch, also operated by a solenoid, which pulls the starter rapidly on to the first contact, the remaining portion of the travel being retarded by an air dashpot. After the armature resistance is cut out (during which operation the field excitation of the motor is a maximum), the starter introduces a resistance in the motor shunt, increasing the speed to the desired amount. The starter itself is provided with six carbon brushes so connected that there are three parallel paths available between the two series of hard-drawn copper contacts to which the starting resistance is connected. The master switch in the cage is connected to the controller proper by a five-core flexible armoured cable, and is provided with three points or positions on each side of the "off" or central position. In starting, this switch may be turned over to the full-on position instantly, and the various operations described, the rotation of the reverser, the cutting out of armature resistance, and the reduction of the motor field, follow in their proper sequence; when approaching a floor, however, the cage switch may be returned from the third to the second position, which has the effect of again building up the motor field, and reducing the speed to one half the maximum. Returning the cage switch to the first position permits the starting switch to return to zero, first re-inserting the armature resistance in circuit, and then opening the circuit at the carbon contacts before mentioned, which at the moment of rupture, are arranged to give a multiple series break, the arc being divided into six distinct portions of negligible amount. At this point in the operation of stopping, with current cut off, and the cage switch in the first position, the reversing controller is still on, and the motor may continue to run very slowly merely by its own momentum, the connections being such that it excites its own field coils and brake magnets. The return of the cage switch to the off position, induces a similar action on the part of the reverser, throwing a duplicate resistance across the armature terminals, which has the effect of absorbing the momentum of the armature itself, and also of absorbing the remaining shunt excitation of the motor and brake coils. The brake blocks are not applied until the motion has practically ceased.

A PROTECTED WALL SOCKET

THE accompanying illustration represents a new pattern of wall socket and plug for use in exposed situations, which Messrs. A. Reyrolle & Co. have recently put upon the market. It will be noticed that the plug is inserted from below, which in itself makes the apparatus more or less rain-proof, but a hinged flap is also provided, which prevents the entry of dust and dirt into



Scale: One-third full size.

IMPROVED FORM OF REYROLLE WALL SOCKET AND PLUG.

the socket, when the plug is withdrawn. The spring catch which keeps this in place when closed also holds the plug by a projecting flange when inserted, avoiding liability to jerking out when the cable is accidentally pulled. The insulating parts of both socket and plug consist of solid blocks of a special material, with no thin places liable to breakage. The construction of the plug is all the more robust owing to the contact arrangement being the reverse of that usually employed, as the pins are placed in a well-protected position inside the socket instead of on the plug. The details of design are well thought out, down to the provision of two screws instead of one for the attachment of each lead in the flexible cable.

Proposed Tax on Gas and Electricity in Germany.—In connection with the proposed taxes in Germany, a Berlin political paper mentions the fact that a tax on gas and electricity for lighting and power purposes has been imposed in Italy for over ten years. The German technical papers, however, correct this statement, pointing out that, according to the Italian law of August, 1895, a tax was imposed on gas and electricity for domestic lighting and heating only. Public street lighting, electric driving, and all other applications of electricity other than domestic lighting and heating, are exempt from the tax. The tax is fixed at about 0·6d. per unit of electricity and about 0·2d. per cubic metre of gas, but the total revenue is said to amount to less than £400,000 per annum. The effect of this tax has been to prevent the introduction of electric heating and cooking apparatus in Italy, and no doubt to retard the progress of electric lighting. As we mentioned on page 495 of our issue of October 1st, it is expected that energy for both lighting and power will be taxed in Germany.

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CATALOGUES AND PAMPHLETS RECEIVED

ARC LAMP LOWERING GEAR.—A new brochure issued by the London Electric Firm, of Croydon, contains a series of over forty views of installations where their patent arc lamp lowering gear is in use, and serves to emphasise the universality of this apparatus.

CONTINUOUS-CURRENT DYNAMOS AND MOTORS.—We have received from the Wilson-Wolf Engineering Co., Ltd., of Thornton Road, Bradford, a new illustrated price-list of their continuous-current machines. These include semi- and totally-enclosed and open type motors of various outputs, from a fraction of a horse-power up to 20 h.p., and dynamos up to 12 kw. Complete information about each machine, including dimensions and cost of accessories and spare parts, is given. Particulars of the firm's motor starters and also of a special line of low-voltage dynamos for electrolytic work are included. Motor generators and vertical spindle motors are also manufactured by this firm. A special line of small continuous-current motors for driving sewing machines, emery wheels, &c., and a line of fan motors with combined thrust and journal ball-bearing at the commutator end, are also listed.

ELECTRIC HEATERS.—Appropriately to the approach of colder weather, a handsome new illustrated catalogue of electric heating apparatus has been issued by Simplex Conduits, Ltd. The numerous patterns dealt with include both luminous radiators and heaters working on the convection principle, the radiators covering a wide range of prices. The type illustrated herewith, shows a cheap form of heater introduced for the first time at the exceptionally low price of 40s., subject to trade discount; it has an iron case, matt finish ornamented with nickel *repoussé* work. To cheapen matters as much as possible, however, it is un-illuminated; the consumption is 1,000 watts, and it is amply sufficient to heat small rooms or offices.

SIMPLEX CONVECTION HEATER.

ELECTRICAL SUPPLIES.—A collection of lists recently issued by the A.E.G. Electrical Co. of South Africa, Ltd., deal with various specialities of the Allgemeine Elektricitäts Gesellschaft Foreign Department, including electric fans, crane controllers and resistances, quartz mercury vapour lamps, current-limiting switches, and junction boxes for lead-covered cables.

FIRE BRICKS.—A leaflet from the Castle Fire Brick Co., Ltd., of Northop, Flintshire, calls attention to this firm's fire bricks, boiler seating blocks, flue cones, made from Buckley Mountain fire-clay.

ILLUMINATED ROAD SIGNS.—A pamphlet issued by the Foster Arc Lamp & Engineering Co. gives particulars of a series of illuminated road signs, such as the well-known red triangles and white speed-limit signs intended to warn motorists of places where fast driving is dangerous. Electrically lighted signs are included, as well as those adapted for lighting by gas or oil.

INSTRUMENTS AND SWITCHGEAR.—A new catalogue, consisting of forty or more leaflets filed in a binder, has been issued by Messrs. Nalder Bros. & Thompson, Ltd., and deals with a large variety of instruments and switches. The apparatus is classified in sections, and a leaflet describing any new development can easily be inserted in the section to which it belongs. Each leaflet contains, besides a wood-cut illustrating the apparatus, a brief technical description, dimensions, and prices, and all leaflets are of a uniform (quarto) size. In the section on switches the new patterns of overload and reverse-current circuit-breakers described in one of our recent Manchester Exhibition supplements, are given, and sections dealing with leakage indicators, recording instruments, testing sets, the "Ohmer," or combined ohmmeter and generator, and three-phase wattmeters for unbalanced loads are also included. Among the recent additions are leaflets describing a new pen for recording instruments, and an automatic switch for protecting earth-current recorders by short-circuiting the recorder when the current exceeds a predetermined maximum.

STORAGE BATTERIES.—A small list is to hand from Messrs. Pritchetts and Gold, Ltd., which is in reality some advance sheets of a larger and fuller catalogue of the firm's well-known storage batteries, which will be issued later. It will be found of use as giving, in a convenient form, the capacities, weights, and dimensions of the standard H and C type cells in glass boxes. The positive plates of these cells are of the Planté formed type.

SWITCHGEAR, FANS, &c.—Two lists issued during the past week by Messrs. Johnson & Phillips deal respectively with electric fans and standard switchboard panels.

TANTALUM LAMPS.—Messrs. Siemens Brothers' Dynamo Works, Ltd., have issued a neat little booklet, measuring 3½ in. by 6 in., containing illustrations and particulars of tantalum lamps and photographs showing their brilliant effect in a variety of different kinds of installations. Particulars are also given of special holophone shades and adapters suitable for these lamps.

TRANSFORMERS.—A carefully arranged and well-printed booklet on the characteristics, manufacture, and use of the "Berry" transformer has been issued by the British Electric Transformer Co., Ltd., of Hayes, Middlesex. There are about fifty excellent half-tone reproductions of photographs illustrating the "Berry" type of transformer in various stages of construction, and showing the system adopted for building up the iron core on a spindle. The method of winding and insulating the coils, and the way in which the iron circuit is completed by bridging across the extremities of the radial end pieces are also clearly shown in these illustrations. A diagram demonstrating the progress made by the firm during the last ten years, and another giving efficiency curves are included, together with a vertical section of a "Berry" transformer, and a coloured horizontal section illustrating the arrangement of the coils and the provisions for ventilation. The first part of the text deals with the transformer generally, and the work of the company in developing an efficient and thoroughly sound piece of apparatus. The construction of the "Berry" transformer is then dealt with, and finally a few notes on the "Berry" series gear for reducing light load losses, are given. A full description of this series gear with diagrams and illustrations will be found in ELECTRICAL ENGINEERING, Vol. III., page 197. It is stated that a separate booklet describing this series system is in course of preparation. It may be mentioned that the company is British throughout, as the name implies, all the work being carried out at the shops at Hayes.

WALL PLUGS, ADAPTORS, &c.—Messrs. A. P. Lundberg & Sons have issued revised editions of several of their pamphlets dealing with this class of apparatus, and the addition of a few new patterns renders the number of combinations of switches, plugs, adaptors for lamp holders, &c., even more complete than before. Among the wall-sockets and plugs may be mentioned the combined switches and sockets, and the two-pin adaptor, whereby two or more ordinary plugs can be connected to one socket. The series of lamp-holder adaptors includes apparatus whereby plugs can be connected to lamp-holders, and an ingenious series adaptor for metal filament lamps, whereby two holders close together can be utilised with no alteration to the wiring. This simply consists of a pair of adaptors each with only one contact plate, and the other terminals connected by a flexible wire.

Westminster Supply Corporation's New Power House.—Under the London County Council (Tramways and Improvements) Act of 1900, certain street widenings were authorised which necessitated the removal of the generating station of the Westminster Electric Supply Corporation in Millbank Street. It was agreed that the station should be removed to a site equally convenient in every respect and of equal size. The Millbank Street site was close to the river, which provided condensing water at little cost, and also permitted coal to be brought by barges and the ashes to be taken away by water also. A new site has been offered in Horseferry Road, which, however, is not on the river, so that special arrangements will have to be made for procuring condensing water from the river, and coal will have to be carted. Arbitration proceedings commenced last week with regard to the matter, the company claiming that in the absence of equal facilities, a money payment should be made by the Council. Another matter was a disagreement as to the arrangements for obtaining condensing water. The arbitration is being held before Mr. Symon, K.C., as umpire, with Messrs. Young & Falconer as arbitrators. An adjournment for a few weeks was made on the second day to enable Sir Alexander Kennedy, on behalf of the company, and the Council's Engineer to discuss some of the details in dispute.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Oct. 29th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in brackets indicate communicators of inventions from abroad.

1907 Patents

5,560. **Operation of Rail Points and Plough Guides from a Car.** W. J. STEWART. This specification covers an apparatus whereby the rail points and plough guides of a conduit tramway system may be worked by the driver of the car. It consists of an arm which projects into the slot, and which is connected by lever mechanism with the rail points and the plough guides. A plunger is let down from the car into the slot, when it is desired to move the points; and this plunger engages with the arm, and causes the points to move over. The points are controlled by a spring, which returns them to the normal position when the car has passed. To hold the points in position when the car is passing, a locking mechanism is provided; the latter is released when the car has gone by. Twelve claims, thirteen figures.

19,882. **Rotor Field Construction for Turbo-Alternators.** BRITISH THOMSON-HOUSTON CO. AND F. H. CLOUGH. The holes for the exciting winding are tunnelled at a greater depth below the surface of the rotor than usual, and the iron above the holes is cut away between the poles to lessen magnetic leakage. By this means, the use of teeth of non-magnetic material between the poles is rendered unnecessary. The end connections are surrounded by a retaining ring, the diameter of which does not exceed the internal diameter of the stator. The arms of the spider are arranged to come opposite to the pole centres. Four claims, two figures.

25,902. **Artificial Cooling of Commutators.** PHŒNIX DYNAMO MANUFACTURING CO., LTD., AND R. POHL. Adaptations of the brush-gear of electrical machines, whereby it is used also as an apparatus for cooling the commutator, are described in the specification. Where a holder of the box type is used, the holder is provided with passages through which air is forced, and jets of cool air are thus caused to impinge on the commutator near the brush tips. The passages are largest nearest the lugs, where the current density and heating are greatest. In another method, the air is forced out of holes in the brush spindles. Three claims, three figures.

27,596. **Alternator Winding.** MATHER & PLATT, LTD., A. C. COUBROUGH, AND J. FRITH. To avoid the use of large section conductors, and the loss due to eddy currents in the same, the armature of an alternator is provided with a number of slots per pole per phase equal to, or a multiple or submultiple of the number of poles. The windings are then arranged so that there are several circuits in parallel in each phase. The conductors in each phase occupy every possible slot position in that phase in passing round the machine. By this distribution of the winding, the wave form is improved and the inductance of the armature diminished. One claim, two figures.

1908 Patents

6,245. **Supports for Metal Filaments.** WESTINGHOUSE METAL FILAMENT LAMP CO., LTD. Owing to the high coefficient of expansion of metal filaments, it is necessary to have a flexible support at the end of the loops. Instead of using a spring, it is proposed to hang a short wire loosely on to the filament, and to limit the movement of this wire by passing it through a short glass tube or a wire loop, the other end of the wire being bent to prevent it slipping through the tube or loop. Four claims, two figures.

12,556. **Carbons for Searchlights.** SIEMENS BROS. DYNAMO WORKS, LTD. (*Siemens-Schuckertwerke-Ges.*) The reduction of the section of the negative carbon in searchlights is known to increase both the intensity and the steadiness of the light. According to this invention the carbon is protected from being too quickly consumed by providing it with a cover of copper or other metal. The copper sheath is melted off before the arc is reached, and there is no discoloration of the arc. By this arrangement a negative carbon for 150 amperes need only have a section of 0·8 sq. cm. instead of 5·0 sq. cm. The positive carbon is arranged horizontally, and the negative carbon is inclined at an angle of about 60° to the horizontal. Two claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in brackets indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

22,473, RIZZO. Electric ships' logs.
22,578, MOODIE. Dynamos carried by motor cars, vessels, or like moving bodies.
22,737, GRADOLPH & HAHNE. Transmission of telephonic and undulatory currents.
22,756, PRESTON & KENNARD. Lighting of railway carriages.
22,860, KALISZ. Galvanic cells.
23,158, BERRY. Fuse-controlled apparatus.
23,148, JOHNSON & PHILLIPS, LTD., & TUBBS. Arc lamps.
23,224, FYNN. Single-phase motors.
23,235, COWPER-COLES. Manufacture of metal tubes.
23,774, GRAETZER. Electrical connection devices.
23,914, BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*). Controlling devices.
24,200, GAGLIO & VILLANI. Switch operating devices.
24,294, MASCORD & BLAKE. Electric bells.
25,398, WUNDERLICH & HUGHES. Raising and lowering of arc lamps.
26,251, MONSON. Telephone systems.
27,010, NOBEL'S EXPLOSIVES CO. & DICKIE. Telegraphic code condensers.
27,298, JOHNSON (Firm of *W. C. Heraeus*). Connecting device for electrical instruments.
28,289, BRAY, & BRAY, MARKHAM, & REISS, LTD. Circuit breakers.
28,507, HARRISON. Overload indicators.

1908 Patents

1,546, PHŒNIX DYNAMO MANUFACTURING CO. & POHL. Armature windings for high-speed continuous-current machines.
2,795, SOANS. Party-line telephone systems.
3,266, JOHNSON & PHILLIPS, LTD., & PATERSON. Arc lamps.
5,099, LUNDBERG, LUNDBERG, & LUNDBERG. Switches.
5,387, BLOXAM (*Siemens & Halske Akt.-Ges.*). Manufacture of electric lamps.
7,188, NATHUSIUS, & WESTDEUTSCHE THOMASPHOSPHATWERKE-GES. Electric furnaces.
9,492, SHEPPEE & SHIPPEY. Motors for pumps.
11,136, STECKEL. Electrical induction clutches.
11,603, SIEMENS & HALSKE AKT.-GES. Manufacture of tungsten filaments.
12,175, RORKE & RORKE. Switch.
13,361, VOSS. Automatic electric advertising apparatus.
15,362, EDISON. Metallic films and process of preparing the same for use with storage battery electrodes.
17,419, LITTLE. Arc lamp electrodes.
17,511, SCHMAHL. Conduit junction boxes.
17,512, SCHMAHL & HENDERSON. Conduit junction boxes for outlet fittings, such as switches and wall plugs.
18,372, ALLGEMEINE ELEKTRICITÄTS-GES. Alternating current commutator motors.
19,169, GLÜHLAMPENWERKE ANKER-GES. Process for packing metal filaments.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

1,240, GUILLOT. Suspension of electric conductors.
2,245, CLEIREN. Power transmission.
15,742, SIEMENS & HALSKE AKT.-GES. Time limit relays.
20,466, FESSENDEN. Wireless telegraphy.
21,069, LUNGREN. Insulated projecting lantern.
21,195, RUTHARDT & RUTHARDT. Rotary current breakers.
21,482, MILLER. Electric automatic train-controlling systems.
21,580, AKT.-GES. BROWN, BOVERI, & CIE. Control of electric power systems.
21,586, LUX. Measuring instruments for alternating currents according to Paalzow-Rubens' Bolometric principle.
21,603, ALLGEMEINE ELEKTRICITÄTS-GES. Devices for protecting transformers, cables, &c.
21,659, N. JACOBSEN'S ELEKTRISKE VAERKSTED. Electrical signalling system.

Expiring Patent

The following patent expires during the current week after a life of fourteen years :—

21,827 of November 12th, 1894. **Asynchronous Self-Exciting Alternating-Current Generators.** J. IMRAY (*La Société Anonyme pour la Transmission de la Force par l'Electricité.*) Single-phase and polyphase generators, in which the armature consist of a series of stationary bobbins, and the field of a short-circuited "squirrel cage" rotor. The necessary exciting current, which must be out of phase with the armature current, is obtained by means of connecting condensers across the armature winding, or from a separate alternator.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. 1907	DIVIDEND PAID. 1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9½—10	
Do. 6% Cum. Second Pref.	10	6	6	10⅝—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	4 *	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98 xd	−2
Brompton & Kensington E. S. Co., Ltd.	5	10	5½*	7—8	
Do. 7% Cum. Pref.	5	7	7	7—8	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	3½—4	+⅛
Do. 4½% Cum. Pref.	5	4½	4½	3¾—4½	+⅛
Do. 4% Deb. Red	Stock	4	4	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½	3½—3¾	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	2⅝—3⅜	
Do. 4½% Deb. Red	Stock	4½	4½	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6	9½—10¼	
Do. 6% Cum. Pref.	10	6	6	12—13	
Do. 5% Deb. Red	Stock	5	5	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5	3½—4	
County of London Elect. Sup. Co. Ltd.	10	5		7—8	
Do. 6% Cum. Pref.	10	6	6	10½—10¾	
Do. 4½% Deb. Red	Stock	4½	4½	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	97—100 xd	−2
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	88—91 xd	−2
Kensington & Knightsbridge E.L.Co.	5	10	4½*	7⅜—8¾	
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4	96—100	
London Electric Supply Corporation	3	2½	—	⅞—1⅛	
Do. 6% Pref.	5	6	6	4⅜—4⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¼—4½	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—4⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	84—89	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	94—97	
Newcastle-upon-Tyne Elec. Supply..	5	8	2½	4⅞—5⅝	
Do. (fully paid)	£9	8	2½	3¾—4½	−⅛
Do. 5% Pref. Do.	5	5	2½	5—5½	−⅛
Do. Do.	4	5	2½	3⅞—4⅜	−⅛
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½*	5¾—6¼	+⅛
Do. 4% Deb. Red	Stock	4	4	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5½*	7½—8	
Do. 7% Non-Cum. Pref.	5	7	7	6¾—7½	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—¾	
Do. 4% Deb. Red	Stock	4	4	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2½—2¾	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7	1⅛—1⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5	½—1	
Do. 5% Cum. Pref.	5	5	5	1⅞—2⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5½*	7½—8½	
Do. 4½% Cum. Pref.	5	4½	4½	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	93—95	
Central London	Stock	3	3½*	68—70	
Do. 4% Preferred	Stock	4	4	86—88	
Do. Deferred	Stock	2	—	49—52	
Do. 4% Debentures	Stock	4	4	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	85—87	
City and South London Cons.	Stock	4½	1½	32½—33½	
Do. 4% Perp. Deb.	Stock	4	4	98—101 xd	−2
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	3½*	7¾—8½	
Do. 4% Perp. Deb.	Stock	4	4	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	4	5	38½—39½	+1
Do. 3½% Preference	Stock	3½	3½	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½	75—78	
Metropolitan District	Stock	—	—	13½—14½	+1
Do. 6% Perp. Deb.	Stock	6	6	124—127	
Do. 4% Deb.	Stock	4	4	82—86	
Do. Perp. Extension Pref (5%)	Stock	—	—	24—29	
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	—	50—55	
Underground Elec. Railways Co of London 5% Prior Lien Bds.				92½—93½	
Whitechapel and Bow 4% Deb.	Stock	4	4	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	−⅛
Do. 5% Cum. Pref.	1	5	—	⅞—1⅛	−⅛
Do. 4½% Deb. Red.	Stock	4½	4½	82—87	−1
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	¾—1¼	
Do. 6% Cum. Pref.	10	6	6	3½—4	−⅛
Do. 5% Perp. Deb.	Stock	5	5	89—92	−1
Do. 4½% 2nd Deb.	Stock	4½	4½	73—75 xd	−1
City of Birmingham Trs. Co., Cm. Pf.	5	5	5	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4	96—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. 1907	DIVIDEND PAID. 1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%	%		
Dublin United Trams Co.	10	6	3	11½—12½	
Do. 6% Pref.	10	6	3	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	¾—1⅛	
Do. 4% Deb.	Stock	4	4	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5	98—95	
London Street Tramways Co.	4	4/6	2½	⅝—⅞	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	70—75	−1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5	¾—⅞	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—½	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅝—⅞	
Do. 3½% Mort. Deb.	100	3½	3½	89—92	
Potteries Electric Traction Co. Ltd.	1	4	—	½—⅝	
Do. 5% Cum. Pref.	1	5	2½	⅝—¾	
Do. 4½% Deb. Red	Stock	4½	4½	92—95	
Provincial Tramways Co. Ltd.	10	4	1½*	4⅝—5⅛	
Do. 6% Cum. Pref.	10	6	6	9½—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6	¾—1	
Do. 4% Deb. Red.	Stock	4	4	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5	77—81	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅝—1⅜	
Do. 6% Cum. Pref.	5	—	—	3—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	58—61	
Do. 6% Pref. Ord.	Stock	6	6*	102—103	
Do. Def. Ord.	Stock	1	—	16½—17	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4	88½—90½	+
Direct Spanish Telegraph Co. Ltd.	5	4	4	3—3½	
Do. 10% Cum. Pref.	5	10	10	8—9	
Do. 4½% Debs.	50	4½	4½	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½	13½—13⅝	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½	100—102	
Eastern & S. African Tel., 4% Mt. Deb.	100	4	4	99½—101½	
Do. do. (Mauritius Sub.)	25	4	—	101½—103½	
Eastern Ext. Australasia & China	10	7	5½	12⅝—13	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4	101—103	
Eastern Telegraph Co.	Stock	7	2½*	135—138	
Do. 3½% Pref.	Stock	3½	3½*	84—86	
Do. 4% Mort. Deb.	Stock	4	4	102—104 xd	−1
G. N. Tel. Co. (Copenhagen)	10	20	2½*	30—32	+½
Indo-European Telegraph Co. Ltd.	25	13	2½*	55—58 xd	−1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅛—⅜	
National Telephone Co., Ltd., Pref.	Stock	6	6½	109—111	
Do. Deferred	Stock	6	6½*	117—119	+½
Do. 6% Cum. 1st Pref.	10	6	6	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6	10½—11½	
Do. 5% 3rd Pref.	5	5	2½	5⅛—5½	
Do 3½% Deb. Red	Stock	3½	3½	98—100	+½
Do. 4% Deb. Red.	Stock	4	4	102—104	
Western Telegraph Co., Ltd.	10	7	6½*	13½—14	
Do. 4% Deb.	Stock	4	4	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—1⅛	
Do. 6% Cum. Pref.	1	6	7½	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	16*	34½—34⅝	−⅛
Do. 6% Pref.	1	6	6½	1⅛—1⅜	
British Insulated & Helsby Cables, Ltd.	5	10	8½*	6½—6¾	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—⅞	
Do. 4% Mort. Deb. Red.	Stock	4	4½	40—45	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½	50—54	
Callender's Cable and Const. Co., Ltd.	5	15	10½*	9½—10¼ xd	
Do. 5% Cum. Pref.	5	5	5	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5½	1⅛—1⅜	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5	98—1 1	
Dick, Kerr & Co., Ltd.	1	10	10½	1⅛—1⅛	
Do. 6% Cum. Pref.	1	6	6½	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½	101—104	
Edison & Swan United "A," £3 paid	5	2/6	—	⅝—1⅛	
Do. do. (fully paid)	5	4/2	—	1½—1⅝	
Do. 4% Deb. Red.	Stock	4	4½	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5½	84—87	
Electric Construction Co., Ltd.	2	—	—	⅛—⅜	
Do. 7% Cum. Pref.	2	7	—	1¼—1⅜	
Do. 4½ 1st Mort. Deb.	Stock	4	4½	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7—7½	−¼
Do. 4% 1st Mort. Deb. Red.	Stock	4	4½	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5½*	101—11½	
Do. 4½% Cum. Pref.	5	4½	4½	5—5½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	107—110	
I. R. & G. P. Co., Ltd.	10	10	2½*	16½—17½	
Do. 4% Deb. Red.	100	4	4½	97—99	
Tel. Const. & Maintenance Co.	12	17½	10½*	32—34	
Do. 4% Deb. Bds. Red	100	4	4½	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	¾—1	
Do. 6% Cum. Pref.	5	6	3/-	2½—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4½	72—76	

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LOCAL NOTES

ABERDEEN: *Supply to Tramway Co.*—A draft agreement between the Aberdeen Suburban Tramways Co. and the Corporation as to the price for electrical energy supplied by the Corporation, and the duration of the final agreement, to be fixed by a Board of Trade arbitrator, has been approved by the Corporation.

ARGENTINA: *Death from Electric Shock.*—In connection with the deaths of two wiremen of the Telephone Co., in Cordoba, due to a broken wire coming in contact with the high-tension mains of the Electric Light Co., the *Review of the River Plate* remarks that it is about time that the Cordoba authorities took steps to make the Electric Light Co. put their mains and installations in general into proper order, as their present condition is scandalous in the extreme and a constant menace to the public.

AUSTRALIA: *Melbourne Railways Electrification.*—It is stated that the Premier of Victoria has recommended the electrification of 29 miles of the Melbourne Suburban Railway system, which forms the first stage of the scheme outlined in Mr. Merz's report. The estimated cost of the work is about £300,000. We gave some lengthy abstracts, together with illustrations, from the report in our issue for September 24th, p. 451.

BARNSTABLE: *Expert's Report.*—Mr. W. H. Trentham is preparing an independent report upon the electrical undertaking.

BLACKROCK: *Dispute with Tramways Company.*—With reference to our note last week as to the possibility of a legal action between the Urban District Council and the Dublin United Tramways Co. regarding the condition of the tramway track in Blackrock, terms have now been arranged between the parties, and the Tramway Co. will commence the work very shortly.

BRIGHTON: *Electric Omnibuses.*—The Buildings Committee have approved plans of a proposed electric charging station for the Brighton, Hove & Preston United Omnibus Co., Ltd. Electrical energy will be taken from the Corporation.

Tramway Receipts.—The aggregate receipts to date upon the municipal tramways are £30,022, an increase of £570 upon the corresponding period of last year.

CARDIFF: *Tramcar Advertisement Contract.*—In the King's Bench Division last week, an action was taken by the Corporation against Edwards, and another to recover £500, being one quarter's rent at £2,000 per annum for placing advertisements upon the city tramcars. There was no appearance on behalf of the defendants, and Mr. Justice Bucknill gave judgment for the amount claimed and costs.

CHIPPING NORTON: *Electric Lighting.*—The Council has made an application to the Board of Trade for an electric lighting Provisional Order.

DEVONPORT: *Mechanical Stokers.*—Twelve months ago the Corporation fitted an underfeed stoker as an experiment. This proved so successful that four additional machines have been fitted, and were inaugurated last week. The total cost has been about £1,400. In future it will be possible to burn coal at 11s. 6d. to 12s. 6d. per ton, against 14s. to 15s. hitherto.

EDINBURGH: *Cost of Deputations.*—A return of Town Council deputation expenses has been prepared by the City Chamberlain, and amongst them are included the expenses of the delegates to attend the Home Office inquiry with regard to Electricity Regulations, and the annual Convention of the Incorporated Municipal Electrical Association at Nottingham. The total cost of the former was £55 4s. 6d., and the latter £58 6s. 4d.

EGHAM: *Supply to Small Consumers.*—The Guildford Electricity Supply Co. are preparing a scheme for wiring small houses, and supplying lamps and energy at 2s. 6d. per lamp a quarter, the current being available from dusk to daylight.

EPSOM: *Electricity Accounts.*—The Lighting Committee's recommendation that the services of Messrs. Jackson, Pixley & Co., chartered accountants, be obtained at a cost of £26 5s. to draw up a statement of the accounts of the electricity undertaking since its inception on a commercial or trading basis, has been adopted.

GLASGOW: *Tramway Running Powers.*—A letter has been received by the Tramways Committee from the Dumbarton, Burgh & County Tramways Co., asking that the company be allowed to run their cars over a section of the Corporation tramways in the Burgh at Clydebank, between Duntocher Burn and the Forth and Clyde Canal in Dumbarton Road, until the new bridge over the canal is completed. The Tramways Committee have remitted the question to the Sub-Committee on Extensions, with full powers to enter into and complete an agreement.

HEYWOOD: *Tramway Running Powers.*—The Town Clerk has been instructed, on the recommendation of the Finance and General Purposes Committee, to take the necessary steps to obtain a Parliamentary Bill to secure mutual powers in Heywood, Bury, and Rochdale.

HULL: *The Trackless Trolley System.*—The Tramways Committee are to give consideration to the report of the Manchester deputation which inspected the trackless trolley system on the Continent.

ILFORD: *Management of Tramways.*—A resolution was moved at the last meeting of the Council, by Councillor Brand, to the effect that it would be advisable to appoint an expert tramway manager, instead of allowing the Electrical Engineer to occupy the dual position of Electrical Engineer and Tramway Manager. An amendment was passed, however, referring it to the Tramways Committee to consider whether any alteration was desirable in the present management of the tramways.

KINGSTON-ON-THAMES: *Electricity Accounts.*—The fourteenth annual report of the electricity undertaking states that the number of consumers has gone up during the twelve months from 909 to 1,024, while the number of connections has increased from 40,741 8-c.p. lamps to 45,229. After paying working expenses there is a balance of £5,209. Payment of interest and instalments of loans caused the net result of the year's working to be a debit balance of £884, as against a debit balance last year of £7. The chief causes of this increased debit balance are a rise in the price of coal of £550, and a decrease in revenue of £188, due to the general adoption of the flat rate of charge, and the reduction in the price of current for power and heating from 2d. to 1½d. The use also of metallic filament lamps contributed to a temporary reduction in the revenue receipts. The total number of units generated was 652,968, which was the largest for any one twelve months in the history of the undertaking, while the receipts per unit averaged only 4·112d, which is the lowest price in the history of the undertaking.

LEEDS: *Public Lighting.*—A street lighting experiment is now being carried out in Manningham Lane, one length of the thoroughfare being illuminated by arc lamps, under the direction of the electricity department, and another section by incandescent gas lamps.

LIVERPOOL: *The Turbine Contract.*—As we have reported from time to time, there have been many discussions and some insinuations made with regard to the Westinghouse turbines in the Lister Drive Power Station. In our issue for October 8th we gave an abstract of the final report of Mr. Bromley Holmes, the Corporation's Consulting Engineer, upon these turbines, in which he took them over from the contractors as being perfectly satisfactory. In the discussion upon this report, Sir William Bowring referred to it as a "whitewashing report," and as a consequence Mr. Bromley Holmes, having taken this as a reflection upon his professional honour, has had a long correspondence with the Councillor with a view to having the remark publicly withdrawn. The correspondence, which was of a more or less friendly character, failed to bring about this result, however, and in his final letter Mr. Bromley Holmes states that he is advised that the remark in question constitutes a very injurious reflection upon his official conduct as well as upon his professional character. He further states that he will not trouble Sir William Bowring with any additional personal correspondence.

LONDON: *London County Council: London Traffic Commission.*—The Prime Minister has been asked to receive a deputation in relation to the report of the Royal Commission on London Traffic, during November.

"G.B." Surface Contact System.—The Highways Committee have now notified the Council of the receipt of Mr. W. M. Mordey's report upon the G.B. surface contact system in the Mile End Road. They are communicating with the G.B. Surface Contact Co. with regard thereto, and propose to report fully to the Council on November 10th, 1908, on the whole subject.

Side Slot Tramways.—Frequent delays have occurred on the Kingsland Road tramways through the defective working of the experimental portion of side slot tramways laid in that thoroughfare. The difficulty arises through the car ploughs becoming jammed at the points where the centre slot changes to side slot and *vice versa*. These delays, which are sometimes of extended duration, have resulted in serious loss of traffic, and in addition considerable expense is involved in repairing the damaged ploughs and points. It is thought that the difficulty might be overcome if the slot diversions, where the change from centre to side takes place, which are at present made in lengths of 19 ft. 3 in., with a radius curve of 40 ft., were altered to a length of 32 ft. 8 in. with a curve of 200 ft. radius. With this proposed alteration the plough will have more time to travel from the centre of the plough carrier to the side and *vice versa*. The cost of altering the whole of the 12 diversions on this route in this manner is estimated at £1,000. After carefully considering the matter, the Highways Committee are of opinion that it would be advisable that two diversions on the down track at Downham Road, where most of the delays have occurred, should be altered as an experiment with a view to ascertaining the effectiveness of the alterations. The cost involved by this proposal will be about £170.

Fulham: Metal Filament Lamps.—The Borough Electrical Engineer has been experimenting with metal filament lamps for street lighting, and the result has proved that the Osram lamp gives the most satisfaction. The actual life of the lamps cannot

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yet be given, but they have already given some 1,300 hours' light, as compared with 450 hours given by three other makes. Arrangements have been made with the makers of the Osram lamp to guarantee an average life of 1,100 hours. It is proposed to change the whole of the 32-c.p. carbon filament lamps to 200-volt 75-c.p. Osram lamps. The Electricity Committee have decided, subject to the usual sanction, to carry out the work immediately, and tenders are to be invited for the supply and fixing of the requisite fittings.

Hammersmith: Condition of Tramway Track.—A letter has been received from the Board of Trade to the effect that the London United Tramways, Ltd., have applied to them, under Section 33 of the Tramways Act, 1870, to appoint an engineer or some other fit person to settle the difference which has arisen between the Borough Council and the company as to the condition of the tramway tracks. The Town Clerk has replied, expressing the Council's disagreement with the company's contention that the difference calls for the arbitration of the Board under the section in question

Marylebone: Public Electric Lighting.—The Electric Supply Committee recommend that a sub-committee be appointed to consider a proposal for lighting the streets with electricity. Owing to the large lighting and power supply which Messrs. Selfridge & Co. require at their new premises in Oxford Street, it will be necessary to carry out certain extensions to the distributing system. This work, which will cost about £3,000, is to be put in hand forthwith. The committee consider the present is a good opportunity for adopting electric street lighting generally. The streets, they say, can be lit as cheaply by electricity as by gas, and the report of the Consulting Engineer shows that, leaving out the cost, if any, of the removal of the gas company's property, and the insurance against damage to the lamps by vehicles, the whole of the lighting in those streets in which mains are already laid can be done electrically for £8,650 for the first ten years, as against a charge of £8,818, the cost of the present gas lighting; while after ten years the charge for electric lighting will be only £8,130.

Poplar: Standby Supply.—The Electricity Committee has received an application from Stepney Borough Council for a standby supply of electricity pending completion of their second generating station at Limehouse. No capital expenditure will be incurred by Poplar, as the spare plant at the main station will be sufficient to afford the supply, while the expenses of coupling up the mains is to be borne by Stepney. It has therefore been agreed to provide Stepney with a supply of electricity to the extent of 500 kw. at any time during the period ending September 30th, 1909, at a cost of £100 for the right of taking a supply whether current is taken or not, and a further sum of ¾d. per unit. In the event of a breakdown or insufficiency of plant, Poplar has the right to cut off the supply.

Wandsworth: Public Lighting.—The County of London Electric Supply Co., Ltd., have asked to be allowed to erect in certain positions in the borough some specimen lamps for the purpose of demonstrating the efficiency of electric lighting as compared with gas for street lighting. Permission is to be granted under protective conditions.

MANCHESTER: *Proposed New Tramways.*—The *Manchester Guardian* states that a syndicate is in the course of formation with the object of financing the promotion of a Bill in Parliament during the next session for powers to construct a system of electric tramways to connect the existing tramways to Stalybridge, Hyde, Mossley, and Dukinfield Joint Board with the Glossop and Hadfield tramways, *via* Mottram and Woolley Bridge (Glossop). The total route mileage will be about seven miles, and the use of single-deck cars is contemplated, owing to the heavy gradients in the vicinity of Mottram. The engineers to the scheme are Messrs. J. M. Newton and J. W. Welch, both of Manchester. The offices of the syndicate are at 13 Spring Gardens, Manchester. Our contemporary further states that should the present scheme go forward and be authorised by Parliament, it is intended during a subsequent session to apply for further Parliamentary powers to construct a mono-rail tramway (about three miles long), from Mottram village along the Stockport Road, *via* Hattersley to Gee Cross, Hyde, to connect there with the Oldham and Stockport tramways, and also another mono-rail tramway (about five miles long) from the Plough Inn (near the Dinting railway viaduct), Glossop, along the Glossop-Marple Road, *via* Charlesworth and Compstall to Marple Bridge.

NEWCASTLE: *Tramway Accounts.*—In the report for the year ended March 31st, 1908, Mr. E. Hatton, the Corporation Tramways Manager, states that the gross receipts amounted to £217,080, compared with £215,120 last year, and that the working expenses were £115,378, against £106,081. The balance, after meeting capital charges, &c., is £19,477, which has been added to the general reserve and renewals fund, bringing that fund to £62,323.

OLDHAM: *Tramways and Trolley Omnibuses.*—Among other matters which will be included in a Bill promoted by the Corporation next session are some tramway extensions and powers to run trolley omnibuses. An extension of the area of electric supply will also be included.

SHREWSBURY: *Hiring Fittings, &c.*—In a general powers Bill, which will be introduced in the coming session of Parliament, authority will be asked to supply and hire fittings, apparatus, &c., for electric light and power purposes.

SOUTH SHIELDS: *Supply by Power Co.*—At a meeting of the Council last week the County of Durham Electric Power Co. applied for permission to lay three underground cables for the purpose of supplying the Harton Collieries, upon certain conditions, including a rental of £250 for wayleaves, terminable by twelve months' notice. The necessary sanction is to be given.

STOKE: *Local Government Board Loans.*—The Council recently made application to borrow money for further extensions, but sanction has been withheld by the Local Government Board in respect of a portion of the proposed loan. On the recommendation of the Electricity Committee, a deputation, consisting of the Chairman, Vice-Chairman, the Mayor, Town Clerk, and Electrical Engineer has been formed to wait upon the Local Government Board, and lay before it the Council's views on the matter. Mr. John Ward, M.P., and Mr. Albert Stanley, M.P., have been requested to accompany the deputation.

STOURBRIDGE: *Electric Lighting Order.*—The Shropshire, Worcestershire & Staffordshire Electric Power Co. and the Midland Electric Corporation for power distribution, have made a proposal to the Council, whereby the existing Provisional Order shall be cancelled and a new order applied for by the Stourbridge Council. The companies ask for a clause in the new order repealing the Stourbridge Order of 1899, and also for the variation of certain clauses contained in the deed of transfer from the Stourbridge Council to the Shropshire Power Co., dated December 31st, 1906. The Electric Lighting Committee's recommendation that the proposal should not be expedited in its present form has been adopted.

WORSLEY: *Council v. Power Company.*—The Council have refused permission to the Lancashire Electric Power Co. to supply current to Messrs. C. Lane & Sons' Hope Mills, Walkden. The Council object to the L.E.P. Co. laying their mains piecemeal—as they obtain contracts—in their township.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ESSEX COUNTY LUNATIC ASYLUM.—The Committee of Visitors of the Essex County Lunatic Asylum invite tenders for the supply and erection of the following plant :—1. Two steam dynamos (100 kw.), steam and motor balances, main switchboard, and travelling crane. 2. Steam, exhaust and rain pipes, and valves. 3. Main cables, distribution boards, wiring, and lamps. 4. Motors, motor starters, and cable connections. 5. Telephones, bells, fire alarms, and electrically-driven clocks. Particulars from the Clerk, New Street, Chelmsford, on and before November 7th, fee £5, returnable, and tenders by November 30th. The engineers are Messrs. Hawtayne & Zeden, of 9 Queen Street Place, E.C.

HULL.—A new feeder cable to the value of about £1,500 is required.

LEITH.—Tenders are invited for the supply of steam slack to the electricity department.

LEYTON.—The Local Government Board has sanctioned the borrowing of £1,000, repayable in 60 years, for the purchase of additional land for the generating station.

LONDON: *Islington.*—A letter has been received from the Finance Committee of the London County Council with reference to the Council's application for a loan of £7,205 in respect of the electrical undertaking. The letter points out that a portion of the expenditure for which the loan is required was incurred some years ago, and the Finance Committee of the London County Council state that they propose to recommend the Council to sanction a loan of £5,541 for various purposes, on the understanding that no further sanctions for balancing purposes in respect of capital expenditure to March 31st, 1908, will be applied for. The letter has been referred to the Finance Committee of the Borough Council for consideration.

MIDDLETON.—Tenders are invited for the supply of 880 yards of three-core distributor cable. Particulars from the Borough Electrical Engineer, and tenders by November 11th.

PENANG.—It is stated that the Government has sanctioned a proposal of the Municipal Commissioners to raise $100,000 for the extension of electric lighting undertaking, including generating plant.

ROTHERHAM.—The Thryberg Parish Council are desirous of entering into a contract for the lighting of certain streets, &c., by means of electricity. Proposals should be delivered to the Clerk to the Parish Council, 4 Clifton Bank, Rotherham, by November 9th.

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Miscellaneous

AUSTRALIA.—A copy of the specification and conditions for the supply of coin attachments for telephones required by the Deputy Postmaster General, Melbourne, is filed at the Commercial Intelligence Branch at the Board of Trade. Tenders will be received up to December 22nd.

A new multiple switchboard is to be erected at Ballarat (V.).

BECKENHAM.—An application is to be made to the Board of Trade for a small loan for the provision of suspension gear for the street arc lamps.

BRADFORD.—The Tramways Committee invite tenders for stores, including electric lamps, for cars, insulating tapes, &c. Particulars from the Tramways Manager (fee, one guinea, returnable), and tenders to the Town Clerk by November 14th.

BRAZIL.—A concession originally granted to Eduardo Pellew Wilson for the installation and working of a telephone system in Bahia has been transferred to Messrs. Guinle & Co. A copy of the contract is filed at the Commercial Intelligence branch of the Board of Trade.

A decree has been issued authorising the Ministry of Industry, Ways, and Public Works to contract with Senhor Luiz Soares de Gouvea for the construction of a railway from Taipu to Caico. The material for this is to be imported from abroad, and includes telegraph apparatus, wiring, and machinery for workshops. A copy of the contract, which has been signed, is filed at the Commercial Intelligence Branch at the Board of Trade.

BRIGHOUSE.—Tenders are invited for a hollow engine-room floor, 54 feet by 30 feet, in ferro-concrete. Particulars from the Borough Engineer, and tenders to the Town Clerk by November 14th.

Tenders are also invited for the erection of the transformer station.

DUBLIN UNITED TRAMWAYS CO.—Tenders are invited by November 30th for general stores, including electrical supplies. Particulars from the Secretary.

LONDON GENERAL OMNIBUS COMPANY.—Tenders are invited for the supply of stores during the year 1909, including electrical appliances. Particulars from the Joint Managers' Department, 8 Grosvenor Road, Westminster, on November 9th and 10th, and tenders to the Directors by November 19th.

LONDON: *Fulham.*—Tenders will shortly be invited for fittings in connection with a change over from carbon filament to metal filament lamps for street lighting.

Hammersmith.—The Electricity Committee have under consideration a report from the Electrical Engineer upon the increasing demand for current for power and lighting purposes, and the necessity for considerable extensions at an early date of the plant and distributing system.

MANCHESTER.—The Tramways Committee invite tenders for structural alterations and additions at the tramway depôt, Hyde Road. Particulars from Mr. J. M. M'Elroy, the General Manager, and tenders by November 17th.

TASMANIA.—Tenders are invited by March 15th, 1909, for the supply of a common battery switchboard, and apparatus for use on subscribers' premises at Launceston, Tasmania. Specifications, special conditions, &c., can be seen at the General Post Office, Hobart, Sydney, Melbourne, Brisbane, Adelaide, and Perth, where tender forms can be obtained.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—School (£12,948), Dingle Lane, Poplar. Builders, J. & C. Bowyer, Ltd., Upper Norwood, S.E.

School (£6,257), Farrance Street, Limehouse. Builder, T. D. Leng, Evelyn Street, Deptford.

School (£3,111). Carter Street, Mile End. Builders, F. & T. Thorne, Isle of Dogs, E.

Poplar Educational Divisional Offices. T. J. Bailey (Education), Architect to L.C.C., Victoria Embankment.

E.C.—Premises for German Y.M.C.A., City Road (£19,000). Architect, G. Waymouth, Raymond House, 32 Theobalds Road, W.C.

S.E.—Additions (140 places), St. John's Church of England School, Russell Place, Greenwich. The Managers.

Enlargement (£650), Blackheath, Lee, Lewisham, and Greenwich School of Art. Secretary of Committee.

Addition to mortuary at Seamen's Hospital, Greenwich. Builders, Holliday & Greenwood, 144A Loughborough Park, Brixton.

Addition to Inlaid Linoleum Works, Blackwall Lane, Greenwich. Builder, Wm. Downs, Hampton Street, Walworth, S.E.

Enlarging "Oliver Goldsmith" School (£5,763), Camberwell Builders, J. & C. Bowyer, Ltd., Upper Norwood.

Enlarging Gloucester Road School (£1,549), Camberwell. Builders, J. & C. Bowyer, Ltd., Upper Norwood.

S.W.—New concert hall, High Street, Tooting (accommodation, 1,440 persons). Architects, Emden, Egan & Co., 2 Lancaster Place, W.C.

Extension of Trevelyan Hall, St. Ann's Lane, Westminster. H. S. Rogers.

Additions, Wellington House Hotel, Buckingham Gate. Architects, Palgrave & Co., 28 Victoria Street.

Re-erection of Crosby Hall, in Cheyne Walk, Chelsea, by University and City Association of London, Ltd.

Billiard hall, High Street, Clapham South, for Temperance Billiard Halls, Ltd.

W.—Alterations, &c., London Pavilion, Piccadilly Circus. Architects, Wylson & Long, 16 King William Street, E.C.

Extension of Paddington Technical Institution. T. J. Bailey (Education), Architect to L.C.C., Victoria Embankment.

Adaptation of premises, High Street, Notting Hill, for branch of London, City and Midland Bank, 5 Threadneedle Street, E.C.

Improving and enlarging Barrow Hall Road School, St. John's Wood (£14,973). Builders, G. E. Wallis & Sons, Ltd., 1 Albemarle Street, W.

PROVINCES.

ABERDEEN.—New dock and reconstruction of wharves in Albert Basin (£85,000). Engineer, Aberdeen Harbour Board.

CHELMSFORD.—New school (800 places), Trinity Road. J. H. Nicholas, secretary, Essex Education Committee.

CHRISTCHURCH (HANTS).—Proposed infirmary. Clerk to the Board of Guardians.

EAST HAM.—Residence at hospital for Medical Officer of Health. A. H. Campbell, surveyor to Town Council.

ECCLES.—Tenders are invited for wiring and fitting for electric lighting of buildings belonging to the Cleansing and Scavenging Committee. Particulars from the Town Clerk, and tenders by November 14th.

EDINBURGH.—Tenders are invited for an electrical installation at the Cattle Market, Gorgie. Particulars from the Borough Electrical Engineer (fee, one guinea, returnable), and tenders by November 14th.

Police station, MacLeod Street (£6,000). J. Sim, surveyor, Town Council.

EPSOM.—Further extensions to Manor Asylum (£15,973). Engineer, W. C. Clifford Smith, Asylums Committee, L.C.C., 6 Waterloo Place, S.W.

GATESHEAD.—Lunatic Asylum, West Dudds Estate, near Stannington. City architect, N. P. Pattinson.

GLASGOW.—School, &c. Hopehill Road, for Directors of Houses of Refuge and Reformatory and Industrial Schools.

Extension to Dead Meat Market for Glasgow Corporation. A. B. McDonald, surveyor to Town Council.

New Pavilion Hospital at Yorkhill, for the Royal Hospital for Sick Children, Glasgow.

HULL.—Art Gallery to the Public Hall. City Architect, Joseph H. Hirst, Town Hall, Hull.

ISLEWORTH.—Church Hall, Spring Grove. Architect, J. E. Franck, 11 Pancras Lane, E.C.

LANCASHIRE.—Buildings on asylum estate at Whittingham for Asylum Board. H. E. Clare, Clerk, Preston.

LEAMINGTON.—New chapel at Midland Home for Incurables. The Secretary.

LEYTON.—Extension of office accommodation at Town Hall (8,600). Surveyor, W. Dawson, Town Hall, Leyton.

LONDONDERRY.—Municipal Buildings (£5,000). W. J. Robinson, Surveyor to City Council.

MONMOUTHSHIRE.—School (£5,137). H. S. Gustard, clerk to the County Education Committee, Newport.

PONTYPRIDD.—School, Maesycoed (£12,091). P. R. A. Willoughby, Surveyor to Urban District Council.

ROTHERHAM.—Cold storage, for Markets Committee. G. Jennings Surveyor to the Council.

High-grade school at South Grove. Architect, D. B. Jenkinson, c/o Rotherham Town Council.

SHEFFIELD.—Cookery centre at Peripathetic Science Department, Townhead Street, for Education Department.

SOUTHAMPTON.—Additions, Portarlington College Place. Architect, A. A. Burnett, 2 High Street.

Adapting premises 48 Payne's Road for police station (£960). J. A. Crowther, Borough Engineer.

SUNDERLAND.—Mortuary at Ryhope. T. Young, Surveyor to the Rural District Council.

TYNEMOUTH.—Proposed swimming bath (£3,000). J. F. Smillie, Surveyor to Town Council.

WATFORD.—Co-operative stores (£11,000). Architect, C. P. Ayres, 6 The Parade, High Street. Builders, Clark Bros., Fearnley Street.

WIGAN.—Additions to cardroom of Trencherfield Mill, off Pottery Road, for W. Wood & Sons, Ltd.

WIMBLEDON.—Empire Theatre of Varieties. Architect, T. V. Woodhouse, 16 Hound Street, West Bridgeford, Nottingham.

Royal Society Medals.—Among the Royal Society medals, the awards for which have just been announced, is one to Prof. Eugen Goldstein, for his discoveries on the Nature of Electric Discharges in Rarefied Gases.

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TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—An order for transformer station equipments in connection with the Adelaide tramway system has been placed with the Australian agents of the Allgemeine Elektricitäts Gesellschaft. Fourteen tenders were received from different parts of the world. Transformation will take place from 11,000 volts three-phrase to 600 volts continuous.

The whole of the first batch of tenders for the supply of wireless telegraphy installations to the Federal Government, namely, those to be provided for the northern and western coasts, were, says the *Australian Mining Standard*, rejected as not complying with the specifications. The tenders for the same work at Launceston or Georgetown, King Island, Flinders Island, and Melbourne, or some point on the coast of Victoria, originally called for August 26th, are not due now until December 9th, and much will depend upon the manner in which tenders come in for those posts, whether fresh tenders will be called for the northern installation, or whether the Government will undertake the work on its own account.

The Commonwealth Postmaster-General is, owing to the fact that the tenders recently received for wall telephones and parts were not satisfactory, making inquiries to ascertain whether a departmental factory should be established for their production, and also for telephone wire. The requirements of the Telegraph and Telephone Department amount to 357 tons per annum.

CARLISLE.—The tender of Messrs. Pratchett Bros., of Carlisle, for the erection of elevating, conveying, and storage plant at the Electricity Works has been accepted, subject to the sanction of the Local Government Board, to borrow £1,000, the cost of the works. The works include a coal bunker, foundations, wiring, and motor and counter gear for measuring fuel, &c.

ENNISKILLEN (County Fermanagh).—Three companies have laid tenders before the local authorities for an electric lighting scheme, and the matter is to be finally settled at a meeting, which will be held at an early date.

EPSOM.—Messrs. Pritchetts & Gold have received an order for a new battery of 210 cells.

GLASGOW.—The Town Council have accepted the tender of W. C. Yuille & Co. for mica insulated bolts.

KINGSTON.—The tender of Siemens Bros. & Co., Ltd., has been accepted for the supply of five lengths of cable at £213 3s.

LONDON: *London County Council.*—In connection with the electrification of further tramways consisting of about 18¼ miles of single track, the Highways Committee recommend that an offer by the Frodingham Iron & Steel Co., Ltd., amounting to £13,017, for the supply of slot rails and conductor tee rails be accepted. An offer by Messrs. Bolchow Vaughan & Co., Ltd., at £8,150 for the supply of track rails and fastenings, is also recommended for acceptance.

The following tenders have been received for the erection of the Norwood tramways car-shed :—Charles Wall (recommended), £24,723; Leslie & Co., £25,860; J. Mowlem & Co., £25.897; Rowley Brothers, £26,807; Kerridge & Shaw, £26,824; Holloway Brothers (London), £27,000; Patman & Fotheringham, £27,283; McCormick & Sons, £27,567; J. & C. Bowyer, £27.618; Henry Lovatt, £27.660; E. Lawrance & Sons, £27,694; Foster & Dicksee, £28,588; F. & G. Foster, £30,286.

Bermondsey.—The following tenders have been received for one set of suction and delivery valves, and seats for boiler feed pump at the generating station :—J. P. Hall & Sons, £5 5s.; Dewrance & Co. (accepted), £5 12s.; W. A. Crips & Sons, £5 16s.

Camberwell.—The Guardians have accepted the tender of Leslie Miller, 93 Hatton Garden, E.C., to repair the X-ray apparatus, at £15 8s.

Hammersmith.—The Council has placed an order with the General Electric Co., Ltd., at £117 and £22 for two low-tension switchboards required in connection with the Council's sub-station at the works of the Wolfram (Tungsten) Metal Filament Lamps, Ltd.

Marylebone.—The Council has accepted the tender of C. A. Parsons & Co. for the supply of two sets of carbon brushes and gear at £40 12s. each.

Stepney.—The Council has accepted the following tenders :—For temporary switchgear required to connect up the Poplar supply : Johnson & Phillips, £93 5s. For motor fans and air ducts in connection with Blyth's Wharf extension scheme, the following tenders have been received :—Matthews & Yates, £628 (incomplete), alternative £744; Sturtevant Engineering Co., £731 17s. 6d.; Davidson & Co., £660, alternative (accepted) £690; Babcock & Wilcox, £684, alternative £722; Underfeed Stoker Co., £741.

Stoke Newington.—The tender of Messrs. W. T. Henley's Telegraph Works Company at £1,372 has been accepted for the supply of cables, to connect the new generating station adjoining the refuse destructor with the existing sub-station, which is supplied by the North Metropolitan Electric Power Supply Company. Other tenders were Messrs. W. T. Glover & Co., £1.556; British Insulated & Helsby Cables, £1,413; Callender's Cable & Construction Co., £1,628.

Wandsworth.—An order has been placed with the Brush Electrical Engineering Co. to supply and fix an 18-hour, 2,500-c.p. plain arc lamp, bracket, and lowering gear outside the Tooting Baths for the sum of £23 10s.

UNITED STATES.—The *Times* correspondent at New York states that the Pennsylvania Railroad Co. has awarded the Westinghouse Electric Co. a large contract in connection with the electrical equipment required for the New York and Long Island new terminals, covering the next two years, the *minimum* estimates for which were over £1,000,000.

COMPANIES' MEETINGS AND REPORTS

BRITISH COLUMBIA ELECTRIC RAILWAY.—The report for the year ended June 30th last states that the gross receipts show an increase of $525,218, or 36 per cent., and the net earnings an increase of $208,749, or 30 per cent. over those of the preceding year. The net profit for the year, after deducting renewals and maintenance, employees' bonus, and amount added to capital amortisation fund, amounts to £154,223, which, with the balance brought forward of £3,481, makes £157,704. Interest on debentures and debenture stock to June 30th, 1908; dividends already paid—on 5 per cent. cumulative perpetual preference stock for the year ended June 30th, 1908; on preferred ordinary stock for the year ended June 30th, 1908; and on deferred ordinary stock for six months to December 31st, 1907—together absorb £83,730, leaving available for further distribution and reserves £73,973. The directors recommend a dividend on the deferred ordinary stock, including the recent issue of 100,000 deferred ordinary shares of £1 each, at the rate of 8 per cent. per annum for the six months to June 30th, 1908, making 8 per cent. for the year: to transfer to reserve fund (increasing this fund to £140,000) £49,000, and to carry forward £4,973.

CAPE ELECTRIC TRAMWAYS CO.—The report for the year ended June 30th shows a balance of £8.823 after providing for debenture interest and redemption of debentures. The number of passengers carried during the year in Cape Town was 14,742.155, and in Port Elizabeth 3,561,211. The receipts in Cape Town were £120,910 and £37,048 respectively, the figures for the previous year being £131,594 and £36,696. The report calls attention to the fact that in addition to suffering severely on account of the general trade depreciation, and shrinkage of the population in both towns, the company's business has suffered from the persistent ruinous competition from the Government and the Seapoint Municipality, which affects the Seapoint section of the company's system.

CUBA SUBMARINE TELEGRAPH CO.—At the half-yearly meeting last week, the report and accounts given in our issue for October 22nd were adopted. In moving the adoption of the report, the chairman said that the half year covered by the accounts had not been a very exciting one, there having been no earthquake in the West Indies, or any such circumstances to cause a special increase in traffic. At the same time affairs in Cuba had been very dull, and owing to the poor sugar crop there had been less traffic for the railways, and less traffic in the shape of messages for the company's cables to deal with.

DEUTSCHE GASGLUHLICHT - AKTIENGESELLSCHAFT (AUERGESELLSCHAFT) BERLIN.—The report for the year 1907-8 shows a net profit of about £171,400, as against £61,260 in the previous year. At the general meeting, which will be held on December 1st, 1908, a dividend of 35 per cent. on the total share capital of £330,000 as against 22 per cent. last year on the then total share capital of £195,000, will be recommended. The reserve fund now stands at £260,000, or about 80 per cent. of the share capital. The meeting will also be asked to sanction the issue of further 5 per cent. preference shares to the value of £330,000, in consideration of the continued expansion of the undertaking. These shares will not be issued at once, however. This company, it will be remembered, manufacture, besides incandescent gas mantles, the well-known Osram lamps.

DOUGLAS SOUTHERN ELECTRIC TRAMWAYS CO.—At the annual meeting on Thursday, the report and accounts were adopted. The company's season consisted of 115 days against 125 days last season, the total receipts being £5,012, against £5,613 last year. The number of passengers carried were 206,994, compared with 231,664. After deducting the necessary items, the net profit was £1,479, to which is added £179 balance of last year, giving a total balance available for depreciation of £1,658, against £1,692. A dividend of 5½ per cent. upon the preference shares has been declared, and a balance of £229 carried forward.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—The report for the half-year ended June 30th, 1908, states that the gross receipts amounted to £290.295,

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against £304,367 for the corresponding half-year of 1907. The working expenses, including £21,156 for maintenance of cables, absorb £150,889, against £155,930 for the corresponding period of 1907, leaving £139,405. From this is deducted income-tax payable in England, expenses in connection with the International Telegraph Conference in Lisbon, and interest on debenture stock, leaving £120,387. After adding £20,389 brought forward, there is an available balance of £140,777. Two quarterly interim dividends of 1¼ per cent. each have been paid for the half-year, leaving £65,777 to be carried forward. The meeting is on Tuesday.

EASTERN TELEGRAPH CO.—The report for the six months ended June 30th, 1908, shows revenue amounting to £568,442, from which are deducted £208,071 for the ordinary expenses, and £53,098 for expenditure relating to maintenance of cables, depreciation of spare cable, sundry differences in exchange, and income tax payable abroad. Adding £35,794 brought from the preceding account, there is a total available balance of £343,066. After providing for income tax payable in England, interest on mortgage debenture stock, and for two quarterly dividends on the preference stock, which in all absorb £82,301, there remains a balance of £260,765, out of which the directors have placed £7,000 to the reserve fund for maintenance ships, £100,000 to the general reserve fund, and have allocated £100,000 to meet the two interim dividends of 1¼ per cent. each on the ordinary stock, the balance of £53,765 being carried forward to the next account. The meeting is on Wednesday.

EDISON & SWAN UNITED ELECTRIC LIGHT CO.—At the ordinary general meeting on Thursday, the report and accounts, given in our last issue, were adopted. Mr. H. Wolfenden, chairman of the company, presided, and stated that it was natural that the considerably reduced profit, as the result of the year's trading, was a position hardly agreeable to the shareholders, but that there was little cause for dissatisfaction when the result was analysed. Apart from a year of depression in the trade generally, and the electrical trade in particular, there had been the special effect resulting from the increasing use of metal filament lamps, which were being installed on account of their economy in consumption of current where long hour burning was needed. In order to extend the area of electric lighting, to counteract this effect, two factors were needed, in addition to an economical high-efficiency lamp, namely, a cheap form of house installation and a more simple method of charging for electrical energy. A cheaper form of house installation was being used on the Continent, and was available for use in this country, but the rules of the fire insurance companies would not allow of it. Under the circumstances, he suggested that the insurance companies might be approached with a view to a frank reconsideration of their rules in this respect, and this might be brought about through the medium of the Institution of Electrical Engineers and other societies interested in the industry. Methods of charging, he said, he need not discuss at the moment, because electrical engineers were fully alive to the needs in this direction, and were giving it their consideration. With regard to the company, they were retaining their carbon lamp factories, but were adding a new factory for metal filament lamps, which they were now producing in some quantity. He claimed that they were the first English firm to produce metal filament lamps upon a commercial scale, and that they were the largest producers at the present time in England. Furthermore, this has all been done without the purchase of any patents. The report and accounts having been adopted, Sir Joseph Swan, F.R.S., and Mr. H. Wolfenden were re-elected directors.

ELECTRIC SUPPLY CORPORATION.—At the annual meeting on Thursday, the report and accounts which were given in our issue of October 22nd were adopted. The chairman, Major C. Heaton-Ellis, stated that very shortly the company would have to ask for increased borrowing powers.

MONTE VIDEO TELEPHONE CO.—The report for the year to July 31st records a substantial increase in the number of consumers, and in gross revenue, but owing to an increase in the rate of wages, to damage caused by storms and the removal of lines necessitated by the introduction of electric traction, the working expenses have more than absorbed the increased receipts. After providing for such exceptional expenditure and ordinary working expenses in Monte Video and London, there is a net profit of £19,400 against £20,383 for the previous year. After deducting the interim dividend already paid, transferring £6,000 to reserve fund and £5,000 to reserve for renewal of plant, a final dividend of 2½ per cent. on the preference shares, and 3 per cent. on the ordinary shares, making 5 per cent. and 6 per cent. per annum respectively, is recommended, carrying forward £2,796.

At the meeting on Friday, the report and accounts were adopted. Mr. C. Lock, who presided, stated that he hoped there was no truth in the reports in certain newspapers that the Government proposed to nationalise the telephone system.

NEW ST. HELENS & DISTRICT TRAMWAYS CO.—The report for the year to June 30th shows a profit of £1,689, compared with £1,068 for the previous year. After deducting the debit balance from last year there is a balance of £1,477 available. A dividend on the preference shares of 1½ per cent. per annum is recommended, carrying forward £278.

NORWICH ELECTRIC TRAMWAYS CO.—The report of the directors for the year ended June 30th last shows a profit of £6,129; to this sum has to be added £181 interest and transfer fees received, bringing the gross profit for the year up to £6,310. Taking into account the sum brought forward from the previous year, after paying the dividend and providing for the reserve, the amount standing to the credit of profit and loss account is £6,470. Deducting from this amount the sum of £2,640, 4 per cent. interest on the mortgage bonds for the year, there remains a sum of £3,830. The directors recommend that the sum of £500 be placed to "reserve fund" account; that a dividend of 1¼ per cent., less income tax, be paid on the shares of the company for the year ended June 30th, 1908, and that the balance of £30 be carried forward. Comparing the accounts with those for the year ended June 30th, 1907, the revenue has decreased by £1,692, and the expenses have increased by £44, showing a decrease of £1,736 in the profits. The directors call attention, however, to the fact that the profits have been arrived at after charging to revenue the following extraordinary expenses, namely: arbitration law costs, £1,185; repairs carried out under arbitration, £427; repaving Unthank Road, £643, a total of £2,255. There is a further liability in respect of arbitration law costs, estimated at about £1,000, yet to be dealt with. The number of passengers carried was 7,190,361, a decrease of 377,845 on the previous year, and the number of car miles run was 1,049,175, as against 1,081,221. At the meeting on Friday the report and accounts were adopted.

RIO DE JANEIRO LIGHT & POWER CO.—The report for the year ended December 31st, 1907, states that the company was originally organised with a capital stock of $25,000,000 and a first mortgage bond issue of $25,000,000. Further large expenditures being necessary, the Board on March 29th, 1908, authorised the issue of £3,500,000, or 88,060,000 frs., of 50-year 5 per cent. mortgage bonds, dated April 1st, 1908. Notwithstanding the financial crisis, the construction work in Rio has been continued without interruption, largely with funds provided through loans from banking institutions. The company has sold 22,500,000 frs. of the new issue in Paris and in Belgium, and a further £900,000 in England. The proceeds are being used in the payment of the floating debt, the completion of the work in hand, and further construction. The company still has in the treasury about £1,700,000 of this second issue, the proceeds of which will be applied to the electrification of the tramways, the reconstruction of the gas works, the extension of the telephone, light and power systems, and other works of construction.

ROSARIO ELECTRIC CO.—At the general meeting last week, the report and accounts given in our issue for October 15th were adopted.

WESTERN TELEGRAPH CO.—The report for the half-year ended June 30th, states that the revenue amounted to £353,185 and the working expenses to £115,485. After providing £16,000 for debenture stock interest and £5,241 for income-tax, there remains a balance of £222,432, including £5,973 brought forward. A quarterly interim dividend, amounting to £31,190, has been paid, £110,000 transferred to the general reserve fund, £5,000 to the maintenance ships' reserve fund, £10,000 to the marine insurance fund, and £10,000 to the land and buildings depreciation fund. The directors now recommend a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, also the payment of a bonus of 2s. per share, both free of tax, which together will amount to £51,983, leaving £4,260 to be carried forward.

WESTERN UNION TELEGRAPH CO.—The gross receipts of the year to June 30th, 1908, are less by $4,274,194 than the revenue of the previous year, and, as the expenses have only been reduced by $1,352,981, there is a net loss on the revenue account, compared with the previous year, of $2,921,213. This result is attributed to depression in business and to the strike of operators which commenced early in August, and lasted until November 7th, 1907.

X ACCUMULATOR CO.—The report states that the amount of working capital originally subscribed was insufficient for the company's purposes, and, after giving particulars of the various items of expenditure, the Directors state that they deem it advisable to take the necessary steps to voluntarily liquidate the Company.

ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT, BERLIN.—The report for the year ending June, 1908, shows very satisfactory results. A dividend of 12 per cent., the same as for the previous year will be proposed at the general meeting, which is to be held on December 5th.

Electrical Industry in Belgium.—An American Consular report states that there are several underground tramway lines in Brussels, worked by two different companies, which employ their own staffs for the laying of the lines. Work for laying the underground telephone lines is done on the contract system. Underground lines are gradually replacing the suspended lines. A concession for electrical tramways has just been granted in Namur. Electric light and power plants are extending in the Brussels Consular district. Projects are made to build plants in Anderlecht, Etterbeek, Auvelais, Montaigu, &c. There are 39 plants in Belgium manufacturing electrical machinery, supplies, &c., in which about 5,900 workmen are employed.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., quoted on Tuesday night, was £64 to £64 10s. per ton (last week £63 to £63 10s.).

ARCOFLAME LAMP.—We are informed by Messrs. J. & H. Grevener that in view of suggestions that their "Arcoflame" lamp is an infringement of the "Bremer-Westinghouse" patents, they are prepared to guarantee all purchasers of "Arcoflame" lamps against any loss which they may incur at the hands of any persons who take proceedings against them on account of their purchasing or dealing in "Arcoflame" lamps.

CHANGE OF ADDRESS.—Messrs. Robertson & Adams, consulting engineers and electricians, have now completely removed from 60 to 52 St. Enoch Square, to where all communications, catalogues, &c., should be sent in future.

DISSOLUTION OF PARTNERSHIP.—The partnership between J. R. Scholes and T. Dawson, carrying on business as electrical and mechanical engineers, under the title of the Union Engineering Co., at Livesey Fold, Darwin, has been dissolved.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the St. Helens Cable Co., Ltd., will be held at the offices of Messrs. Oppenheim, Windle Chambers, St. Helens, Lancs., on December 3rd, at 2.30 p.m., for the purpose of hearing the liquidator's account of the winding up.

MISCELLANEOUS CITY NOTES

CITY OF BUENOS AYRES TRAMWAYS CO.—A dividend of 1s. 3d. per share, less income tax, has been declared for the three months ended September 30th.

MEXICAN LIGHT & POWER CO.—In reference to the breaking off of negotiations for the amalgamation of this company with the Mexico Tramways Co., a committee of influential shareholders has been formed to represent the views of those who desire to see the amalgamation carried through. Steps have been taken to hold a special meeting of the shareholders during November, in order that some agreement may be arrived at on the question of the lease, so that the shareholders may be guided as to their vote at the special meeting on December 3rd, which the directors have convened, to pass resolutions for increasing the capital of the company.

WESTERN TELEGRAPH CO.—The directors have, after transferring £110,000 to the general reserve fund, £5,000 to the maintenance ships' reserve fund, £10,000 to the marine insurance fund, and £10,000 to the land and buildings depreciation fund, decided to recommend a final dividend of 3s. per share, making with previous distributions a total dividend of six per cent. for the year ended June 30th, 1908, and also the payment of a bonus of two shillings per share, both free of income tax. The balance of the account is carried forward.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. M. O'Neill has been appointed electrical engineer to the Balla Shire (V.) Council.

An installation assistant is required at Belfast (see an advertisement).

Mr. A. H. Unwin, manager of the Rosario Electric Light Co., has, says the *Review of the River Plate*, left for London to consult with his directors concerning the acquisition of more machinery to meet the ever-growing demand upon the station.

Electric Traction on the Italian State Railways.—According to *Elektrotechnik und Maschinenbau*, the favourable results obtained on the Valtellina and Milan-Porto-Ceresio railways have induced the Italian Government to introduce electric traction, on the three-phase system, on nine further main-line sections, with a total length of 135 miles. The work is to be carried out within three years. The most important lines are that between Genoa and Bussala, with a total length of about 18 miles, and the 2½ mile line through the Giovi tunnel. These two lines are to be completed by the middle of May, 1909. The rolling-stock will be supplied by the Westinghouse Co., and the overhead equipment by Brown, Boveri & Co. Each train, consisting of 21 double cars, and weighing 420 tons, will be hauled by two 1,600 h.p. three-phase locomotives. Energy will be supplied from a large steam turbine power station in the Genoa docks, which has at present two 5,000-kw. units installed. These machines generate at 13,000 volts, 15 cycles. A third unit will be installed in a short time. The contact line pressure is to be 3,000 volts. Speed variation for the locomotives, each of which will carry two 800 h.p. asychronous three-phase motors, will be obtained by cascade connections. The regenerative capacity of the three-phase system will be taken advantage of to a large degree, as there are several heavy gradients on the lines to be electrified.

COMPANY MORTGAGES

SWITCHGEAR CO.—An amended return re second debenture, dated July 7th, 1908, securing £2,000, has been registered. Original return gave address of holders (Cowans, Ltd.), as 4 Queen Victoria Street, E.C., instead of Victoria Works, Wilfred Street, Salford, Manchester.

The following relate to total amounts outstanding on July 1st, in respect of mortgages, &c., created prior to the date, and required to be registered under Section 12 of the Companies Act, 1907:—

MADEIRA ELECTRIC LIGHTING CO., LTD.—Debentures, dated 1896 and 1897, securing £15,000.

MORLEY ELECTRICAL ENGINEERING CO., LTD. (Stanningley)—Amount, £3,000. (No particulars.)

NEW COMPANIES

AERO FIRE ALARM.—This company was registered on October 26th, with a capital of £25,000 in £1 shares, to acquire the British rights in an invention or inventions known as Aero Fire Alarm, and the business carried on at 66 Cheapside, E.C., as the Aero Automatic Fire Alarm Co., to adopt an agreement with G. L. Smith and W. Rattray, and to carry on the business of fire alarm and appliance manufacturers, electrical engineers, &c. Registered office: 66 Cheapside, E.C.

CAMBAO CARTROAD CO.—This company was registered on October 16th, with a capital of £100,000 in £10 shares, to acquire concessions granted by the Government of Colombia for the reconstruction, maintenance, and improvement of the Cambao Cartroad, and to reconstruct, maintain, improve, and equip the said road or any parts thereof with all buildings, works, telegraphs, telephones, and appliances ancillary thereto, and to adopt an agreement with T. G. Ribon. Minimum cash subscription, 8,000 shares. The number of directors is not to be less than two nor more than five: the first are to be appointed by the subscribers. Qualification, £1,000. Remuneration, £100 each per annum (£200 for the chairman). Registered office, Finsbury Pavement House, E.C.

EASTON LIFT CO.—This company was registered on October 20th, with a capital of £10,000 in £1 shares to carry on in the United Kingdom or elsewhere the business of manufacturers of and dealers in lifts, elevators, cranes, hoists, and lifting machinery of all kinds, hydraulic, electrical, mechanical, and general engineers, electricians, suppliers of electricity, iron-founders, &c. The subscribers are:—R. A. Smith, Palace Chambers, Westminster, consulting engineer; L. Phillips, 22 Pickwick Road, Dulwich, S.E., engineer. Private company. The number of directors is not to be less than two nor more than five: the first are R. A. Smith and L. Phillips. Registered by Bristows, Cooke, and Carpmael, 1 Copthall Buildings, E.C.

NEW PUBLICATIONS

"Outlines of Electrical Engineering." By Harold H. Simmons. (London: Cassell & Co., Ltd.) 21s. net.

The Architects' Directory: Travellers' Edition, 1908. Edited by A. C. Freeman. (London: British Manufactures Publishing Co., Ltd.) 5s.

"Science Abstracts," October, 1908. Section A, Physics. Section B, Electrical Engineering. (London: E. & F. N. Spon.) 1s. 6d. each.

Electric Power in Bolivia.—The British Vice-Consul in Oruro, Bolivia, gives the following information with regard to the use of electric power in tin mines in the district. Mining plant, including drills, crushing mills, and aërial ropeways, is being continuously erected, and there is a considerable demand for electric power. A German firm has an engineer in the district, who is preparing a scheme for utilising the water-power of the rivers on the eastern slope of the Tres Cruces range, some 90 miles distant from Oruro. The immediate demand is estimated at about 3,000 h.p. With regard to lighting, the mines work day and night, and therefore there is a large demand; the town of Oruro is lighted by a private company, the charge being 1/6d. per unit, but most of the private houses are lighted by petroleum.

The Vice-Consul in Sucre reports that a German company obtained a municipal concession in 1906 for the public lighting of that city for 30 years, and that the power station is now being constructed. Owing to the delay in the delivery of the machinery, the time contract has not been fulfilled, and a large portion of the municipal subsidy of £2,000 will be forfeited. The station is being erected, eight miles distant from the city, on the River Cachimayo. The same Consul states, with regard to electric lighting and power in Potosi, that a scheme is now on foot for the erection of a power station on the River Pilcomayo, 22 miles from Potosi, at a cost of £58,000. The available power is estimated at 600 h.p., of which 450 h.p. would be used for power in the tin mines.

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ELECTRICAL ENGINEERING

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SUMMARY

Professor W. E. Ayrton died on Sunday morning last, at the age of 62, after an illness of about three weeks. (Page 634.)

The following books are reviewed in this issue:—"Natural Sources of Power," by R. S. Ball; "Electric Furnaces," by Wilhelm Borchers, translated from the German by Henry G. Solomon; "The Slide Rule," by Charles N. Pickworth; and the twenty-sixth edition of Molesworth's Pocket Book of Engineering Formulæ. (Page 635.)

The Paper on turbo-alternators, read by Dr. M. Kloss at the Manchester Local Section of the Institution of Electrical Engineers last week, emphasised some of the leading differences between slow-speed and high-speed alternators in regard to the necessity for artificial ventilation, the fact that such close inherent voltage regulation was not attainable with turbo-alternators as with slow-speed machines, and the influence of the amount of margin allowed in the specification of the rated load factor on the price of the machine. (Page 637.)

We give an abstract of an article which appeared recently in a German contemporary, emphasising the importance of measuring the no-load losses of a continuous-current machine with the brushes in the neutral position, when this measurement is to be used for estimating the efficiency of the machine at full load. (Page 638.)

A new aluminium works, which is designed for an eventual output of five tons of aluminium per day, has been almost completed by the Aluminium Corporation, Ltd., near Conway, in North Wales. Continuous current for the electric furnaces is derived partly from a 4,000 kw. high-fall water power plant in the works driven by Pelton wheels and utilising the waters of neighbouring lakes, which render a fall of 1,000 ft. available, and partly from motor-generators supplied through a 20,000-volt three-phase transmission line 13 miles in length from the water power generating station of the North Wales Power & Traction Co., near Snowdon. (Page 639.)

Under "Electrometallurgy and Electrochemistry" we give some notes on the origin and development of the Roechling-Rodenhauser combined induction and electrode furnace. The substitution of two 250 h.p. Stassano furnaces for a battery of crucible furnaces in a large German steel works has been attended with considerable success; we give some figures for the costs of production, which have been published by these works, together with some notes on the management of the furnaces. (Page 645.)

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A NEW form of "magazine" fuse has recently been brought out which enables a circuit to be re-fused four times by merely turning a milled head at the bottom of the case. (Page 646.)

A NEW pattern of portable rheostat especially suitable for use when testing meters on a consumer's premises is described. It consists of several resistance units, any number of which can be placed in parallel across the full pressure. (Page 646.)

Two large slow-speed double flywheel generators have been installed at the Rombacher smelting works in Germany. Each generator consists of two separate armatures mounted on a common spider, and two separate field systems. Particular interest attaches to the method whereby the commutator lugs and the equipotential windings are supported on the frame of the machine. The machines are coupled to 1,200 h.p. gas engines, running at 120 r.p.m. (Page 646.)

THE report of the Special Committee appointed by the Tramways and Light Railways Association to consider the whole question of tramway brakes is a valuable contribution to the literature of the subject. The general requirements of brakes are considered, prevailing practice is dealt with, and after a detailed examination of a number of patterns, their suitability to varying conditions is discussed. A number of recommendations are made. Where service stops are frequent, one power brake and one hand brake are recommended. The importance of proper sanding gear is emphasised, and the medical examination and proper training of drivers are insisted on. (Page 647.)

AN article by J. E. NOEGERATH in an American contemporary gives some particulars of several acyclic generators ranging up to 2,000 kw. in output, which are in actual operation, with some notes on the construction and running of machines of this class. (Page 649.)

A PAPER read before the Birmingham Association of Mechanical Engineers on Saturday last by Mr. C. A. ABLETT dealt with the application of electric driving to brass and copper rolling mills. Saving in space, increased output, freedom from breakdown, and easy extension were amongst the advantages claimed for electric driving. In the discussion which followed it was mentioned that before the end of the year 4,000 h.p. of rolling-mill motors would be connected to the Birmingham Corporation mains. (Page 650.)

MAJOR PRINGLE'S report on the fire which occurred at the beginning of last month in a train at the Swiss Cottage station of the Metropolitan Railway states that the origin of the fire was not electrical, but makes some comments on the structure of the carriages. (Page 650.)

AMONG the specifications published by the Patent Office on Thursday last is one by E. M. PRESTON and A. E. KENNARD for an improvement in the "Stone" system of train-lighting, which renders the gear independent of the direction of travel. A method of protecting the small transformer of a series transformer distribution system is patented by A. F. BERRY, and a specification by JOHNSON & PHILLIPS, LTD., and C. F. TUBBS relates to a flame arc lamp with two or more pairs of carbons burning in series. V. A. FYNN has a specification describing a single-phase traction system, in which a motor-generator on the locomotive supplies asynchronous polyphase motors; and another by O. GRAETZER covers a construction of cable- or wire-connector in which screw terminals are avoided by the use of a spring-grip action. A method of mounting the end connections of the armature windings of high-speed continuous-current machines is described in a specification by the PHŒNIX DYNAMO MANUFACTURING CO. and R. POHL; and another communicated by SIEMENS & HALSKE AKT.-GES. refers to the manufacture of metal filament lamps. Short abstracts of these are given in our Patent Record. (Page 651.)

SOME notes are given on the equipment of a large steel works in America. (Page 653.)

THE possibilities of the trackless trolley system are under consideration at Aberdeen and Malvern.—Arrangements for the purchase of the Bath municipal electricity undertaking by a company formed by Mr. E. Schenk are now completed.—An international exhibition is to be held at Brussels in 1910.—The Dudley Corporation are making arrangements for the purchase of the tramways in their district, and for their lease to the British Electric Traction Co.—A scheme for tramways between Halifax and Huddersfield is being considered by the West Yorkshire Tramways Co.—The Hastings Corporation have at last agreed unconditionally to the running of the tramways of the local company on Sundays.—An agreement has been arrived at between the City Corporation and the Highways Committee of the London County Council for running tramways to Liverpool Street.—The London County Council has been asked, but has refused, to deal with the question of the expenses of delegates from the London electricity undertakings at electrical and other technical conferences.—The Tramways Committee of the Oxford Corporation, whilst inclined to agree to the adoption of a combined conduit and overhead trolley system of tramways in place of the surface contact system originally contracted for by the National Electric Construction Co., refuses to assent to a reduction in the rent payable by the company. (Pages 653-655.)

THE sum of £25,000 is to be spent upon electrical extensions at Port Elizabeth (South Africa). A condensing plant is to be installed at Bridlington. Local Government Board inquiries have been held as follows: —Hull (£24,000), St. Helens (£10,426), Tynemouth (£4,251). Electrical stores are required by the Great North of Scotland Railway Co., the Wakefield and District Light Railway Co., and the Chatham Borough Surveyor's Department. Extensions amounting to £17,000 are contemplated by the Christchurch (N.Z.) Corporation. (Pages 655-656.)

SUBSCRIPTIONS have been invited during the week for an issue of 85,000 preference shares of £1 each in the Rees Roturbo Manufacturing Co., Ltd. In connection with the proposed amalgamation between the Mexican Light and Power Co. and the Mexican Tramways Co., the latter has guaranteed an issue of about £1,000,000 of debentures either for its own purposes or for the combined undertaking, should the amalgamation be carried through. (Pages 656-667.)

SOME British-made porcelain insulators are described on page 658.

IT is anticipated that the consideration of the London and District Electricity Supply Bill will be concluded before Sir LUKE WHITE'S Committee of the House of Commons this week. Since our last issue considerable progress has been made with the case for the opposition, among the local authorities who have been heard being Marylebone, Battersea, Croydon, Woolwich, West Ham, St. Pancras, Shoreditch, Southwark, Hornsey, Finchley, Chiswick, Bexley, Beckenham, Stepney, and Hammersmith. On Friday the opposition of the eight companies, who are promoting the London Electric Supply Bill, was opened, and evidence was given by Mr. C. P. SPARKS and Mr. J. S. HIGHFIELD, in addition to the Secretary of the City of London Co., and the Manager of the County of London Co. All the opponents doubted the need of a new power company, in view of the magnitude of the supply now being given by the existing authorities in relation to the possible demand. With regard to the railway load, upon which the promoters set considerable value, the opinion of the engineers to the existing companies is that separate plant would have to be installed. Owing to the character of this load, the supply should not be mixed up with the general load (Page 659.)

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THE September Circular of the Tramway and Light Railways Association, published last week, consists of the report of the Special Committee on Tramway Brakes, which was appointed in the autumn of 1906, after a suggestion by Col. YORKE in his report on the Highgate accident that the tramway associations should investigate the whole subject with a view to ascertaining how brake failures could be eliminated from the causes of tramway accidents. The Committee's report shows that it took the matter seriously, and deals with the question systematically, beginning with a discussion of the functions required from brakes and the means available for filling them. This discussion shows that the most important factor in braking action is the available coefficient of friction, a factor which varies in value with the state of the rails. One of the most valuable results of the Committee's work is an experimental investigation of the values of coefficients of friction applicable to brakes under different conditions. The experiments are not exhaustive, but some important deductions to be drawn from them are likely to lead to certain modifications in braking equipment, whilst they indicate the direction which further experiments should take. We believe that these experiments are the first which have been made to determine coefficients of friction under conditions applicable to braking problems, since the well-known tests of Westinghouse and Galton thirty years ago. In addition to these tests a large number of measured braking stops are recorded in tables and curves, which show what can be done with the brakes tested. The Committee heard evidence from a large number of tramway managers, engineers, manufacturers, and some inventors, and has drawn up a concise description of most of the tramway brakes on the market. and their special advantages and disadvantages, which is a useful record of the present state of the art, and should not only assist in the selection of brakes, but also suggest the way to improvements. The most important appliance of all, the man who handles the brakes, is not ignored, and the suggestions made for the training and examination of drivers will go far to improve tramway services in many ways if generally put into practice. The general conclusions or recommendations of the Committee will, we think, meet the approval of tramway men generally, and, armed with this report, the tramway engineer or manager will find it easier to lead his committee or board in the right way as to brakes equipment and maintenance and the training of men. If reports of this kind reach the general public at all, the effect of this one will be reassuring as to the intrinsic safety of tramway working, as it shows clearly enough that means for safe working under any workable conditions are available, and that their proper application, maintenance, and use are well within the range of the common sense and vigilance essential to the conduct of any important public service. It follows that any public so informed will be more reasonably critical of any accidents that may occur within its ken. A point of some importance, as affecting the useful range or population distributing power of tramways, is that some of the brakes investigated maintain their efficiency at quite high speeds, and hence promise an early increase in the maximum speeds permitted, which means an increase of useful range. Naturally this has less application to town lines, where the slowness and cussedness of other traffic are more dangerous than the speed of the tramcar, than to suburban and inter-urban lines. But it is just these latter lines that are the disappointment of the tramway industry, mainly because they have failed to materialise; and it may happen that indirectly the Brakes Report may assist in their development.

THE first Paper of the session to be read before the Manchester section of the Institution of Electrical Engineers was interesting in several ways, and was eminently suitable for discussion by such a meeting. Its purpose was to convey a message from one section of the electrical engineering fraternity to another, and to take advantage of the provision by the Institution of a common ground whereon both the designing engineer, representing the contractor, and the consulting engineer, who represents the purchaser of plant, can meet on equal terms. Dr. KLOSS brought forward certain points in connection with turbo-generator specifications, which he desired to emphasise, and which would, he claimed, if more attention were paid to them, result in benefit to both sides of the industry. He was not in any way attempting to teach consulting engineers their business, nor seeking to persuade them to smooth the troublous path of the contractor. He simply desired to place the experience of the designer at their disposal. He sought to bring out clearly the ways in which the essential differences of low and high speed alternators affect their performance and capabilities, and the discussion of his Paper should lead to a more widespread understanding of the conditions under which the best results are given. Mr. SALTER'S amusing parody of the Paper in the discussion, if it is to be taken seriously, shows as much as anything the need for a better sense of proportion in considering both the advantages and the limitations of this class of machinery.

WILLIAM EDWARD AYRTON

Sept. 14, 1847—Nov. 4, 1908

WE have deep regret in announcing the death, after an illness of about three weeks, commencing with an attack of influenza, of Professor W. E. Ayrton, F.R.S., at his residence, in Norfolk Square, at 2.30 on Sunday morning. By his death a well-known figure in electrical circles has been removed, and another of the links between the present-day progress of electrical engineering and the pioneering work which preceded it has been severed. Professor Ayrton's health had been declining for some time previously to his fatal illness, and during the last seven years he has suffered somewhat from his heart. He retained, however, a considerable measure of that intense energy of intellect which characterised his life-work, and he attended the college as recently as October 16th. Although the last time he took part in the discussions of the Institution of Electrical Engineers was on February 7th, 1907, on the occasion of a Paper by Mr. C. C. Paterson on light standards, his occasional contributions to the Press have shown the continued keenness of his interest in technical matters and new problems.

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At the time of his death he had been for twenty-four years professor of electrical engineering at the Central Technical College of the City and Guilds of London Institute in Exhibition Road, South Kensington. Prior to this he held a professorship for a few years at the Finsbury College of the same Institute. Much of his work, in conjunction with Professor John Perry—and the two names will always be remembered together—was done during this period, but their collaboration had an earlier origin, dating practically from their meeting in 1875 in Japan, where Ayrton had already been for two years professor of physics and telegraphy at the Imperial College of Engineering, Tokio, and Perry joined as professor of engineering. This was not, however, his first visit to the East, for in 1868 he went out to Bengal, where he was assistant electrical superintendent of the telegraph department and later superintendent. Between these two visits to Asia he returned to England to take charge under Lord Kelvin and Professor Fleeming Jenkin of the manufacture of the Great Western cable in 1872. To complete this brief sketch of his career it should be mentioned that he was educated at University College School and University College. He was a native of London, and the son of a barrister.

To attempt to indicate all the directions in which the work of this versatile man has lain is impossible. His greatness lay alike in his powers as a teacher of imparting knowledge and awakening enthusiasm, in his skill and powers of perception as an experimental investigator, and in his originality as an inventor. His indefatigable energy in all these directions is shown as much by the prodigious list of Papers communicated to the Royal Society, the Institution of Electrical Engineers, and other bodies, bearing his name either alone or in conjunction with others, as by the almost equally extensive list of patents which protected his inventions. He and Professor Perry were pioneers of more than one branch of electrical engineering. Their instruments were familiar when electrical measurements were but emerging from chaos, and many an electrical problem has been propounded as new from time to time which they had thoroughly investigated. Prof. Ayrton's long but more recent connection with Mr. T. Mather has led to another group of measuring instruments of a different character, and the Ayrton-Mather galvanometers are now as well known as the famous Ayrton and Perry twisted strip ammeter of earlier years. Much of his early work was devoted to electric traction and its possibilities, as well as electric lighting. In conjunction with Prof. Fleeming Jenkin a system of telpherage was developed by him before electric traction in any form was general. As far back as 1882 Ayrton and Perry patented a surface-contact system of electric traction, and in the following year, as joint engineers to the Faure Accumulator Co., they carried out the electric lighting of the Grand Hotel in London.

Prof. Ayrton was elected a Fellow of the Royal Society in 1881, was President of Section A of the British Association in 1888, of the Physical Society of London in 1890, and of the Institution of Electrical Engineers in 1892. He took a prominent part in the meeting of the British Association at Johannesburg in 1905.

His widow, Mrs. Hertha Ayrton, whom he married in 1885, is also well known as an original investigator in electrical science, and has the distinction of being the only lady member of the Institution of Electrical Engineers. Our sympathies and those of a wide circle of devoted friends will go out to her in her bereavement, and also to his two daughters. The funeral will take place at Brompton Cemetery at 2.30 to-day, and it is announced that to-night's meeting of the Institution of Electrical Engineers will be adjourned after references to his death by Prof. J. Perry and the President.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 12TH.

Royal Society.

4.30 p.m. Meeting at Burlington House, Piccadilly, London. Among the Papers down for reading are the following:—(1) "The Charges on Ions in Gases, and the Effect of Water Vapour on the Motion of Negative Ions," by Prof. J. S. Townsend, F.R.S.; (2) "The Charges on Ions produced by Radium," by C. E. Haselfoot; (3) "The Occlusion of the Residual Gas and the Fluorescence of the Glass Walls of Crookes' Tubes," by A. A. Campbell Swinton.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster. The meeting will adjourn after the announcement of the death of Professor W. E. Ayrton.

Institution of Electrical Engineers: Dublin Local Section.

8 p.m. Opening meeting of the Session at the Royal College of Science, when Mr. S. F. Pilditch, the chairman, will deliver his Inaugural Address.

FRIDAY, NOVEMBER 13TH.

Physical Society.

5 p.m. Meeting at the Physics Laboratory, University College, Gower Street, London. Agenda:—(1) "The Photo-Electric Properties of Potassium-Sodium Alloys," by Prof. J. A. Fleming, F.R.S.; (2) "Note on the Recombination of Ions in Air," by P. Phillips; (3) "On the Influence of the Magnetic Field on the Photographic Patterns produced by the Electric Spark," by A. W. Porter; (4) "On the Rate of Growth of Viscosity in Congealing Solutions," by A. O. Rankine; (5) "On the Isomeres of Adsorption by Solid Surfaces from Solutions," by Prof. F. T. Trouton. (6) Mr. A. W. Porter will exhibit an experiment illustrating an anomalous effect of lagging thin wires.

SATURDAY, NOVEMBER 14TH.

Birmingham and District Electric Club.

7 p.m. Meeting at the Colonnade Hotel, New Street. Paper to be read, "Electric Power for Small Consumers," by V. E. Walters.

MONDAY, NOVEMBER 16TH.

Institution of Electrical Engineers: Newcastle Local Section.

8 p.m. Opening meeting of the session at the Armstrong College, when the Chairman, Mr. A. L. E. Drummond, will deliver his Inaugural Address.

TUESDAY, NOVEMBER 17TH.

Institution of Electrical Engineers: Glasgow Local Section.

7 p.m. Seventh Annual Dinner at "The Grosvenor," Gordon Street.

Institution of Electrical Engineers: Manchester Local Section.

7.45 p.m. Ordinary meeting at the University, when Prof. E. Rutherford, of the Manchester University, will deliver a lecture. This lecture takes the place of the Paper announced on the syllabus by Messrs. R. G. and J. G. Cunliffe on "Vagabond Currents."

Junior Institution of Engineers.

8 p.m. Meeting at the Royal United Service Institution, Whitehall, London, when Mr. James Swinburne will deliver his Presidential Address on "Available Energy."

WEDNESDAY, NOVEMBER 18TH.

Royal Meteorological Society.

7.30 p.m. Meeting at 25 Great George Street, Westminster, London. Among the Papers down for reading is the following:—"Investigation of the Electrical State of the Upper Atmosphere made at the Howard Estate Observatory, Glossop," by W. Makower, Margaret White, and E. Marsden.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Opening meeting, when Mr. J. S. Highfield will deliver an address on "The Responsibility of the Engineer."

Royal Society of Arts.

8 p.m. First ordinary meeting of the session. Inaugural Address by the Vice-President and Chairman of Council, Sir William White, K.C.B., F.R.S.

THURSDAY, NOVEMBER 19TH.

Institution of Electrical Engineers.

8 p.m. Extra meeting at 25 Great George Street, Westminster. Col. R. E. Crompton, C.B., the retiring President, will distribute the premiums awarded for Papers read during the session 1907–8. Mr. W. M. Mordey will then deliver his Presidential Address, and afterwards hold a reception in the library.

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AN IMPRESSION OF THE LATE PROFESSOR AYRTON

By an Early Finsbury Student

FOR nearly thirty years Professor Ayrton has taken a leading place in the training of electrical engineers, and there can be few men more widely known in the profession than he. The announcement of his death will affect a very large number with a sense of personal loss, for Ayrton was a man whom one remembers even after short acquaintance. The writer is one of those who attended the Finsbury classes when they were commenced in the basement of the City of London School in 1879, when Professor Ayrton commenced his work for the City and Guilds Institute, and has ever since had reason to thank his teacher, not only for what he taught, but for showing him the right way of looking at the problems of engineering—teaching him how to learn, in fact, the rarest and best of the teacher's gifts. Lucidity and sympathy marked his lectures and his laboratory talks—lucidity and accurate expression, interesting and consecutive diction. One waited for the next lecture as though it were a chapter of an exciting story. Sympathy in the true sense of the word, a "feeling with" the learner, in his difficulties, and therefore showing him the way through them. Not exactly a patient man in general temperament, Professor Ayrton was never impatient or hasty with a student who tried to learn. A fine mathematician, with the "eye for an equation" that enabled him to omit half or three-fourths of the algebraic steps from his blackboard work, so that one had perforce to copy it there and prove it at length at leisure. He would at first go back over the work and through the steps verbally for the slow ones, but with a sense of justice to the quicker-minded or better equipped, he later arranged a special class for those who could not get through the work unaided, and so saved time for the others. Although since those Finsbury days the writer has only met Ayrton casually, he has always ranked him as a greatly valued friend, one who impressed for good, whose influence is lasting and beneficial.

There must be many of the hundreds of students who passed under Ayrton's teaching who feel likewise, and who now deem themselves the poorer for his death. The good he did is not "interred with his bones," for he taught applied science not only efficiently as science, but in a way that gave it a lasting moral value.

May the sympathy of many feeling thus comfort those he has left behind. As was well said a few days ago of his great master, Lord Kelvin, we will not sorrow for his loss, but rejoice that he lived.

REVIEWS OF BOOKS

Natural Sources of Power. By R. S. Ball. 348 pp. 5½ ins. by 8½ ins. 104 illustrations. (London: Archibald Constable & Co.) 6s. net.

THIS excellent book would have attracted more readers, and have suffered nothing in accuracy, if it had been called "Water and Wind Power," or by some other title which would indicate that it deals with water-wheels, turbines, and windmills. The author has succeeded in producing a practical handbook, and has steered between the rocks of abstruse theoretical design and the shallows of a popular treatment of the subjects. He defends his title by contrasting the direct application of water and wind with the decomposition which coal, oil, and other fuels must undergo before heat is developed, and the second transformation of heat into mechanical energy in some kind of engine. This distinction does not seem to be a material one; it is not easy to think of any source of power which is not "natural."

Perhaps the only weak part of the book is the electrical section of the elementary introduction. But it is possible that the author has deliberately avoided the conventional and misleading language of the text-book and lecture-room. Dealing as he has to do in the hydraulic part of the book, with cubic feet of water per second, he suggests that there is a difficulty "with the proper understanding of the unit of current—the ampere. It is unfortunate that we do not generally express a measure of current in any other way than by a single word, which itself hides the important element of time." Surely that is an advantage. We need not, as the French, speak of the intensity of the current, nor as the German, the strength of the current; but we use the simple idea of current, and the simple name ampere, and the workman's slang contraction, the "amp." Many a student has worried over the question whether an ampere is a coulomb per second or whether a coulomb is an ampere second; and if both are true, which is the essential or fundamental idea? We electrical men may pity hydraulic engineers that they have no word to express cubic feet per second or gallons per minute; the name of Francis might be employed for one of these.

The account of methods of gauging water, calculating water power, and levelling surveys are practical, and the descriptions of water-wheels, turbines, and their governors are clear and well illustrated. The latter part of the book dealing with windmills gives a very useful account of a little-understood branch of mechanical engineering. Thirty years ago, when the pumping windmills of Holland and the English fens were being replaced by steam engines and centrifugal pumps, and when steam-roller mills were superseding the corn-grinding windmill, it seemed that that "engine," to use the word in its older sense, would soon disappear. But while this is true of the old type of windmill, with its house and slowly turning sails, another class of mill is being adopted, and the author tells us that they are so widely used in great agricultural countries like Australia and the western parts of America and the Argentine that the manufacturers have found difficulty in keeping pace with the demand, notwithstanding the fact that there are several firms that turn them out by the thousand, and who can always find a ready market for them.

While the use of advanced mathematics is carefully avoided, details of design and questions of cost of power are carefully worked out, and the book will be of value not only to the student, but to the professional engineer.

Electric Furnaces. By Wilhelm Borchers. Translated by Henry G. Solomon. 218 pp. 8½ in. by 5¼ in. 282 illustrations. (London: Longmans, Green & Co.) 7s. 6d.

THE name of Wilhelm Borchers is so well known to all those who are interested in electrochemistry and electrometallurgy, that by all these and many others whose knowledge is more general this translation of Mr. Solomon will be welcomed. The English edition which is a translation of the second German

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edition has, so far as possible, been brought up to date by the inclusion of recent work which has been published since the German book was printed, and therefore is of even greater use than the original German work. The book starts with an introduction dealing with methods of heating, and commencing with the conversion of electrical energy into heat. The following chapters all begin historically, and describe the different classes of furnace employed, from their inception upwards. Davy, as is generally admitted, appears to have constructed the first electric furnace in his classical experiments on the decomposition of the alkalis and alkaline earths. Of course, his experiments with the primitive means at his disposal were carried out on a most limited scale, beside which our present-day furnaces appear of mighty proportions. In his first experiments he employed direct heating, but he very soon found that better results were obtained by fusing the electrolyte with the electric current as well as employing it for electrolysis, and it is interesting to note that this has been the experience of all those engaged in the construction of modern electrometallurgical plant.

The first furnaces described are those used in connection with the manufacture of aluminium; there is not very much new, perhaps it is not possible to give anything new, in reference to this furnace. The Cowles furnace is described, then that of Hèroult, which is followed by reference to Borchers' own aluminium furnace and that of Minet, which is recommended for production of very pure aluminium, but which, as the author points out, although it might possibly give you pure aluminium, will only produce it at a cost which would make it prohibitive.

The furnaces of Hall & Bradley are then described, and it is mentioned that the British Aluminium Company employ the Hèroult furnace at their works at Foyers in Scotland. Of course, owing to the secrecy which has for long been maintained by the aluminium companies, the details given as to the work of the furnaces, their dimensions, and so forth, are very meagre. An account of iron and steel furnaces then follows. There is, perhaps, here rather too much description of furnaces which have never existed beyond the draughtsman's board. You see, for example, Wilkstroem, "who proposes to pass pig-iron immediately after it leaves the blast from the cupola furnace through a narrow channel, closed at the top, and to refine it quickly by subjecting the narrow stream of metal as it flows through to the action of an air blast . . . at the same time heating it electrically." But as this furnace has never got beyond being proposed, we doubt whether it should have been put in the book. The next one referred to is that of Gin, which, the author says, has not yet come into practical use. We are rather inclined, however, to think that the author is mistaken in his assumption, as a model of this furnace was shown at the Franco-British Exhibition, and it was there stated that it has been used on a commercial scale.

In an appendix at the end of the book, added by the translator, further reference is made to steel furnaces. Resistance furnaces of the Acheson and other types are well described.

Chapter IV. is devoted to direct arc heating, in which the substance to be heated forms one or both poles of the arc; perhaps the simplest form of such a furnace is that of Borchers himself, in which a thick carbon rod is bored out to form the interior of the crucible; the carbon rod is then made one pole, the material to be smelted placed in it, and then another carbon rod connected with the other pole is let down into the first one. Chapter V. treats of combined resistance and direct arc heating, and then Chapter VI. with indirect arc heating, where the substance to be heated is placed in a space which obtains its heat by radiation; such a furnace, for example, is well illustrated by the original Moissan furnace.

The book is well got up and illustrated. In parts we should have liked to have had a little more theory, and the furnaces are not always described quite sufficiently fully for those who are not already acquainted with them. It is, however, an extremely useful and standard work, and Mr. Solomon is to be congratulated upon the manner in which he has translated it.

The Slide Rule. By Charles N. Pickworth. Eleventh edition. 122 pp 7¼ in. by 5 in. 29 illustrations. (London: Whittaker & Co.) 2s.

In introducing the principles of logarithms, which is done very clearly and at no unnecessary length, the author points out that although many who have no conscious understanding of logarithms make good use of the slide rule, the blind reliance upon rules imposes limitations which can only be removed by a fuller grasp of the fundamental principles which underlie the operation of the slide rule. The ways in which the ordinary arithmetical operations are carried out are set forth in clearly worded rules. With regard to the question of finding the position of the decimal point, the author takes up a very sensible attitude, holding that this is a matter upon which it is not desirable to dogmatise. The personal factor has to be reckoned with, and while most practised users experience no difficulty in estimating the magnitude of the result by inspection or rough calculation, others find rules of considerable assistance. Would that the average text-book showed such broad-mindedness. The collection of methods of obtaining various powers and roots on the ordinary rule, operations appearing to many more difficult than they really are on account of lack of familiarity, is very complete. It includes a convenient method of the author's for determining cube roots, which we believe appears in this edition for the first time. Numerous examples of a practical nature illustrate the methods, and at the same time indicate the immense range of adaptability, of the slide rule. The latter portion of the book describes a number of special forms of the slide rule, including those for involution and evolution on the "log-log" principle, first applied by Dr. P. M. Roget in 1815, and since revived and rediscovered by others. The whole book is practical in the best sense of the word, but we think that the degree of accuracy obtainable in slide-rule results might have been kept a little more prominently before the reader throughout the work, instead of being only briefly treated in the concluding paragraph.

Pocket Book of Useful Formulæ and Memoranda for Civil and Mechanical Engineers. By Sir Guilford L., H. B., and W. H. Molesworth. 900 pp. 5 ins. by 3 ins. (London: E. & F. N. Spon.) 5s.

There is no engineering work better known than the famous pocket-book originated by Sir Guilford Molesworth in 1862, the twenty-sixth edition of which is now in circulation. The form of the work is the same as before, it is still a true pocket-book, but its contents have been so completely revised from time to time that the last edition is as up-to-date as was the first. The rapid strides of electrical engineering have necessitated the entire rewriting of the electrical section, occupying the last hundred pages or so of the book, and this has been done by Mr. W. H. Molesworth in a way which fully maintains the high reputation of the rest of the work. Looking through the pages, we find a quantity of useful matter not always included in these publications. Full particulars of aluminium, as well as copper, conductors are included, and such things as correct definitions of load factor and diversity factor have not been lost sight of. The section on electrical testing is not, however, quite as up to date as some other portions. The testing set described is of an antiquated, although undoubtedly excellent, type, and no mention of instruments of the "Megger" type is included. Again, in dealing with primary batteries, a description of the Grove cell is not required for reference by the practical engineer. The information on street lighting is thoroughly up to date, and in a most useful form, and the same may be said of the brief traction section, which includes an interesting table of running costs of recently opened electric railways. The misspelling of the name Zossen in this section will doubtless be corrected in further editions. The aim of the true pocket book has been consistently kept in view, and the redundant elementary and historical matter which spoils so many works of this class has been successfully avoided.

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THE RATING OF TURBO-ALTERNATORS

AT the outset of his Paper on turbo-alternators, read on Tuesday, November 3rd, before the Manchester Local Section of the Institution of Electrical Engineers, Dr. M. Kloss (of Messrs. Siemens Brothers Dynamo Works) remarked that when reading specifications of such machines, one often found conditions laid down which were simply copied from slow-speed alternators where they were quite within the limits of commercial or physical possibilities, whereas in the case of turbo-alternators they might be impossible of fulfilment owing either to mechanical reasons or to commercial considerations. The object of the Paper was to investigate some of these points, more especially as regards ventilation, voltage regulation, and the influence of the power factor on the size of the machine.

In leading up to the subject of ventilation, it was pointed out that under otherwise equal conditions the output of an electrical apparatus increases approximately in proportion to its volume or as the cube of its linear dimensions, whilst the radiating surface only increases as the square. Hence there must be a limit of size where the surface is no longer sufficient to radiate the heat produced in the apparatus. Numerical examples were given to show how very much sooner this limit was bound to be reached with turbo-alternators than large slow-speed machines, owing to their much smaller surface compared to their output, and that it was quite necessary for the designer to provide special means for dissipating the heat, which was generated in a relatively very small space. The consequence of this, he continued, is that makers must design the rotors so that, either by their own shape or by additional fans at their ends, they produce a strong draught through the machine. This seems to be now quite common practice, at all events with machines, say, up to about 3,000 kw.

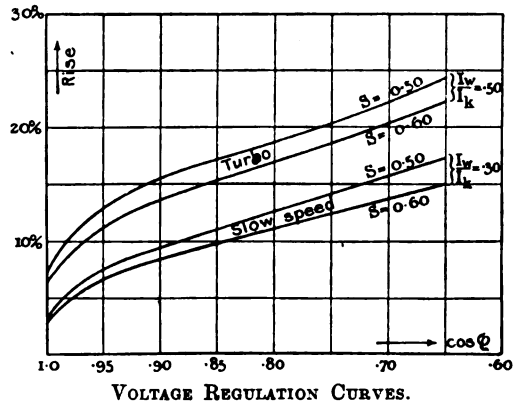
If, however, sets of larger capacity are to be installed the user has to face the fact that rather large quantities of heat will be produced in a comparatively small space, and it is quite a serious problem to consider beforehand what he is going to do with this energy. For instance, in a power station where it is intended to install six turbo sets of 6,000 kw. each, the amount of heat produced by these six sets running at the same time will be something like 1,500 kw., without allowing for the heat radiated by the steam turbines. If this great amount of energy were allowed to go into the engine-room without special provision for dispersing it, it would not be surprising to find the temperature in the engine-room rising rather rapidly to a point which would make it impossible for men to stay in the room.

The question thus resolves itself into the relative advantages of ventilating the engine-room or the machine itself, and a calculation for a hypothetical case showed that the amount of air required per minute was vastly less in the latter case. There were also the following advantages of the arrangement:—The machine is cooled with fresh, clean air, free from dirt and moisture, and therefore has a lower temperature rise than if the ventilating air was taken from inside the power-house. The machine is fully enclosed, and by this means the noise is reduced to a minimum. The appearance of the machine is greatly improved. The hot air issuing from the machine does not enter the engine-room, so that it is quite easy to keep this at a moderate temperature. The capital outlay for the necessary ventilating plant is smaller if the machines themselves are ventilated than if the engine-room is specially ventilated. In addition to this it is quite possible to utilise the energy contained in the hot air. It could be used either for heating buildings, or heating feed water for boilers, or by blowing it into the boiler fires, or for all kinds of other useful purposes, so that one may regain part of the energy which would otherwise be lost entirely.

As an example, the scheme adopted for the new 6,000-kw. turbo-alternators at Stuart Street, Manchester, was shown by an illustration which appeared in ELECTRICAL ENGINEERING, Vol. III., page 736.

The Paper then passed on to consider in what respects high-speed alternators differ from slow-speed alternators in regard to voltage regulation. In the first place, it was pointed out that in turbo machines with a small number of poles the amount of winding space per pole pitch was much more restricted than in large slow machines, so that it was difficult to find room for a sufficient number of ampere-turns to keep the armature reaction within reasonable limits. Indeed, Dr. Kloss went so far as to say that the output of such a machine was never limited by the stator, but always by the rotor, whether this be of the salient pole or of the cylindrical type.

In designing a machine which should be saleable as regards price, he continued, one is bound to go to the heat limit of the rotor. But even then it will not be possible to obtain the same number of ampere-bars per centimetre as in a multipolar machine. Consequently the armature strength must also be reduced, which means a reduction in the output per centimetre of circumference, with a corresponding increase in price per unit of output. Now, in order to prevent this increase in unit price from becoming prohibitive, we are driven to design the machine with a comparatively lower short-circuit current, because then we need not reduce the armature ampere-turns per centimetre in the same ratio as we are bound to do with the



VOLTAGE REGULATION CURVES.

field ampere-turns. This, of course, results in sacrificing something of the regulation of the machine, and it was this point which the author desired to make quite clear to those who had to draft specifications for turbo-alternators.

Some curves were then given to illustrate the point quantitatively. In this investigation the general case was taken of a machine with a short-circuit current, I and a normal current at a power factor cos ϕ of I_n. The factor $\frac{I_n}{I_k}$ was considered as giving the rating of the machine corresponding to its kilovolt-ampere output. In order to put this in a form more useful to station engineers, the watt component, $I_w = I_n \cos\phi$ was considered, and the kilowatt output of the generator expressed by the ratio $\frac{I_w}{I_k}$. Curves were given for various values of the saturation factor, with a view to showing that it was advisable to work at relatively high saturation, especially in the case of machines which are to be designed for a relatively low short-circuit current, that is to say, for a high ratio of $\frac{I_w}{I_k}$, whereas in machines with a high short-circuit current the saturation factor has not so great an influence on the regulation. However, as the high increase of exciting current at high saturation was not desirable, one was obliged to work at lower saturations than one would do if only the voltage regulation had to be looked out for. We must therefore make a compromise, and from his experience he found that for a modern machine the saturation factor should be between 0·50 and 0·60. The value of $\frac{I_w}{I_k}$ which can be worked to in a turbo machine, is not so low as that attainable in a slow-speed machine for reasons already pointed out. As fair average figures we can assume an $\frac{I_w}{I_k} = 0{\cdot}50$ for a turbo, and $\frac{I_w}{I_k} = 0{\cdot}30$ for a slow-speed machine. The two pairs of curves given in the figure can therefore be taken as representing relative conditions in the two classes of machines.

Summarising these results, it may be said that when specifying the voltage rise of a turbo-alternator due allowance should be made for the fact that the figures obtainable are not so low as those which can easily be obtained with multipolar machines. As fair figures for turbo-alternators can be regarded—5 to 7 per cent. for unity power factor; 13 to 15·5 per cent. for cos $\phi = 0{\cdot}90$; and 15 to 18 per cent. for cos $\phi = 0{\cdot}80$.

In the last portion of the Paper the influence of the rated power factor on the rating and price of a machine was dealt with, and it was shown by actual examples how much more expensive a machine has to be to be able to cope with a full-load current at a low power factor, and it was shown that when specifying the power factor at which a turbo-alternator has to

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work, it is of no use to put in a lower figure than is actually prevailing in the station, as nothing can be gained by this, and it would, if anything, decrease the possible output of the machine.

DISCUSSION.

The discussion was opened by Mr. A. H. Law (Messrs. C. H. Parsons & Co.), who thought that the Paper should be very useful to the engineers to whom it was addressed. He was inclined to criticise the method of ventilation adopted in the 6,000 kw. Siemens turbo-alternator at Stuart Street, in which, apparently, the cold air went in from the outside, passing inward through ducts along the rotor, and then out again through the feet of the stator case. In view of Dr. Kloss's statement that the output of such a machine was limited, not by the stator but by the rotor, this seemed to him to be wrong, as the air passed through the rotor last, whereas this was the very part which required to be cooled as much as possible. Again, he thought that the author had not sufficiently realised the value of the V-shaped space between the poles for ventilating passages. In the machines at Carville this was fully taken advantage of. Forced ventilation was, he thought, being carried rather too far with small machines; it was absurd for machines under 500 kw. running at 3,000 r.p.m. His firm had long realised the limitations imposed by consideration of voltage regulation, and he passed on to recapitulate the leakage flux compounding arrangement adopted by them (see Electrical Engineering, Vol. III., page 546). This had been found very successful in cases of very variable loads, and enabled the machines to be designed for a much higher short-circuit current. The author's curves were no doubt correct as regards the voltage rise on throwing off the load, but he would like some further data regarding the voltage drop on putting on the load, a quantity which designers were rather shy of giving. He was fully in agreement with the author regarding the power factor question.

Mr. C. D. Seaton then made a characteristically witty speech, looking at the matter from a commercial point of view. The turbine builder was usually the main contractor, and many of the electrical troubles fell upon his shoulders also.

Mr. J. S. Peck (British Westinghouse Co.) personally favoured self-ventilation wherever this was practicable. At Lots Road, Chelsea, the 5,500 kw. alternators were all self-cooling, and although they discharged their hot air into the engine-room, the temperature was not unpleasant, even in summer. Dr. Kloss had shown that the amount of air required for cooling the machine was less than for ventilating the building, but this was discounted by the fact that it had to be forced against a much higher pressure. It was a debatable question whether close inherent regulation in large machines was really worth while. Indeed, on a heavy short circuit the poorer the regulation the less the resulting damage. In this respect, he said, Mr. Miles Walker's system of compounding an alternator is of great value, since it holds a constant voltage for ordinary load fluctuations, but in the event of a short-circuit where the power factor is very low, it gives poor regulation, and consequently a minimum amount of damage is done.

Mr. S. J. Watson (Chief Electrical Engineer, Bury Corporation) referred to the possibility of turning the heated air into the boiler furnaces, in order to improve their efficiency. He asked for some further details of losses of 6,000 kw. machines, especially as regards windage. The question of power factor was similar to regulation of D.C. machines. In order to obtain it it was obvious that some part of the machine had to be overworked or underworked at some time or another.

Mr. J. Frith (Messrs. Mather & Platt, Ltd.) thought that rather an artificial distinction had been made by some of the speakers between artificial cooling and self-ventilation. It had to be done with a fan in either case, whether this was mounted on the rotor shaft or on a shaft somewhere else. He then made the interesting suggestion of going further than this, and using a compressor in which the heat was extracted from the air, first in the water cooling of the compressor. The drop of temperature due to the expansion of the air in the turbine case would enable the machine to be worked at a lower temperature rise "above the surrounding air."

Mr. J. R. Salter (Chief Engineer Lancashire United Tramways Co.) regarded all these limitations and complications as arguments against the use of turbines at all, and thought that although the turbine had generally a lower price, if the extra losses due to the necessity for obtaining a higher vacuum and superheat, and for getting rid of the heat from the alternator were capitalised, there was very little to choose between a turbine and a reciprocating set. He was inclined to summarise Dr. Kloss's remarks as follows:—"You people, you have been used to slow-speed reciprocating alternators, they have had good ventilation, good regulation, and a good power factor. For goodness' sake do not come and ask me to give you those conditions, because I cannot do it."

Mr. Miles Walker (British Westinghouse Co.), wished to inform Mr. Salter that the efficiency of a turbo-generator was much higher than that of the ordinary reciprocating set, and one could obtain quite a good regulation. He did not agree with Dr. Kloss that the rotor temperature limited the output. It was quite possible to have a machine in which the highest temperature is reached in the armature, although the regulation was better than was that specified for the engine type of machine.

Dr. E. Rosenberg made some remarks regarding the effect of variations in the saturation factor. In a salient pole machine, high saturation is accompanied by high leakage; but with a cylindrical rotor, with a distributed winding, high saturation did not increase the leakage to any considerable extent. Therefore, for the same saturation factor, better regulation would be obtained with a cylindrical rotor than with the salient pole type. Dr. Kloss's statement "the inherent regulation of a turbo-alternator being naturally lower than the regulation of multi-polar machines," was quite right, as long as the same type of field is considered, but the particular demands of the turbo-alternator justified a departure from the type of slow-speed rotor, and it was possible to obtain, without undue cost, in a machine with only two or four poles, an even better regulation than in the multi-polar machine.

Dr. Kloss only replied briefly, reserving his full remarks for communication to the *Journal*.

THE DETERMINATION OF THE EFFICIENCY OF CONTINUOUS CURRENT MACHINES

A RECOGNISED and frequently used method for the determination of the efficiency of continuous-current machines is to run the machine light as a motor at full voltage, and to calculate the full-load efficiency from the no-load losses obtained in this way, by adding the value of the armature C^2R losses at full load as determined from the armature resistance. The Verband Deutscher Elektrotechniker includes this method in their rules as a sufficiently accurate test of efficiency, but no mention is made of the importance of taking the no-load losses with the commutator brushes in the neutral position.

In an article in a recent issue of the *Elektrotechnische Zeitschrift*, by W. Linke, some experiments carried out in the experimental laboratory of the Allgemeine Elektricitäts-Ges. are described, which show the variations in the efficiency which can be obtained when the above detail is not considered. The machine experimented with was a 10 h.p. motor, taking 19 amps. at 440 volts, and running at 1,150 r.p.m. Sparkless commutation at full load was obtained with a lag of 9 degrees, corresponding to about 1·6 segments; and when the motor was run light with the brushes in this position there was only a very slight sparking. The no-load current with the brushes in this position was 2·4 amp., corresponding to an input of about 1,100 watts, but when the brushes were placed in the neutral position, the input was only about 580 watts. There was thus a difference of over 500 watts, or about 6 per cent. of the total input to the motor. This difference is, of course, due to the heavy short-circuit currents in the armature, caused by the fact that the brushes were not in the neutral position in the first case. The coils short circuited by the brushes are in a strong field when the motor is running light, but at full load the armature reaction so shifts the neutral zone that the short-circuited coils are in the same relative position to the field, as they would be if the machine were running light with the brushes in the neutral position. To avoid these exaggerated armature losses, therefore, the no-load test must be made with the brushes in the neutral position. With an interpole motor, the neutral zone hardly changes from no-load to full-load, and so, in this case, the brush position is the same for no-load and full-load, and there are no short-circuit currents to be considered. The author describes a large number of experiments to demonstrate these facts, and gives oscillograph records of field flux density and armature current. The difference between the no-load losses as measured with the brushes in the full-load position and in the neutral position is largest with small machines, but even with large machines may amount to 20 or 30 per cent. of the no-load losses. To obtain the right efficiency, therefore, the brushes should be in the position in which the no-load losses are least, that is, the neutral position.

Electric Railways of the United Kingdom.—In the annual report of the Board of Trade, containing returns relating to the railway companies of the United Kingdom, it is stated that at the end of 1907 the length of electric railways (equivalent of single track) worked solely by electricity was 216¼ miles, and that 162 miles were being worked partly by electricity. The corresponding lengths of line at the end of 1906 were 197¼ and 157½ miles respectively. The total quantity of electrical energy used in 1907 was 213,675,447 units, as compared with 159,581,401 units in 1906. The total number of train miles run was 18,771,690, and the equivalent number of car miles 74,589,759. There are now 86 electric locomotives in use, 809 electric motor cars carrying passengers, and 1,275 trailer cars. These figures, it should be pointed out, include the Blackpool and Fleetwood tramroad and the Bessbrook and Newry tramway, which are classed as railways.

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THE NEW WORKS OF THE ALUMINIUM CORPORATION IN NORTH WALES

High-fall Water Power Plant and 20,000-Volt Transmission Line

A NEW works for the manufacture of aluminium by means of electric furnaces is being established by the Aluminium Corporation, Limited, at Dolgarrog, six or seven miles from Conway, in North Wales. The Corporation have a factory of a similar character at Newcastle, which has been in operation for some time, but special interest attaches to this newly completed works in North Wales, since the principal source of energy is a water supply at a head of over a thousand feet, and a supplementary supply of electric power is obtained from a high-pressure overhead transmission line. Both sources of supply are unusual in this country. This additional supply of power is taken from the existing Cwm Dyli water-power generating station of the North Wales Power

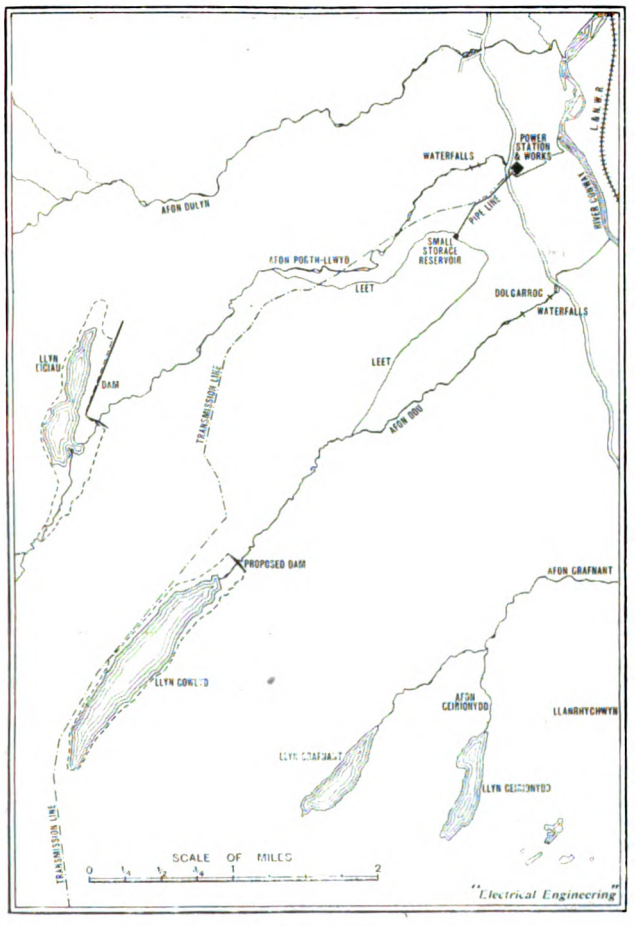

FIG. 1.—SKETCH MAP SHOWING POSITION OF WORKS.

and Traction Co., in the Nant Gwinant Valley, near Snowdon, through a 13-mile 20,000-volt transmission line. The power received over this line is converted to the low-pressure continuous current required for the aluminium furnaces by a pair of 600-kw. motor generator sets, which, together with the four main 1,000-kw. continuous-current machines driven by Pelton wheels, bring up the available power supply to the furnaces to 5,200 kw. In addition to this plant, another water-driven set of the same size is to be erected later on. The whole of the engineering work has been carried out under the supervision of Messrs. Harper Bros. & Co., of 13 St. Helen's Place, E.C., in conjunction with Messrs. Kincaid, Waller, Manville & Dawson, of 29 Great George Street, Westminster, who are joint consulting engineers to the scheme.

As shown in the sketch-map in Fig. 1, the site of the works is on the west side of the Conway river near the Porthllwyd waterfall and not far from the village of Talybont. The commercial facilities afforded by the position of the works are important. Steamers of 200 tons can discharge at Conway, and goods can be lightered from thence almost to the works door. A short bridge and embankment would give access to the L. & N.W. Rly. on the opposite side of the river. The works is furthermore immediately adjoining the main road, so that access is possible by road, rail, and river.

The watershed forms part of the Snowdonian Range, and is the highest land of considerable area in England and Wales. It comprises 14¼ sq. miles of land, situated at an elevation of 1,000 to 3,500 ft. The annual rainfall is from 60 to 170 inches, or an average of 100 inches per year. Two streams, Afon Porthllwyd and Afon Dhu, are tapped in the upper parts of their

FIG. 2.—VIEW SHOWING CONSTRUCTION OF LEET.

respective valleys at about 1,050 ft. level, and the water brought along by leets to a small service reservoir at the top of the hill overlooking the power station.

In order to provide a more continuous and reliable supply than is afforded by these two streams, although each of them is the overflow of a large mountain lake, the engineers have selected one of these lakes as a storage reservoir; Lake Eigiau, although at present smaller than Lake Cowlyd, has a larger rainfall basin, and, owing to the valley formation, can be made a much larger body of water than Cowlyd by damming the outlet. Accordingly a dam to raise the water level 20 ft. is in course of erection, and is, in fact, about three-fourths completed; this will provide an estimated storage of about 160 million cubic ft. of water, or about three times that of the lake at present. The intake works on the Porthllwyd stream have been completed; the whole length, one and a half miles, of the leet, part of which is shown in Fig. 2, to the service reservoir has been lined with concrete to make it watertight, and the service reservoir at the head of the pipe-line is complete with sluice-gates and screening apparatus. A telephone connects the power house with the service reservoir, and also with the Eigiau dam.

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The water-power rights over Llyn Eigiau, which is 1,219 ft. above sea-level, were formerly the property of the North Wales Power Company, but were ceded to the Aluminium Corporation under agreements which also provided for the auxiliary supply of power already referred to over the transmission line which was constructed by the Aluminium Corporation. The rights over Llyn Cowlyd were obtained by arrangement with the Conway and Colwyn Bay Joint Water Board.

From the small service reservoir supplied in this way, a single 36-in. steel pipe-line descends the hillside, which for about one-third of its distance has a gradient of 1 in 1·3, straight down to the power station, giving an available head of 1,010 ft. with only 1,108 yards of pipe. This pipe-line can be seen in Fig. 3. The contractors for the hydraulic works and pipe-line were Messrs. Bott & Stennet, and the pipe work was supplied by Messrs. Stewart & Lloyds, of Glasgow.

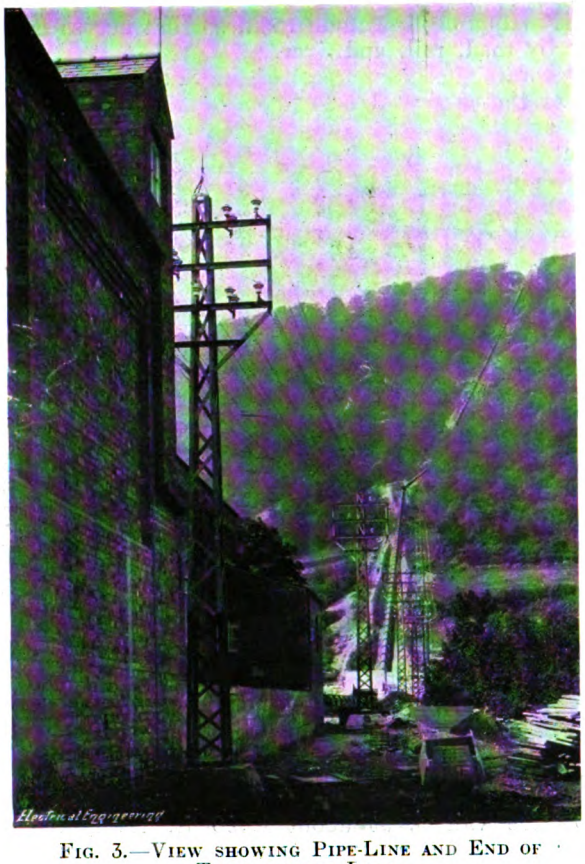

FIG. 3.—VIEW SHOWING PIPE-LINE AND END OF TRANSMISSION LINE.

The pipe is 36 in. diameter throughout. The upper portion is of the lock-bar type, varying from $\frac{1}{4}$ in. to $\frac{3}{8}$ in. in thickness, and jointed with lead and yarn. The main portion is of lap-welded steel, varying from $\frac{1}{2}$ in. to $\frac{7}{8}$ in. in thickness, with rubber joints. The appearance of these two styles of pipe is shown in Fig. 5. The whole pipe-line is divided into seven sections, each anchored at its lower end, and with an expansion joint at its upper end. The pipe continues through a 36-in. main sluice valve in a trench alongside the power-house, and the 12-in. branches to the main water wheels and the smaller connection for the lighting set are taken off at right angles opposite each set.

A general view of the works is shown in Fig. 4. The machine-room contains a row of four double horizontal shaft Pelton wheels manufactured by Messrs. Ganz & Co., of Buda-Pesth, each coupled directly to two 500-kw. continuous-current generators manufactured by Messrs. Bruce Peebles & Co. In addition to these are the two motor generators already mentioned for dealing with the power from the high-tension line. A further 1,000-kw. Pelton set is to be installed later on as a spare.

The Pelton wheels are of practically the same design as those in the main power-house of the North Wales Power Co. except for minor improvements, such as in

FIG. 4.—GENERAL VIEW OF WORKS.

the construction of the filters, &c. Each machine contains two separate bucket-wheels, each with the usual twin buckets, and the supply can be regulated by hand by needle valves which alter the volume of the jets. The automatic governing is, however, done by deflecting the nozzles so that a greater or less amount of water passes clear of the buckets direct down the tail race. The arrangements of the nozzles on trunnions for this

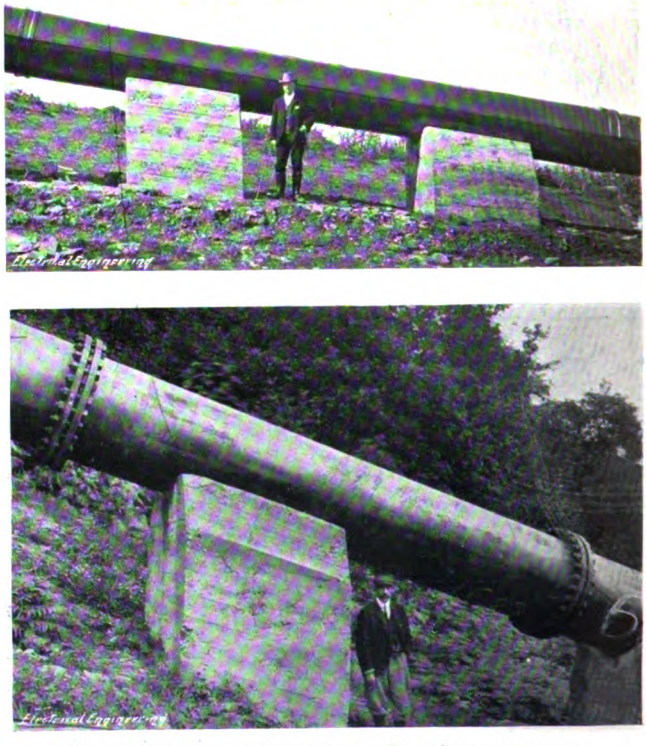

FIG. 5.—VIEWS OF SECTIONS OF PIPE-LINE, SHOWING LOCK-BAR AND LAP WELDED PIPES.

purpose and other mechanical details can be seen from Fig. 6. The governor is of the centrifugal type, and actuates the deflecting nozzles through the medium of a hydraulic relay cylinder. The machines have water-cooled bearings, and run at 450 r.p.m., with a water pressure at the valve of about 430 lb. per

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sq. in. The speed of each set is indicated by a belt-driven "gyrometer" of Messrs. W. H. Bailey's manufacture, mounted on a pillar by each set. Coupled direct to each water-wheel through rigid couplings and a 10-in. shaft are two 500-kw. continuous-current 16-pole shunt-wound generators coupled in tandem. The two machines of each set are connected permanently in parallel, and the total output per set is 8,000 amperes at voltages varying up to 125 volts. The appearance of one of these sets is shown in Fig. 7. The guaranteed efficiencies of the generators are as follows:—full load, 93 per cent.; three-quarter load, 92 per cent.; and half load, 90·5 per cent.

The lighting of the works is obtained, as will be seen hereafter, partly from a small independent water-driven set also supplied by Messrs. Bruce Peebles & Co. This consists of a horizontal shaft Pelton wheel manufactured by Messrs. Carrick and Ritchie, of Edinburgh, driving a Bruce Peebles continuous-current dynamo with an output of 30 kw. at 105 volts. The Pelton wheel is designed to give out 50 B.H.P. when running at a speed of 900 r.p.m. under a head of

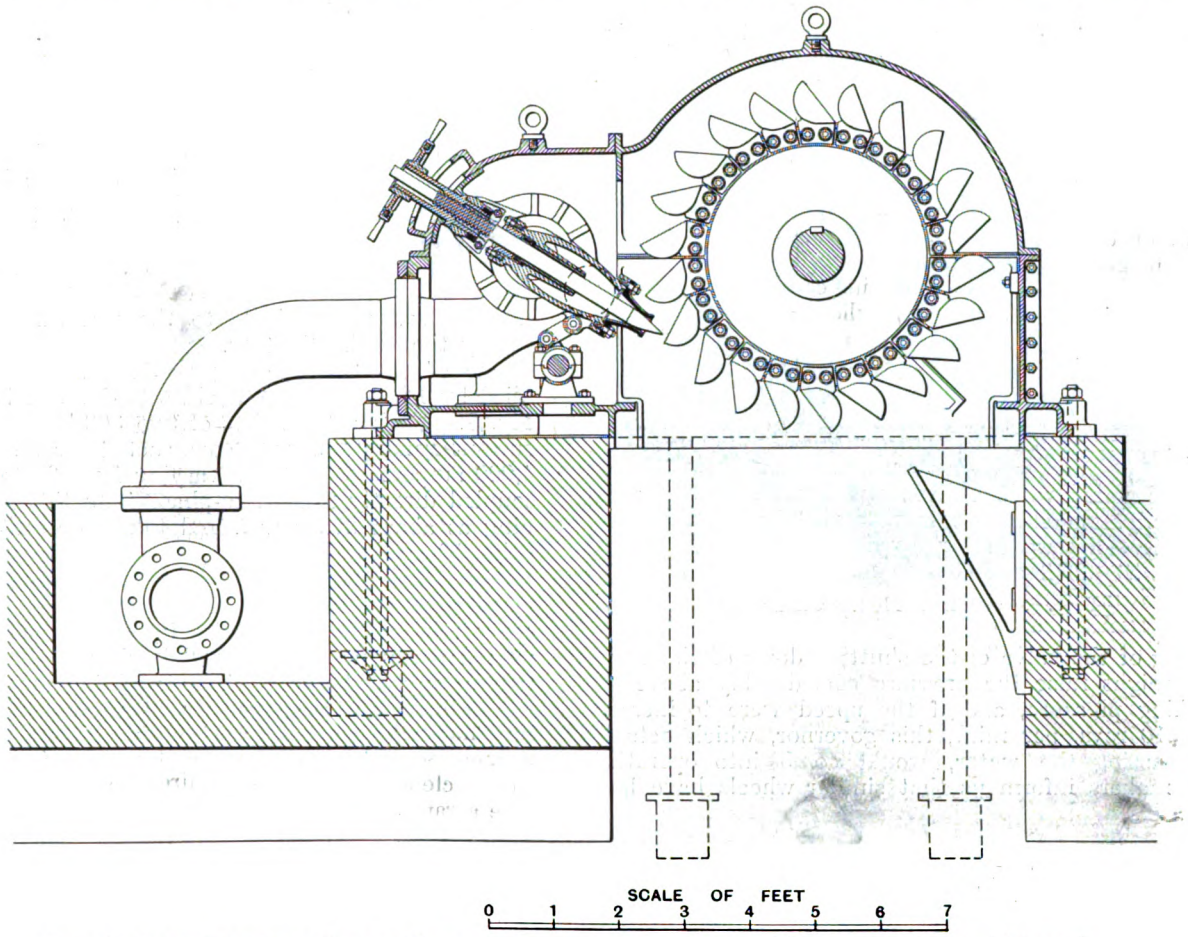

FIG. 6.—CROSS SECTION OF PELTON WHEEL, SHOWING ARRANGEMENT OF NOZZLES AND BUCKET WHEELS.

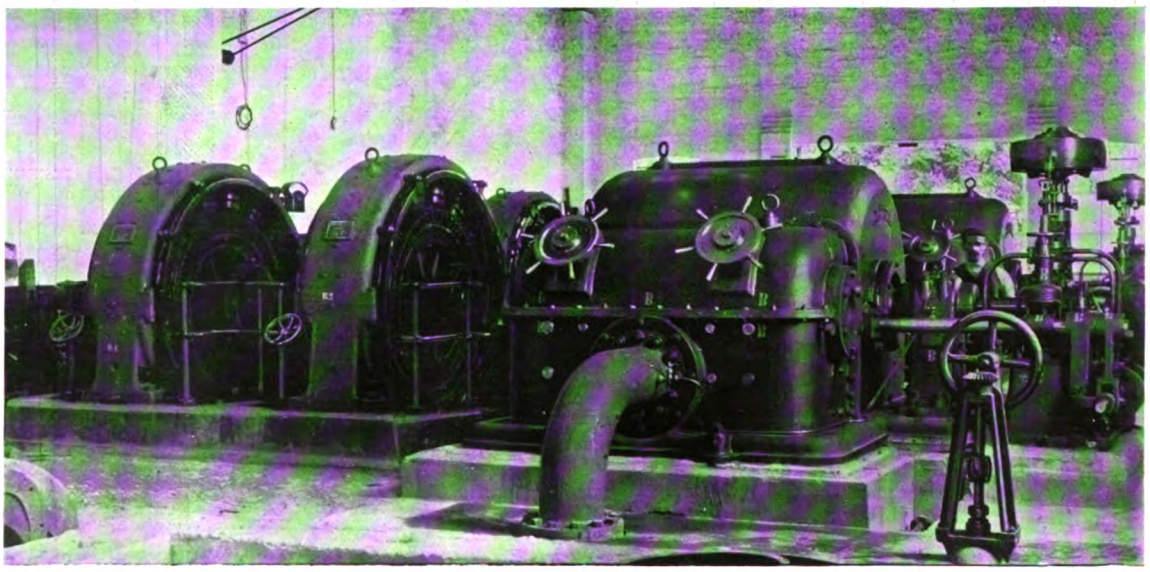

FIG. 7.—1,000 KW. PELTON WHEEL SETS.

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1,000 ft., and is constructed entirely of steel. The method of governing employed is of some interest. In addition to a hydraulic Pickering governor throttling the supply, another governor has been fitted to relieve the pressure, if through any circumstance it rises above the ordinary working pressure. The sudden

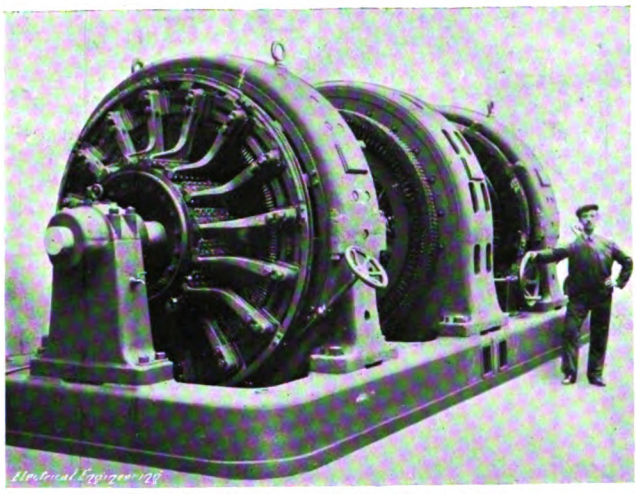

FIG. 8.—600 KW. MOTOR GENERATOR.

closing of the valve or the shutting down of the entire load might raise the pressure considerably above the working pressure, and if the speed were to increase only 10 revs. per min., this governor, which acts by bye-passing the water, would come into operation. The makers inform us that similar wheels have been tested elsewhere, where one per cent. increase of speed immediately brought the governors into action.

Before describing the switchgear used in connection with the machines already described, we may draw attention to the converting plant which deals with the 20,000-volt supply from the North Wales Power and Traction Co. This supply, which reaches the station at a full-load voltage of about 19,250 volts at 50 cycles, allowing for the drop in the line, is first of all stepped down to 1,050 volts in a pair of three-phase "Berry" oil-immersed water-cooled transformers, each of which has a capacity of 1,000 k.v.a., and is intended to supply one of the motor-generator sets already alluded to. The efficiency of these transformers on full load is as high as $98\frac{3}{4}$ per cent., and the voltage regulation on any power factor is guaranteed to be within 1·4 per cent. It may be mentioned that arrangements are made whereby these two transformers can be run in parallel, although it is intended usually to run them each on its own separate motor-generator circuit. There is also an auxiliary 30-kw. Berry transformer stepping down to 105 volts, which can be used alternatively to the water-driven set to supply the works lighting.

One of the two motor-generators which were supplied by Messrs. Bruce Peebles & Co. can be seen in Fig. 8. Each set consists of two 300-kw. continuous-current generators, each constructed for an output of 4,000 amperes at voltages varying from 25 to 75 volts, coupled directly to a three-phase induction motor running at about 375 r.p.m. and taking current at 1,050 volts 50 cycles from the transformers already mentioned. The three machines are mounted on one bedplate with the motor in the centre. The generators are of the 16-pole type with interpoles, and are connected permanently in parallel without the intervention of any switchgear. The induction motors are of the ordinary slip ring type with star-connected stators, provided with rotor short-circuiting device worked by a hand wheel at the side, and are started up by means of liquid starters placed alongside the sets.

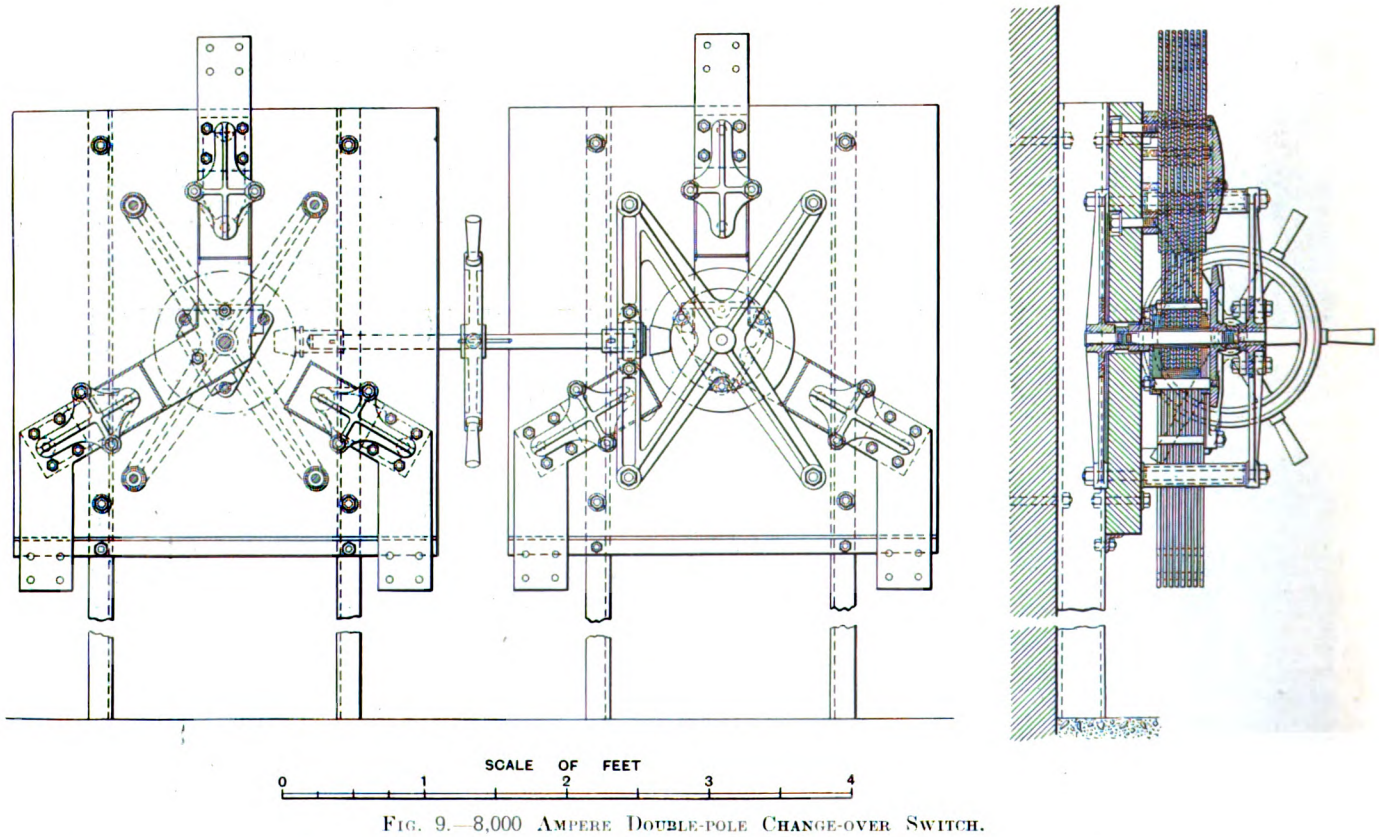

FIG. 9.—8,000 AMPERE DOUBLE-POLE CHANGE-OVER SWITCH.

The furnace room, the exterior of which can be seen in Fig. 4, adjoins the machine room. It is lofty and well lighted, and is some 200 ft. long by 160 ft. wide. Along the wall immediately adjacent to the generating sets runs a pair of copper 'bus-bars 8 sq. in. in section. These bars are only intended to be used occasionally as "hospital-bars," or for coupling together any de-

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sired machine or furnace circuit. Ordinarily, each line of furnaces will be fed from its own machine through the massive connections coming direct through the wall. These main connections are each of 16 sq. in. section aluminium, built up of eight bars each 4 in. by ½ in. From each of these, a set of eight 1 sq. in. flexible copper cables lead to the furnaces. These are arranged in groups of 25 connected in series, and taking a working current of about 7,500 amperes, but the groups can, of course, be sub-divided if required. Five such groups will eventually be installed, and of these three are already erected. Thus, when working at full power, each water-driven machine will run one group of 25 furnaces with a pressure of from 120 to 130 volts, each pull of each machine, and each pair is operated through gearing by a hand-wheel, and is so arranged that in its different positions, either the machine, or the furnace circuit, can be connected to the 'bus-bars in the furnace-room or to each other, independently of the 'bus-bars. There are no fuses, circuit-breakers, or other protective devices in the circuits. The only other switchgear relating to the continuous-current side of the plant is the marble control panels with instruments and shunt rheostats, placed alongside each generator set and motor generator. These were supplied by Messrs. Ferranti, Ltd.

On the other side of the machine-room is a three-panel marble board also by Messrs. Ferranti, Ltd. This is composed of three panels, two of which belong to the 1,000-volt motor-generator circuits and the remainder is the works lighting distribution panel, provided with necessary switches for taking the supply for this from either the auxiliary water-driven generator or the small transformer already mentioned, fed from the incoming transmission line. The induction motor panels do not call for special remark; the main switches are of Messrs. Ferranti's standard oil break pattern mounted immediately behind the board, and operated by levers projecting through slots in the panels; they

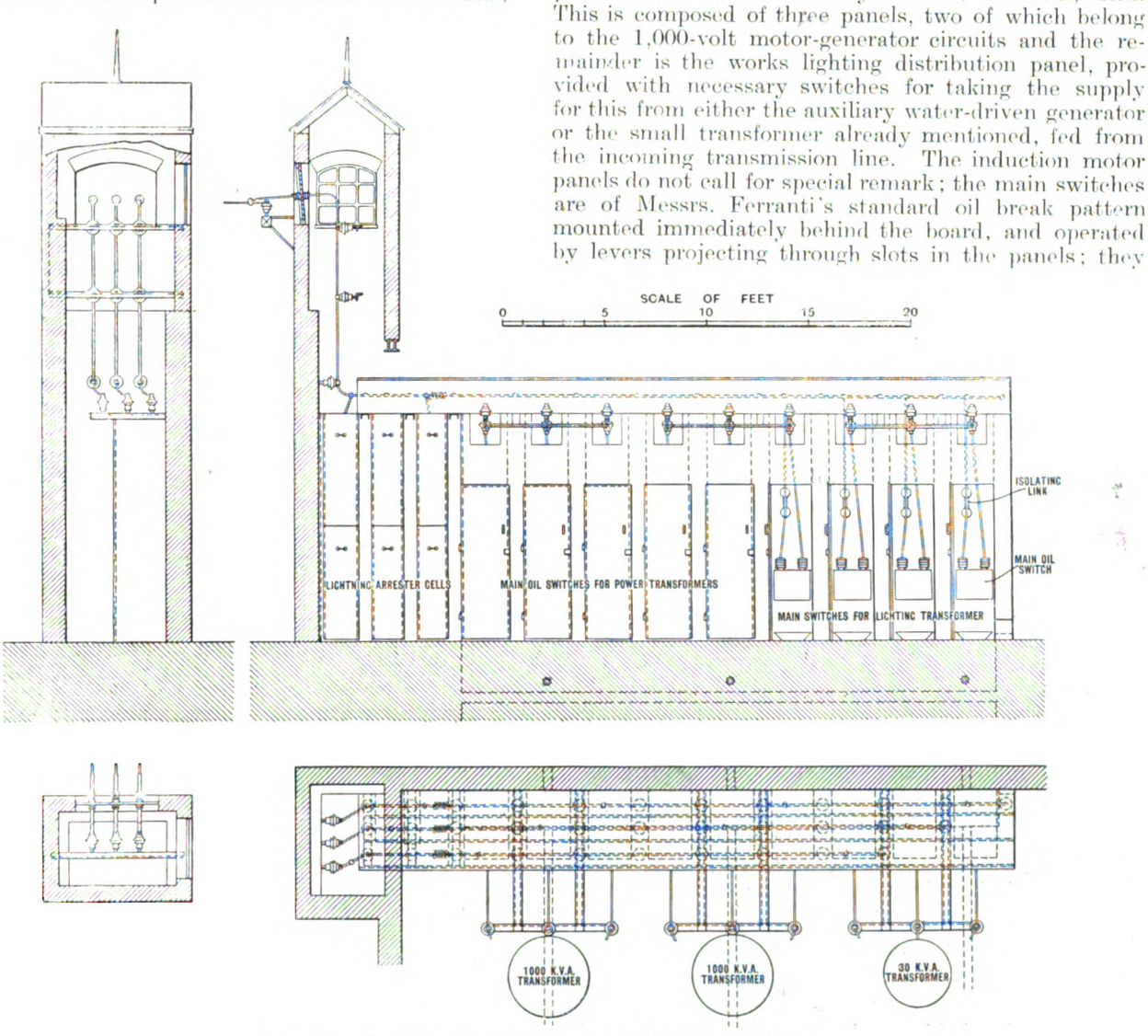

FIG. 10. GENERAL ARRANGEMENT OF E.T.H. SWITCHGEAR.

across the terminals of the group, while the remaining group of 18 furnaces only will be run off one of the motor generators, which, as already seen, work only up to 75 volts. In practice, however, various other combinations can be made. The total capacity of the works will be five tons of aluminium per day. The behaviour of each furnace can be studied by means of the conspicuous low reading voltmeter with which each is provided, and which indicates the voltage drop across the terminals of the furnace.

The switchgear between the generators and the furnace room connections is simple and substantial, but at the same time ingenious, and consists of special 8,000 ampere "capstan" switches supplied by the British Thomson-Houston Co. The construction of these is shown in Fig. 9. One of these switches is placed on are provided with release coils worked in connection with three-pole overload time-limit relays. All the high tension connections are contained in a large expanded metal cage in the switch-room, immediately behind the board. In the same room are placed the transformers already mentioned, and the brickwork cells closed by iron doors containing the 20,000-volt switchgear. The main 20,000-volt oil switches in the primary circuits of the large transformers are entirely without release gear, and are operated through rodding by large levers and quadrants in the main machine-room.

The general arrangement of the 20,000-volt switchgear is shown in Fig. 10. The three wires of the transmission line enter the top of the switchroom through three large porcelain insulators lined with mica

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tubes and set in the centre of marble panels. These tubes and panels are inclined so as to drain outwards in the usual way. Each phase is provided with a lightning arrester equipment, and these are contained in the first three of the row of brick cells at the end where the line enters. The lighning arresters are of a type developed by Messrs. Ferranti, Ltd., who supplied the whole of the E.H.T. gear. The main gap

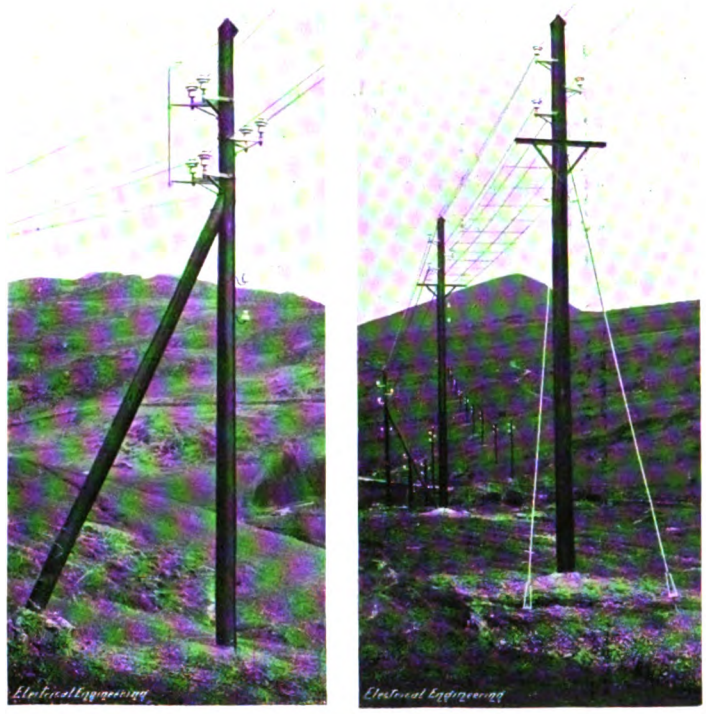

FIG. 11.—VIEWS OF TRANSMISSION LINE, SHOWING DIFFERENT ARRANGEMENTS OF POLES.

consists in each case of a pair of brass balls $\frac{1}{4}$ in. apart, without any horn or other blow-out arrangement. In series with these, on the earth side, are a set of ordinary multi-cylinder arresters with 45 gaps in series, and finally between these and earth is a water resistance formed by a rubber hose with metal connections, through which water obtained from the main-pipe-line through a reducing valve is always circulating. A similar lightning arrester equipment is installed at the power-house end of the line, but there are no intermediate arresters of any kind along the 13 miles of line. The E.H.T. 'bus-bars, which can simply be looked upon as extensions of the line, as they are unprovided with incoming feeder switches, run through choking coils between slate partitions across the top of the cells and are supported on similar insulators to those used for the line. The remaining nine cells contain the main 20,000-volt oil switches for the two 1,000-kw. power transformers and the small lighting transformer respectively. Each phase is in a separate cell, which contains nothing else but the oil switch and suitable isolating links. There are no current or pressure transformers, nor release coils or relays, as there are no instruments on the E.H.T. side, and, as already mentioned, only the secondary oil switches are fitted with tripping attachments. The whole arrangement is thus of particularly simple and reliable character. For the sake of easy distinction, apparatus belonging to the respective phases is here and there painted red, white, and blue.

The end of the transmission line is shown in Fig. 1, and the lower portion where it comes down the hill alongside of the pipe-line can be seen in Fig. 3. With the exception of the four lattice steel poles shown in Fig. 3 the line is entirely supported on wooden poles. The photographs reproduced in Fig. 11 and the drawings in Fig. 12 show the arrangement, not only of the standard pole on straight portions of the line where it runs across open country, but also the special arrangements adopted for corner poles, road crossings, &c. The line was also erected by Messrs. Bott & Stennett. As a general rule, the poles, which are set in concerete, are 120 ft. apart, and they vary in height from 36 ft. to 38 ft., but the minimum height of the lowest of the three wires above the ground is 26 ft. A telephone line runs the whole length of the line at a height of about 22 ft. above ground, and elaborate precautions are taken to avoid risk from this becoming alive. The wiring was done by Messrs. Saunders & Co., of London.

The line wires are of copper 6 mm. diameter, supported on triple petticoat porcelain insulators supplied by the Karlsbader Kaolin-Industrie-Gesellschaft, of Merkelsgrün, near Karlsbad (Austria). These insulators are 8 in. over all height and 7 in. extreme width, and have all been tested up to 90,000 volts. They are mounted on iron pins, to which they are affixed by a cement of glycerine and litharge. The pins are supported by galvanised iron brackets of the simple form shown in the illustrations. These brackets are all connected to the overhead earth wire strung above the line wires from the tops of the poles. The line is divided into ten sections for testing purposes, and was designed for a voltage drop on full load of 1 per cent. per mile. Each pole is to be provided with an inverted crown of

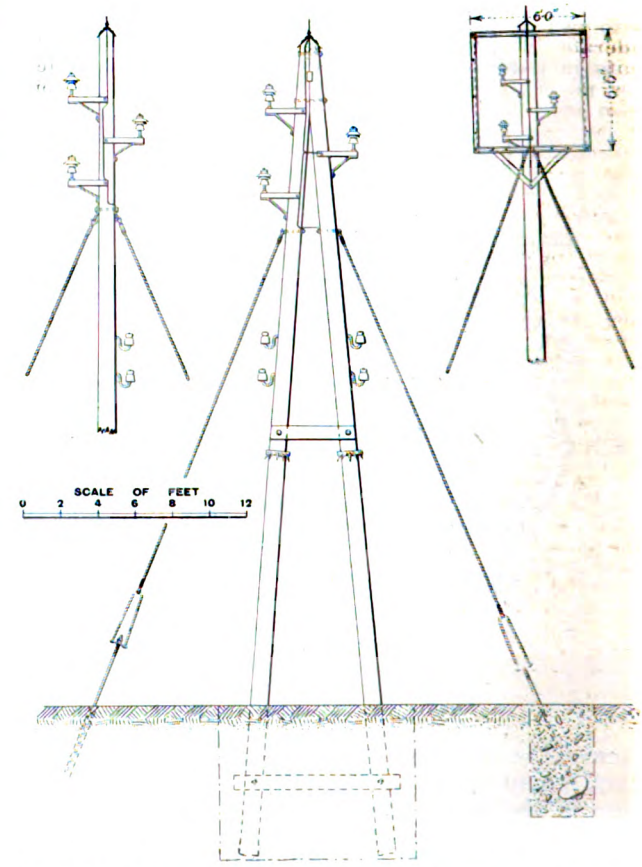

FIG. 12.—ARRANGEMENT OF STANDARD AND SPECIAL POLES.

spikes to prevent the inquisitive climbing up the poles, and a warning notice is provided, reading:—Rhybudd: Dalier sylw mae yn beryglus i gyffwrdd a'r gwifrau, with the English equivalent—Take notice, it is dangerous to touch the wires.

The only additions to the plant at the Cwm Dyli power-house to deal with the transmission line have been the 10,000/20,000-volt step-up transformers,

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which are of the Westinghouse auto-transformer type, and the necessary switchgear and lightning arrestors on similar lines to that at the Dolgarrog end of the line.

In conclusion, we wish to express our thanks to Messrs. Harper Brothers, consulting engineers to the scheme, for putting at our disposal the drawings and photographs from which the illustrations in this article have been prepared, and who, partly through their representative at the works, Mr. L. D. Taylor, and Mr. E. H. Rainbow, gave us technical particulars of the work. We also wish to acknowledge the kind assistance of Mr. E. F. Jones, Works Manager to the Aluminium Corporation, Mr. Hutchinson, the Station Superintendent, and Mr. R. Waite, of Messrs. Bruce Peebles & Co., on the occasion of the visit of our representative to the works.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN *Electrochemical and Metallurgical Industry* for November there is a description of the Roechling Rodenhauser three-phase induction furnace, and it is pointed out that this type of furnace originated in the simple induction furnace, which led to the combined induction and electrode type for single-phase currents, and finally to the three-phase type. Both electrical and metallurgical considerations have been the cause of this development. Electrically, the power factor has been the prime consideration. The original induction furnace was essentially a transformer with a secondary of fused metal, and the high temperature of this secondary required very careful heat insulation from the primary winding, and also from the magnetic iron core. For these reasons the whole of the magnetic flux does not link with both primary and secondary, and consequently there is considerable magnetic leakage. There is self-induction in both circuits in place of mutual induction, and consequently there is a low power factor. The improvement of the power factor has been one of the chief aims of designers of induction furnaces. It can be accomplished by reducing the frequency of the alternating current, but if this reduction is carried out to an extreme it is necessary to have large and expensive generators made for large furnaces. The solution of the difficulty was ultimately obtained by relinquishing simple induction, and adopting combined electrode and induction furnaces. The pole plates in the Roechling Rodenhauser furnace are to all intents and purposes electrodes; they are really a new class of electrode, as they contain no carbon, and do not require regulating mechanism, but they have rendered possible the building of combination furnaces which will work at ordinary commercial frequencies with a satisfactory power factor. Other causes which led to the evolution of this furnace were of a mechanical nature, as, for example, the very narrow channel for the fused secondary in the earlier form of induction furnace, which caused difficulty in charging, cleaning, repairing, &c. The large hearth of the new furnace also solves a metallurgical difficulty. When steel has to be refined by means of very hot slag it is difficult to get the slag at a sufficiently high temperature in a pure induction furnace owing to the induced currents preferring to pass through the metal bath, which is the path of least resistance. In the Roechling Rodenhauser furnace the current from the pole plates is forced through the slag, and further, the rotary magnetic field causes an automatic circulation of the bath.

A recent American Consular Report contains the following information relating to the successful results obtained in a large German steel works by the substitution of two 250 h.p. electric furnaces for the original plant of thirty-two crucible furnaces. Each of the two furnaces is capable of holding a charge of one ton of metal, and only one is used at a time. Power is supplied to the works at 5,200 volts three-phase from a large generating station near Cologne, and transformed down to 110 volts at the works. These furnaces have been used continuously since the beginning of this year, and the main product has been cast steel, containing about 0·06 per cent. phosphorus, 0·03 per cent. sulphur, and from 0·08 to 0·18 per cent. carbon. Occasionally charges of tool steel have been cast, containing from 0·7 to 1·3 per cent. of carbon, with and without the addition of nickel, chromium, or tungsten. The material employed is ordinarily slugs, cuttings, turnings, and other waste of wrought iron, costing about £3 10s. per ton. A fusion, including the refining, lasts about five hours and involves a consumption of about 900 kilowatt hours for one ton of cast steel. The entire charge of one ton is poured at once. When the furnace is kept in continual use the magnesite lining lasts for about seventy operations, *i.e.*, twenty to twenty-five days. A stoppage of five days is required for each renewal, but during this period the reserve furnace is employed. The cost of current to the works is only about 0·54d. per unit, so that the total cost of current for a single operation amounts to about 40s. Including capital charges, and all working costs, as renewal of lining, labour, electrodes, and also cost of raw materials, the total cost of cast steel produced by this method is about £8 per ton. It is stated that cheaper raw materials can be used in the new furnaces, and that, owing to the high temperature at which the metal leaves the furnace, much better castings are obtained. The furnaces are constructed on the Stassano system, in which carbon electrodes enter by openings in the side of the furnace, the arc being struck just above the furnace of the metal. The furnace is rotated about an axis slightly inclined to the vertical by a 5 h.p. motor, to bring about a thorough mixing. The electrodes are water-cooled. A fusion takes 3½ hours, with a further period of 1½ hours to remove the phosphorous and sulphur. The report concludes with the statement that the crucible processes will soon be entirely superseded by the new electric furnaces.

Tramway Rail Imports and Exports.—In answer to a question in the House of Commons last week, the President of the Board of Trade stated that 1,362 tons of tramway rails of a declared value of £8,766 were imported into this country from Belgium in 1907, and 2,509 of a declared value of £18,046 from other countries. In the same year 4,077 tons of tramway rails of British manufacture, valued at £69,284, were exported from the United Kingdom.

Disturbances on Australian Telegraph Lines.—In a report submitted to the Australian Postmaster-General by the engineer for New South Wales, mention is made of a serious disturbance which took place last September, causing considerable delay on the Sidney-Melbourne lines. The foreign current was so strong that quadruplex work had to be temporarily abandoned. Duplex working was carried on, however, by making the line current coincide with the foreign current. After a few hours the foreign current fell from its maximum value of 20 milliamperes to 9 milliamperes, and quadruplex working was resumed. The chief engineer, Mr. Hesketh, reports that it was the most severe disturbance he had ever met with in Australia.

Students' Section I.E.E.—As usual, the Students' Section of the Institution of Electrical Engineers during the next session will meet in the Library of the Institution, 92 Victoria Street, Westminster, S.W. The following are the Papers down for reading:—November 18th, Opening Address by Mr. J. S. Highfield on "The Responsibility of the Engineer"; December 2nd, "Electric Road Vehicles" (other than tramcars), by Stanley H. Hills; December 16th, "Auto-Transformers and Metallic Filament Lamps," by George H. Stevens; January 20th, "Modern Mining Switchgear," by John F. Shipley; February 3rd, "The Direct-current Variable-speed Motor and its Application to Modern Machine Tools," by W. Stanley Lonsdale; February 17th, "Purification of Boiler Feed Water," by Thomas Walmsley; March 3rd, "Rheostats," by J. S. Messent; March 17th, "Central Station E.H.T. Switchgear and Control," by Edward F. Hetherington; March 31st, "Electricity Supply," by W. Bernard Thompson; April 21st, "Sewage Pumping Electrically of a Small Town," by Joseph S. Lazarus; May 5th, "Some Notes on Relays," by Ernest W. Moss. No programme of visits has yet been arranged, but the committee will be pleased to consider any suggestion put before them. The hon. secretary is Mr. G. H. Stevens, 266 Barry Road, Dulwich Park, London, S.E.

The Acton Electricity Undertaking.—In our issue for August 27th, 1908, page 311, we gave some particulars of the Acton electricity undertaking, and of the heavy loss which has been incurred, in spite of the fact that this undertaking has merely the simple task to perform of buying its electricity in bulk, converting it to low pressure, and retailing it to the consumer. Electrical energy is purchased from the Metropolitan Electric Supply Co., Ltd., at an average price of under 2d. per unit, the average selling price being 3·88d. per unit. This margin, however, has not been nearly sufficient to meet the sub-station, distribution and management costs, and the capital charges. The capital cost of the undertaking, including money spent upon consumers' installations, has worked out at £191 per kw. Owing to the unsatisfactory condition of affairs Sir Alexander Kennedy was called in to advise, and has now presented his report. In this report the obvious fact is pointed out that all the charges relating to the undertaking are too high and can only be appreciably reduced by an increase in the demand, which, however, is regarded as improbable, owing to the impossibility of being able to reduce the price. Sir Alexander Kennedy then referred to a new offer made by the Metropolitan Co., under which the total amount of about £4,000 per annum should not be decreased, but that a larger amount of energy should be supplied for this sum until a load of 500 kw. is reached. The advisers to the Council, however, estimate that this proposal is equivalent to £7 7s. 4d. per kw. of maximum demand per annum, plus one-third per unit, and there does not seem any disposition to accept the proposal. This price is being contrasted with the prices scheduled in the London Power Bills.

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THE DENNY MAGAZINE FUSE

ONE of the novelties at the Manchester Exhibition was a new form of "magazine" fuse, which was shown both by Messrs. Bullers, Ltd., of Tipton, Staffs., and also by Messrs. Berry, Skinner & Co., who are the selling agents. It is manufactured by Bullers, Ltd., under Denny's patent. The illustrations below show the fuse in its case, and also the porcelain interior, which takes five fuse wires. This is rotated by a

Complete. With case removed.

DENNY MAGAZINE FUSE.

milled head at the bottom of the case, and the fuse, together with a number, is visible through the window in the front of a case. There is a ratchet arranged so that the fuse-holder can only be revolved in one direction, and this makes it impossible to turn back on to a way in which the fuse has already blown. There is a sixth position of the fuse-drum, in which the word "Off" appears at the window, and it is only when the drum is in this position that the interior can be removed for replacing the fuse.

PORTABLE METER TESTING RESISTANCES

THE practice of testing meters on the premises of the user in preference to taking them to the station for testing is becoming more and more common. With a view to facilitating the testing *in situ* which necessitates the provision of a steady load of sufficient magnitude for enabling the test to be done with rapidity, Messrs. Wm. Geipel & Co., of Vulcan Works, St. Thomas Street, S.E., are introducing a series of portable rheostats especially arranged for this purpose. The rheostats consist of a number of resistance units of the well-known Ward Leonard pattern, each one being of suitable capacity for connecting directly across the line pressure. These units are enclosed in a compact, perforated metal case. The load is adjusted to suit the test by switching in one or more of the resistance units by means of the knife switches provided for the purpose; 20 different loads can thus be made by equal increments, each switch being marked with the corresponding number of amperes. They can be supplied in various sizes from 10 to 50 amperes, for use on all pressures between 100 and 250 volts. The rheostat is light, small, and of convenient shape for portability. For example, a 20-ampere, 100-volt rheostat weighs 13 lb. and measures 5 in. by 12 in. by 9 in. The case is furnished with eyelets which can be attached to straps for carrying.

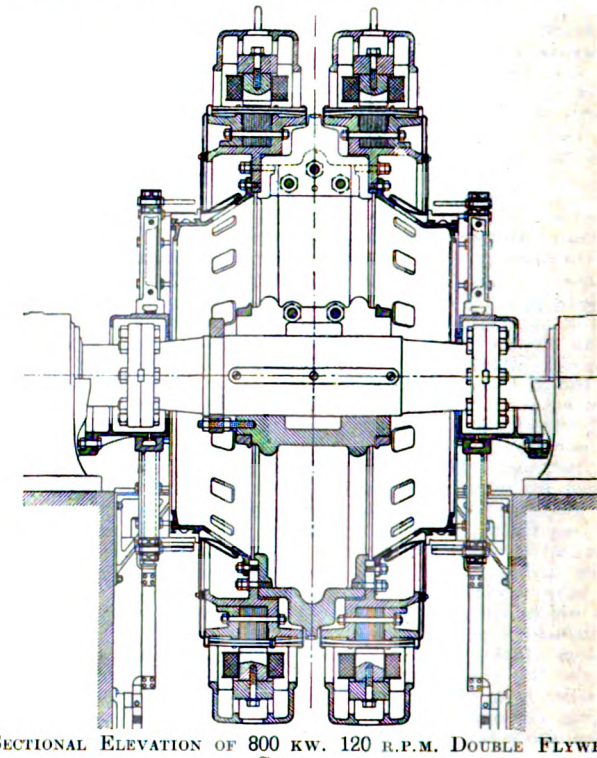
The Olympia Motor Show.—The seventh exhibition organised by the Society of Motor Manufacturers and Traders will be opened at Olympia to-morrow, and will remain open till Saturday, November 21st, inclusive. The Exhibition, as was the case last winter, will be confined to passenger vehicles intended for private use, with tyres and accessories. The exhibition of commercial vehicles will be held as usual in the spring. It is announced that over 300 firms will be taking part.

Railway Electrification in Chicago.—A decision has definitely been arrived at by a general meeting of the shareholders of the Illinois Central Railroad to convert the service within the limits of the City of Chicago to electric traction. There has been for some time an agitation in favour of this, mainly on account of the smoke nuisance from the existing steam locomotives. The change will involve 26 main lines entering the city, and six terminal stations, besides lesser lines.

A LARGE SLOW-SPEED DOUBLE FLYWHEEL GENERATOR

SOME details of an interesting double flywheel generator are given in a description of the electrical plant at the Rombacher smelting works, in Germany, which appeared in a recent issue of *Elektrische Kraftbetriebe und Bahnen*. The generating plant at these works includes a large number of alternating-current and continuous-current generators, and of these latter, four are of the flywheel type, and are coupled to slow-speed gas engines running on blast-furnace gas. Two of these generators are constructed as single flywheel machines, and the other two as double flywheel machines. The construction of the latter can be seen from the section drawing reproduced below. Each generator consists of two armatures mounted on a common spider by means of a double row of arms, and two separate field systems. The complete machine is mounted in the middle of the shaft of a four-cylinder gas engine, with two cylinders working in tandem on either side of the generator. The gas engines were supplied by the Vereinigte Machinenfabriken Augsburg, of Nürnberg.

The gas engine is rated at 1,200 h.p., and has a speed of 120 r.p.m.; each half of the generator is rated at 400 kw. The machines generate at from 230 to 350 volts per armature.



SECTIONAL ELEVATION OF 800 KW. 120 R.P.M. DOUBLE FLYWHEEL GENERATOR.

Each armature is provided with a series-parallel winding for five circuits and twenty poles; and equipotential connections, the position of which on the commutator sleeve can be seen in the illustration above, are also provided. This drawing also shows the manner in which the unusually long commutator lugs are supported by means of an insulating ring fixed to a projection of the armature frame. Wrought iron poles of oval shape are bolted on to the cast iron yoke, which is bell-shaped to give great rigidity. The brush-rockers are supported, as shown, on castings surrounding the couplings, and fixed to the main bearings. The following are a few further particulars of the machine:- Armature diameter, 3,500 mm.; length, 180 mm.; number of poles, 20; number of slots, 675; conductors per slot, 2; number of commutator segments, 675; outer diameter of frame, 4,500 mm. The weight of the stationary parts amounts to nearly 27 tons, and the weight of the rotating part 37 tons. The single flywheel generators have also an output of 800 kw. each, and are coupled to gas engines running at 110 r.p.m. These generators have a rather larger armature diameter, but weigh less than the double flywheel machines.

The Association of Teachers in Technical Institutions.—At the fourth annual meeting of this Association, held on Saturday last, Mr. J. Wilson, of the Battersea Polytechnic, was elected President, and the annual report was adopted. A meeting of the London Branch was held afterwards, at which Mr. W. J. Lineham read a Paper on "Technical Education at the Franco-British Exhibition."

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REPORT OF THE COMMITTEE ON TRAMWAY BRAKES

Appointed by the Tramway and Light Railways Association

IN his report to the Board of Trade on the accident which occurred on the Highgate Archway tramway on June 23rd, 1906, Col. Yorke suggested that it would be desirable for the Tramways Associations to consider carefully the whole question of braking apparatus and sanding arrangements for tramcars. The Council of the Tramways and Light Railways Association, recognising that it was necessary for the Association to reassure the public as to the precautions taken to ensure their safety, at once appointed a Special Committee to inquire into and report on the whole question of brakes.

This Committee, which has now issued a report occupying over 200 pages of the official circular of the Tramways and Light Railways Association, consisted of the following members:—

Mr. Stephen Sellon, Consulting Engineer (Chairman); Mr. A. L. C. Fell, Chief Officer, London County Council Tramways; Mr. W. Worby Beaumont, Consulting Engineer; Major P. Cardew (Messrs. Preece & Cardew), Consulting Engineer; Mr. A. N. Connett, Director and Chief Engineer, Messrs. J. G. White & Co., Ltd.; Mr. R. J. Howley, Inspecting Officer, British Electrical Federation, Ltd., Mr. A. H. Pott, Chief Engineer, Metropolitan Electric Tramways, Ltd., and Mr. H. M. Sayers, Consulting Engineer.

The report commences with a masterly recapitulation and discussion of the general objects to be arrived at to obtain braking effects, and the usual methods adopted, and classifies the conditions under which tramcar braking has to be carried out as follows:—

(1) Service stops, for the setting down and picking up of passengers, and the observance of Board of Trade and Traffic Regulations prescribing stops at certain places. (2) The regulation and control of speed on falling gradients, or "coasting." (3) Stops to avoid accidents, from collision with other vehicles, pedestrians, or obstacles. (4) Runaway stops, to bring under control a car which has attained a dangerous speed on a falling gradient, and is likely to suffer collision, derailment, or overturn unless stopped before reaching a given point.

The results of a number of tests for determining the coefficient of friction of brake-blocks under service conditions. So far as they go these tests indicate that steel shoes maintain a higher coefficient of friction on bad rails than has been supposed. Tests with both wood and steel through a higher range of specific pressures corresponding to service loads, and with rails "greased" with the mud of different localities, are needed to complete our knowledge of the subject.

A large amount of information was obtained from tramway undertakings, and full particulars were obtained relating to 5,018 cars, 3,625 of which are mounted on single trucks and 1,393 on double trucks. The following are the types of brake fitted to these cars:—

Hand wheel brake	5,018	cars
Rheostatic brake	2,866	,,
Magnetic track brake	1,278	,,
Mechanical track brake	1,967	,,
Electric short-circuit brake	917	,,
Pneumatic track brake	121	,,
Regenerative control	60	,,

Eighty-seven cars are reported to have the controller so arranged that when it is in the "off" position an electric short-circuit brake comes into operation automatically when the car runs back. The particulars collected show that for ordinary service stops the hand-wheel brake is generally used, except on systems working heavy bogie cars in congested traffic, where the magnetic track brake has been largely adopted as a service brake. In some cases the magnetic track brake, while fitted, is reserved for emergency work; the reason it is not used for service stops appears to be the limited capacity of the motors. The rheostatic brake is also used to some extent for making service stops. All systems, with but few exceptions, report the use of an electric form of brake—short-circuit, rheostatic, or magnetic track—for making emergency stops. Where the pneumatic track brake is fitted, it is used, often in combination with the hand or electric brake, for making emergency stops. The rheostatic brake is very largely fitted, especially by the smaller undertakings working in semi-urban and rural districts. The reason of its popularity appears to be that it is inexpensive. The hand brake is generally used for coasting on a gradient flatter than 1 in 20, except in some cases where the magnetic track brake is fitted and is used for this purpose. On gradients steeper than 1 in 20 some form of track brake is usually fitted. When coasting on the mechanical track brake the rule appears to be to apply it before commencing the descent, the speed regulation being controlled by the hand-brake.

The Committee examined and tested a large number of forms of brake, and their opinions and conclusions are given below:—

Wheel Brakes.—The limiting retarding force possible is the product of adhesion and weight. When the applied force exceeds this, skidding results, and in consequence diminished retardation. For general tramway purposes it is inadvisable to calculate on a higher coefficient than 0·25, or a higher retardation than 8 ft. per second. Should the rail be greasy the adhesion value may be considerably less, and the retardation correspondingly reduced. If it is a hand brake, the retardation must be comparatively slow. The time of application, physical effort, and other operations, which he must simultaneously perform, make it unreasonable to demand of a motorman efficient stops. However, with a power wheel brake which requires no effort to apply and to moderate in power after initial application, good results should be expected.

The effect of the condition of the rail on the possible braking effort can be reduced to within small limits by the use of sand. A careful examination of tests leads us to believe that the hand brake should give a retardation from 3 feet per second for a heavy double-deck car to 5·50 feet for a single-truck lighter car.

Slipper Brakes.—The limiting retardation possible is the product of the whole weight of the car carried on the slipper shoes, and the coefficient of friction between brake shoes and rail. With wooden shoes giving 0·5 coemcient on a dry rail, this would be 16 feet per second. With metal shoes and 0·20 coefficient, the retardation would be 6·4 feet per second. How near these results are realisable in practice depends upon the safe proportion of the weight of the car which may be carried on the shoes and the time to apply the maximum effort.

Mr. Pott made an interesting experiment with a single-deck radial truck car weighing about 10 tons, equipped with the old design of Spencer brake, and found that by applying the maximum efforts of a man, 50 per cent. of the weight of the car could be raised. In ordinary practice it is probable that this would not be more than 40 per cent. with this individual brake. Experience shows that at least 40 per cent. of the weight of car may be safely taken on the slipper blocks. With Estler Brothers' pneumatic slipper brake the car equipped with two-cylinder brake equipment weighs 7 tons and that with four-cylinder equipment 9½ tons. At 50 lbs. pressure this would mean 33 per cent. total weight in one case, and 43 per cent. in the other. It is evident, however, that this type of brake could be designed to take any predetermined percentage of the car weight.

It is important to note that the proportion of weight carried by slipper brake shoes diminishes the efficiency of the wheel, or any brake acting through the wheel, and therefore dependent upon wheel adhesion to the same extent; however, as the coefficient of friction with wood slipper shoes is greater, the effectiveness of the car weight for braking purposes is proportionately increased. The hand slipper brake is slow in application, and requires considerable effort, two serious disadvantages. With power application, both of these disappear. The Pringle type of slipper brake can only be an emergency brake, and the same may be said of the Freund brake in the form seen by the Committee, but it is understood that a later form is designed to extend its scope to service and coasting use.

Rheostatic Brake.—This brake is dependent upon wheel adhesion. Its extreme limit of effectiveness is therefore the same as the wheel brake. But it is independent of the varying coefficient of friction of wheel brake shoes. If it could be set at a maximum constant value for any condition of rail, it would give a maximum stop up to rail adhesion with a uniform retardation. But as the speed decreases, the power of the brake diminishes, unless the resistance of the brake circuit is correspondingly diminished. It is not practicable, therefore, to consider anything like maximum results for this brake; however, the tests generally show that it is an effective brake for quick stopping. The use of sand to maintain adhesion at its higher values is a necessary adjunct to the brake. A retardation of 4·0 ft. per second can be expected. It is open to the objection of bringing additional work on the motors.

Magnetic Track Brake.—The retardation with this brake

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comes from several features which differ considerably in the different types of the brakes. All have one feature, viz. the friction of the magnetic shoes with the rail. With the Westinghouse brake, the shoes are allowed to "drag" on the rail, and communicate a retarding force through the wheel brake shoes in so doing. In the "Maley Brake" this "drag" is communicated to metal track brake shoes. The British Thomson-Houston Co.'s brake is not fitted with either of the above features.

All types of this brake having motor excitation have a corresponding rheostatic brake action working through the wheels to produce retardation. A hand mechanical attachment to the magnetic shoes can be fitted to any of these brakes. Broadly speaking, the latest pattern of magnetic shoe in general use on bogie cars has a maximum force of application to the rail of 4,000 lb., while that of a shoe as fitted to a single truck car is 2,800 lb. The coefficient of friction of the shoes is not easy to determine. Mr. Fell, who has made such a variety of tests on these brakes, and who has also carried out experiments to determine the coefficient of magnetic shoes on a steel rail, has assumed this at 0·22, which is the value indicated by his tests. Assuming, however, a value of 0·20, we have a retardation force of 3,200 lb. in the case of a bogie car, and 2,240 lb. in the case of a single truck car. These forces are independent of the weight of the car. Taking the weights of the cars as 14·5 tons and 10·5 tons respectively, we get retardations due to the magnets alone of 3·18 ft. per second and 3·06 ft. per second respectively. The rheostatic brake and the wheel brake action combined, or the former alone, as the case may be, should not exceed 50 per cent. of the maximum adhesion of the car wheels, as in other electric brakes acting through the wheels; for the danger of skidding must be avoided, as the whole brake then ceases to act when motor excitation is used, which is almost universally the case. The retardation, then, through the wheels becomes 4·0 ft. per second, or a total retardation of 7·18 ft. per second in the first case, and 7·06 ft. per second in the second case. As the exciting current available for these shoes is largely in excess of that required for saturation throughout the greater portion of the braking operation, it is safe to take the average value of the magnetic force at 90 per cent. of the maximum value. Assuming this figure, the retardations due to magnet shoes alone drop to 2·86 ft. per second and 2·75 ft. per second, and the total retardations to 6·86 ft. per second and 6·75 ft. per second for bogie and single truck cars respectively. The magnetic brake with or without wheel block attachment may be fitted with a solenoid device for controlling the motor field current, and thus eliminating all danger of skidding the car wheels. The advantage that the Maley brake may have over the ordinary form of Westinghouse brake is that the danger of skidding the wheels is reduced. That these brakes are efficient in stopping a car is certain. That they add to the work of the motors is also certain, and, further, they have the disadvantage that faults occurring in an electrical brake are not so obvious as those of a mechanical brake.

The report then passes on to consider the most frequent causes of accidents, which are discussed briefly under the following headings:—Insufficient training of motormen; physical unfitness; the human element; multiplicity of motormen's duties; defective mechanism, and insufficient inspection.

A long section follows entitled "Various Types of Brakes," and describes in more detail all the best-known types of tramway brakes, tabulating their advantages and disadvantages as they appear to the Committee. Regarding the general suitability of different brakes to varying conditions, the following remarks are made:—

The wheel and rheostatic brakes are the simplest and cheapest. They may be relied upon for retardations up to 3 ft. per second with average rail conditions and moderate speeds. For cars not exceeding 10 tons in weight, manual application is suitable for wheel brakes. The rheostatic brake has the advantage of utilising the whole available wheel adhesion independently of speed within the limit of "flashing." The two brakes named are fair alternatives for each other. The retardation stated is suitable for service stops, but is not sufficient for working on heavy gradients or making emergency stops from high speed. On clean rails or with the assistance of sand, greater retardation can be reckoned on, but to make full use of it, especially with heavy cars and high speeds, the time of application of wheel brakes must be minimised by the use of power. The "runback" use of the rheostatic, or rather short circuit, brake is a valuable device where moderate or severe gradients are worked over.

Regenerative control considered as a braking device is equivalent to the rheostatic brake with the addition of definite speed control between certain limits.

The slipper brake with wooden blocks is especially suitable for controlling speed on severe gradients. With manual application it is not sufficiently rapid in action, and is also too exacting on the driver to be used as a service or emergency brake. With power application it becomes a good emergency brake, and only the rapid wear of the wooden blocks is against its use for service purposes. With iron blocks there is little or no advantage in utilising the weight of the car on slippers instead of on the wheels.

The skid brake is a pure emergency appliance, and must be considered as a special addition to the normal braking equipment to meet special risks.

The magnetic track brake applied to the rail-head only has the advantage of rapid and easy application, but it does not afford a great addition to the braking power which is obtainable from wheel brakes under given conditions of rail. It is, in effect, a rheostatic brake of increased power, and may take its place under moderate conditions of service when quicker stopping power seems desirable.

The magnetic track brake with auxiliary blocks applied to the wheels is an extremely powerful brake, capable of giving retardations up to 9 ft. per second, and, therefore, especially suitable where the service demands high speeds with frequent stops amid thick traffic. The magnetic track brake with auxiliary blocks applied to the rail-head is at present in a somewhat experimental state, and is evidently capable of further development, especially in the direction of utilising blocks having a higher coefficient of friction against the rail than the magnetised blocks.

The question of sanding gear is then dealt with in a similar way, and the next section of the report itself sets forth a proposed scheme for the efficient training of tramcar drivers.

The general conclusions of the Committee are summarised at the end of the report as follows:—

All cars should be fitted with two brakes. Where quick and frequent stops are necessary (the usual conditions of urban lines), one of these should be a power brake. Where traffic is light and the maximum speed low, both types may be manually applied, but where steep gradients exist, only one of these should be dependent on wheel adhesion. The combination of wheel and slipper brakes accompanied with a regulation for a compulsory stop for the application of slipper brakes before descent of a severe gradient, meets this condition.

The power brake when fitted should be the service brake, as quick application and release are essential features in a service brake, and as full retardation can be obtained without the exercise of great physical effort. The power brake best suited to the general requirements is one which will give a powerful and easily moderated force for ordinary service stops, and which can apply, when necessary for emergency stops, a force equal to half the car weight instantaneously and continuously to slipper blocks. Where a magnetic track brake is in use on very steep gradients, an attachment for manual application is recommended.

In regard to the best position of brake blocks on wheels, there are practical difficulties in carrying these above the horizontal, and the Committee fail to see that there is any advantage in such a position. The most important point is the stiffness of the brake hanger. The links should be so arranged as to prevent the brake blocks from lifting. The methods of adjusting brake blocks in some cases are rather crude, and require improvement. In many instances the trucks used under the cars are mechanically weak in design, and are unsuitable for cars run at high speeds where powerful brakes are necessary.

Motormen should not be allowed to adjust the brakes of a car when in service. On all tramway systems there should be a man responsible for the state of the brakes on every car, and a frequent and systematic examination of all brakes should be made.

The power of all brakes being dependent upon the condition of the rail, the sanding apparatus should be absolutely reliable. On steep gradients the rails should be kept clean and sanded. There should be two sand boxes at each end of the car. Curved sand pipes should be avoided. Sand should be sharp, clean, and dry.

All motormen should be medically examined on engagement, and re-examined at intervals of not less than five years. A course of training is recommended, and motormen should be periodically re-examined in their work.

On narrow gauge lines, having sever gradients and sharp curves, the use of double deck cars, especially with top covers, is inadvisable.

Particulars of a very large number of tests are contained in appendices to the report.

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ACYCLIC GENERATORS

A GOOD deal has been written both for and against the adoption of acyclic, or, as they are sometimes designated, unipolar or homopolar machines, for some classes of continuous-current work, and an article by Mr. J. E. Noegerath, in the *Electrical World* (New York), is of interest as giving some particulars of what has actually been done in the construction of machines of this class. The machines referred to have been built by the General Electric Co., and have all been in commercial operation for at least eight months. They include a 6-volt 8,000-ampere machine running at 1,200 r.p.m., forming part of a motor generator, a vertical shaft steam turbine-driven 2,000-kw. generator, for working simultaneously at 200, 250, 300, and 600 volts for electrolytic purposes, and an experimental acyclic direct-current auto-transformer, capable of converting from 125 volts to 6·25 volts, and multiples thereof, and *vice versa*. The latter machine is probably the first acyclic machine that ran as a motor, and the first direct-current rotary auto-transformer. An illustration is also given in the article of two 500-kw. turbine-driven acyclic generators supplying energy to a three-wire, 600-volt system, having a combined lamp and motor load.

The principle underlying these machines is shown diagrammatically in Fig. 1. The main factor influencing the design is

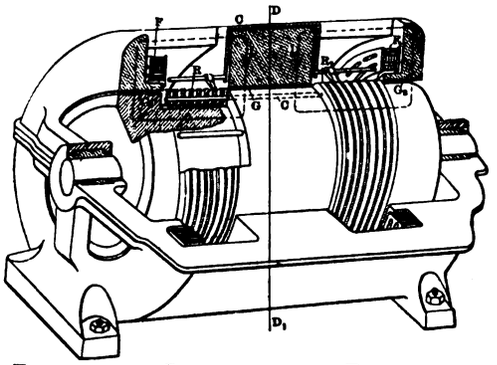

FIG. 1.—DIAGRAMMATIC SKETCH SHOWING PRINCIPLE OF ACYCLIC GENERATOR.

high peripheral speed. While this may appear at first glance to be a great disadvantage, embodying such problems as the collection of current at speeds up to 25,000 ft. per minute, high centrifugal stresses, and so on, it has been the endeavour to benefit rather than to lose by these extreme conditions.

Investigation covering a wide range of conditions have served to show that at high speeds the losses due to the collection of current do not increase appreciably with increasing speed, provided the windage is kept within limits, while, on the other hand, the excellent ventilating facilities reduce the required cooling surfaces. Moreover, the high speeds permit of very simple connections on the revolving conductors, where excellent contacts are guaranteed by the centrifugal force making it even possible to do away entirely with soldered contact on the revolving parts.

The stationary frame consists of solid steel castings of a cylindrical shape having two rows of large openings and two rows of small openings; the large openings are used for the inspection of the collecting system and the small ones carry off the hot air which is thrown out between the collector rings. The air is guided from the collector rings to these small openings by means of deflectors. The size of the small openings is determined, on the one hand, by the current output of the unit (size of the brushes), and, on the other hand, by the core losses. The stationary conductors are fastened on the outside of the frame, and the whole winding is so arranged that by changing these few frame conductors the voltage rating of the generator can be changed without affecting the kilowatt output. The efficiency of the material of the field coils is high because of the excellent ventilation possible, the copper being cooled by fresh air received directly from the armature, as is apparent in Fig. 2. The field-winding spools on the vertical machines are suspended from keys inserted in the frame. Special coils are used at the bearing for the purpose of counteracting the stray fields, which tend to convert the shafts into small acyclic generator armatures. The heavy currents which otherwise would be produced therein would be short-circuited through the bearings and tend to destroy them. However, this action is effectively neutralised by the auxiliary coils.

The main features of the armature spider are that all of its material carries flux. It is a solid casting, well ventilated, and of simple construction. It carries no binding wires or bands of any kind. The air for ventilation enters at the ends through axial ducts, and is led into a cylindrical chamber, from which the radial ducts propel it outward. The cylindrical reservoir is formed by a division of the armature spider into two castings which are separated for a distance under the collector rings.

On horizontal machines there is provided an adjustable ring assembled on the outside of the armature spider, and arranged so that the gap between this ring and the stationary part can be adjusted, thereby obtaining a perfect balance of the magnetic side pull. Instead of this arrangement a stationary ring can be used.

From the point of view of an armature-winding department no winding is used on the armature. If the importance of electrical design with regard to core losses and armature reaction are properly taken into account, and the distances between the adjacent conductors and between the conductors and the air-gap are properly selected, there can be used as armature conductors studs insulated by tubes of suitable material. In some instances the armature conductors form part of the collector studs, while in others they are separate.

Various different methods can be used for the support of the collector rings. In larger machines, where the axial expansion of the collector rings comes more prominently into action, the design shown in Fig. 2 is used. The supports, *A*, have flanges, *B*, which are elastic and of such proportions that they give rigid support to the weight of the collector rings, but are sufficiently flexible to allow of bending when put under the strain which occurs, because, when operating, the axial expansion of the collector rings is greater than that of the shell on which the collectors are mounted. The collector rings form a unit with the collector shell, and the collector studs. It has been found that copper brushes wear away with too great rapidity at the high peripheral speed, and a more durable form of brush of two special metals has been developed. The number of brushes used on a 2,000-kw. 300-volt generator is 96.

In the actual running of these machines they have been found to resist damage under short circuits exceptionally well, as the only limits are thermal, and the machines are of large heat capacity. It is stated that the voltage regulation under sudden changes of load is better than with ordinary machines, as changes in the flux, in the solid castings of which the machines are composed, are sluggish.

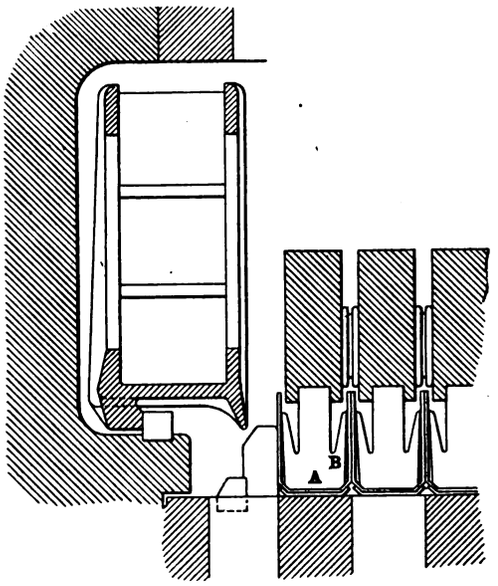

FIG. 2.—FIELD COILS AND COLLECTING RINGS OF ACYCLIC GENERATOR.

The field of application is in a general way conditioned more by the drive and the voltage than by the character of the service; that is, very small units can be built commercially only for low voltages, while for large units voltages higher than common direct-current practice prescribes can readily be obtained. There are, however, other conditions which may be favourable to the design, such as the necessity for a wide range in voltage, or a high flywheel effect, &c. In any event, it is

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essential for the prime-mover to be a high-speed machine, whether it be a steam turbine, a water wheel, or an electric motor.

It is to be regretted that no particulars of weights are given in the article, as it has been argued by some that the weights and corresponding cost of these machines would be commercially prohibitive.

ELECTRICALLY-DRIVEN BRASS AND COPPER ROLLING MILLS

A PAPER was read on this subject before the Birmingham Association of Mechanical Engineers on Saturday last by Mr. C. A. Ablett, of Messrs. Siemens Brothers' Dynamo Works, Ltd.

In the first part of the Paper, the advantages of converting a steam mill to electric driving were pointed out. The advantages claimed were:—(1) economy of working; (2) saving in space; (3) greater output from existing plant; (4) great reliability and freedom from breakdown; (5) easy extension; (6) easy measurement of power taken.

With regard to saving in space, the author stated that assuming the supply to be obtained from the Corporation H.T. mains, the saving in space for a 500 h.p. plant would amount to 2,000 square feet if electricity be used in place of steam, and that such space could be used for 8 or 10 additional rolls. An increased output of 20 per cent. was mentioned as being the result obtained by the introduction of electric motors owing to the steady and uniform speed obtained. In order to check the power used by a mill it was recommended that an indicating ammeter, calibrated in h.p., should be supplied with each motor, as well as an integrating meter for all large motors and separate departments. In this way careful records can be kept of the units required per ton rolled.

The second part of the Paper was taken up with a description with diagrams of the transformers, motors, and switchgear, &c., which would be required for a mill taking its supply from the 5,000-volt mains of the Birmingham Corporation. The author recommends that motors of 100 h.p. and upwards should be run direct off the 5,000-volt mains, and thus save transformation losses. Liquid type starters were recommended for large motors, and views of several, including one for 1,000 h.p., were shown on the screen.

The rules of the Birmingham Corporation require that no fluctuation of current shall take place which corresponds to more than 25 amperes in the H.T. circuit; this represents a fluctuation of approximately 250 h.p. The author showed how the peaks can be very greatly reduced by the provision of a flywheel, the necessary change of speed being obtained by means of a slip resistance in the rotor circuit of the motor, the slip resistance being either permanently in circuit or else automatically inserted as the current increases.

A detailed comparison between the steam and electric drive was then made, in which the great overload capacity, the high efficiency over a wide range of load, and the ready response to varying demands for power of the electric motor, was well brought out. The Paper concluded with some remarks on the connecting up of motors to various types of rolls, by ropes, belts, and spur gearing.

The author gave some interesting details, illustrated by lantern slides, of some typical electrically-driven rolling mills. Perhaps the most interesting of these is a large reversing cogging mill in Germany, driven by a 7,000 h.p. motor. This mill rolls ingots of about 23 inches square section, and 5 tons weight. The rolls are 35½ inches diameter, and the mill turns out 60 tons per hour, and runs at 60 r.p.m. The motor can be reversed from 60 revs. in one direction to 60 revs. in the other direction, 28 times per min. This motor is supplied with power from an Ilgner converter set, driven by a 1,300 h.p. motor running at from 340-450 r.p.m., and although the power of the rolling motor is continually varying from 0-7,000 h.p., the power taken from the generating station is maintained by the converter set at the steady value of 1,300 h.p.

The discussion was opened by Mr. R. A. Chattock (Chief Electrical Engineer, Birmingham Corporation), who stated that 4,000 h.p. of rolling mill motors would be connected to his mains by the end of the present year. Mr. Chattock said that in the case of one mill, the drop in engine speed used to amount to 50 per cent. on heavy loads, whereas since the introduction of electric motors the drop had never exceeded 5 per cent. As regards cost, the figures obtained from several recently-converted mills proved that the electric drive was from 10 per cent. to 30 per cent. cheaper than the old steam drives.

A large number of members took part in the discussion, amongst whom were several rolling mill managers; most of these gentlemen bore testimony to the superiority of the electric drive, but it was stated that unless current could be supplied at a lower price than ¾d. per unit there was no economy over the steam drive.

THE FIRE ON THE METROPOLITAN RAILWAY AT SWISS COTTAGE

Board of Trade Report

MAJOR PRINGLE'S report to the Board of Trade on the slight fire which took place on October 6th in a passenger train at the Swiss Cottage station of the Metropolitan Railway has now been issued. The cause of the fire is shown to have been non-electrical, and due to the proximity of a lighted lamp to certain vessels in the train containing naphtha. At the conclusion of the report Major Pringle calls the attention of the company to the following matters:—

(*a*) The inadvisability of conveying naphtha, or naphtha lamps, in passenger trains, especially on the underground sections of their system.

(*b*) Where it may be absolutely necessary to do this, I suggest that, in addition to the precaution prescribed by the rules of having someone travelling in charge of the spirit, the luggage compartment should be ventilated as freely as possible, by having the side doors left open.

(*c*) In the case of a fire occurring in an underground station, all passengers should be hurried out of the train, and out of the station, and should not be permitted to return until all danger from fire or smoke is over.

(*d*) No extincteurs are, I understand, carried on passenger carriages. Although these may not be of great utility in the case of electrical fires, they have been proved effective, if used early enough, in the case of ordinary fires, and on this account should, in my opinion, be carried.

(*e*) It is to be regretted that the company have not made more use of non-inflammable woodwork and materials in the construction of their electric cars. For example, it would be possible to line luggage compartments with metal instead of soft wood, to provide asbestos millboarding to the single deal roof, and to render the interior fittings of passenger compartments, panels, seats, &c., less combustible by submitting them to some protective process. The elimination of wooden platforms in underground stations is also very desirable. These are all matters dealt with in the Requirements of the Board of Trade for new underground electric railways, and call for due consideration by the company.

In this connection the following notes on the construction of the cars, taken from the earlier portion of the report, are of interest:—

The car was divided into three parts by partitions. In front was the usual motorman's cab; in rear of this a luggage compartment, about eight feet in length, and of the full width of the car; the remainder was fitted on each side with the usual upholstered seats for third-class passengers. The floor of the car throughout is made of iron sheeting. All round the outside of the body, steel panelling is fixed between the floor and the level of the windows sills. In the passenger portion of the car there is a coating of cement to the flooring. The window frames and inside lining are of oak, and there is a double deal roof with an inside lining of asbestos millboard. The seats have steel frames covered with stuffing and upholstering. In the luggage compartment oak battens, spaced at intervals, are screwed to the iron floor. The inside lining is of deal with oak framing, the roof being single of bare pine. The doorway leading into the passenger compartment is solid oak. The motorman's cab is lined, roof and sides, with uralite. None of the timber-work, upholstering, &c., had been rendered non-inflammable by any treatment.

Machine Tools.—Messrs. Drummond Brothers, Ltd., of Guildford, inform us that they have just received a large order for the motor repairing works of the Morvi State, India. Included in this equipment are two special motor repairing lathes, one of the medium light type, 5 in. self-acting, sliding, boring, surfacing, and screw-cutting lathes, and one of the firm's new heavy high-speed all-geared head, self-acting, sliding, boring, surfacing, and screw-cutting lathes, this latter tool being fitted with quite a novel form of turret, which, when affixed to the saddle, converts the lathe into a full self-acting Hexagon turret lathe, capable of rapidly producing any work required in quantities, such as standard bolts, studs, pins, &c., which cannot be quickly procured up-country in India.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Nov. 5th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1907 Patents

22,756. **Train Lighting.** E. M. PRESTON AND A. E. KENNARD. (J. STONE & Co., LTD.). This specification describes an improvement in the system of train lighting developed by this firm, which causes the correct connections to be made between dynamo and battery when the train is started, irrespective of the direction of travel. This is effected by the use of a loose brush-rocker, the friction between brushes and commutator being utilised to move the rocker to one side or the other, according to the direction of rotation. By this means alternate contacts are opposed to the contacts on the centrifugally operated switch, with different directions of travel. In the case of a double-battery system, the brush rocker also operates a change-over switch. Seven claims, eleven figures.

23,138. **Series Transformer System.** A. F. BERRY. In the alternating-current distribution system, known as the "Berry" series transformer system, and described in ELECTRICAL ENGINEERING, Vol. III., page 197, a small transformer for light loads is short-circuited when the load on the same is large enough to be taken up by the main transformer. The present invention consists of a method of protecting this small transformer from overload (when the automatic change-over device fails to act), by suspending a silk thread over the high-tension fuses. When this is destroyed, owing to the heating of the fuse, a weight or lever is allowed to fall and cause the transformer to be short-circuited. Four claims, two figures.

23,148. **Multiple Carbon Flame Arc Lamp.** JOHNSON & PHILLIPS, LTD., AND C. F. TUBBS. A flame arc lamp, with two or more pairs of carbons burning simultaneously, is described in this specification. The arcs are arranged in series, and the upper carbons, which rest on stops, are fed forward by gravity. Each carbon holder is suspended by means of a flexible cord over a pulley, and the separate pulleys are mounted on rocking frames which are linked together by an equalising device to compensate for unequal burning of the carbons. Three claims, six figures.

23,224. **Single-phase Traction System.** V. A. FYNN. This is a system of electric traction in which the single-phase current collected from the overhead conductor is converted into two- or three-phase current by means of a motor generator. Asynchronous motors are used, and speed variation is obtained by the insertion of resistance in the rotor circuits, or by cascade or pole-changing connections. Resistance is also inserted at starting. A number of modifications of the system, and various methods of improving the power factor are also described. Eighteen claims, seven figures.

23,774. **Cable or Wire Connector.** P. GRAETZER. A connector for cables or wires is described in this specification. It consists of a casing closed at one end, and internally conical towards the other end, which is perforated to admit the wire. A tubular internal piece, into which the wire enters, is pushed towards the narrow end by means of a spring, and metal balls inserted in perforations in the sides of this tubular piece, grip the contained wire. To release the wire, the internal piece is drawn to the wide end of the casing, which operation releases the balls. Six claims, thirteen figures.

1908 Patents

1,546. **Armature Windings for High Speed C.C. Machines.** THE PHŒNIX DYNAMO MANUFACTURING CO. AND R. POHL. This invention relates to the mounting of the end connections of the armature windings of high-speed continuous-current machines, in which connections are brought from the armature winding, through the centre of the armature core, to additional segments of the commutator, in order to decrease the voltage per segment. The commutator end is to some extent imitated at the other end of the armature, in that lugs are brought down from the main armature bars to a number of insulated segments, clamped together by conical end rings. The auxiliary bars below the core are also connected to these lugs. The equalising rings may be arranged close to the segments, and may be connected to the lugs by short bars. To produce a cooling draught the lugs may be arranged as fan blades. Six claims, five figures.

5,387. **Manufacture of Metal Filament Lamps.** A. G. BLOXAM. *(Siemens & Halske Akt.-Ges.).* According to the process described in this specification, compound filaments, consisting of an internal core of tungsten or other non-ductile metal, surrounded by a skin of ductile metal, after having been drawn down to the required diameter, are extended on the supporting frame, and fixed to the leading in wires. The whole is then inserted into the lamp bulb, and the bulb is connected to the exhaust pump. By raising the filament to incandescence, the volatile outer skin is distilled off, and the tungsten core only remains. Any deposit is cleaned away with acid. Two claims.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

22,667, BROWN. Lifts or hoists.
22,719, BOULT (*Woodbridge*). Switchgear.
22,850, NALDER BROS. & THOMPSON, LTD., & NALDER. Indicating thermometers.
23,144, LOTZ. Transformers and converters.
23,145, COWPER-COLES. Apparatus for purifying electrolytes.
23,215, DEUTSCHE BECK-BOGENLAMPEN GES. Electrodes for arc lamps.
23,280, GARRARD & FERRANTI, Ltd. Protective devices.
23,429, GROTE, & FOSTER ARC LAMP AND ENGINEERING CO. Electrodes for arc lamps.
23,432, BERRY. Alternating-current distributing systems.
23,441, VON NIKOFOROFF. Means for amplifying feeble currents applicable to telegraphy and telephony.
23,449, BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) Circuit breakers.
23,609, LAKE (*International Telemeter Co.*). Signalling systems.
24,096, SCHOOP. Welding aluminium.
25,026, COCKSHOTT & MALEY. Magnetic brakes.
25,272, EVANS (*Allgemeine Elektricitäts-Ges.*). Electric welding.
26,179, LE TALL (*Lederer*). Manufacture of hollow metal filaments.
28,595, MITCHELL. Brake for tramcars.

1908 Patents

286, EISENSTEIN. Wireless telegraphy or telephony.
880, BOULT (*Benjamin Electric Manufacturing Co.*). Lamp sockets.
1,770, BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). Dynamo-electric machines.
3,891, STRANGE. Rotary floor surfacing, scrubbing, and polishing machines.
4,847, WAELDE. Insulating composition.
7,563, RICHARDSON. Construction of steam turbines.
7,930, EBNER. Ignition devices.
8,895, HOLDEN. Electrical firing mechanism for breech-loading guns.
8,968, SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*). Electrical control of railway points.
9,128, GRIMLER & NEYLAND. Flexible lamp stands.
9,962, PEGLEY, PEGLEY, & GRIFFIN. Tram rails.
11,119, BACHTEN & GALLAY. Lighting dynamos for motor cars and other vehicles.
11,330, BRENTA & HOOSEMANS. Combined motor-driven band saw, roughing, and planing machine for wood.
11,600, RITTERSBERG & RUBERT. Filaments of Chinese ink for electric lamps.
13,761, GHILARDUCCI. Electrostatic machines for Röntgen rays, electro-therapeutics, and wireless telegraphy.
14,480, HOLMES & ALLEN. Trolley-heads.
14,667, SCHEING & HOFMANN. Rail joints.
15,079, ARON & GEIGER. Method of decarbonising filaments for metal filament lamps.
15,262, Firm of ROBERT BOSCH. Ignition apparatus for large internal-combustion engines.
16,534, COOLIDGE. Manufacture of refractory conductors.
16,775, HÄGI. Pedestal or socket for poles carrying electric conductors.
17,456, GRAETZER. Insulating and gripping devices for electric conductors.
18,755, ZAHRINGER. Magneto-electric ignition apparatus.
19,501, EBNER. Condenser for electric ignition apparatus.
19,891, SIEMENS BROS. DYNAMO WORKS, Ltd., & KIEFFER. Commutator cooling methods.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

21,667, MARTINI. Suspending and projecting device for incandescence bodies with extensible sleeve ring.
21,761, ALLGEMEINE ELEKTRICITÄTS-GES. Device for cooling commutators by means of wing-like projections on the segments.
21,826, PETERSEN. Suspended railways.
21,957, FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. Transporting apparatus.
21,959, MOSCICKI. Apparatus for producing oxides of nitrogen.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. 1907	DIVIDEND PAID. 1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9½—10	
Do. 6% Cum. Second Pref.	10	6	6	10⅝—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	4½*	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98 xd	
Brompton & Kensington E. S. Co., Ld.	5	10	5½*	6¼—7⅜	−¼
Do. 7% Cum. Pref.	5	7	7	6¾—7⅜	−¼
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½	3¾—4⅛	
Do. 4% Deb. Red	Stock	4	4	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½	3⅜—3⅞	+⅛
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	2⅝—3⅜	
Do. 4½% Deb. Red	Stock	4½	4½	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6	9⅛—9⅞	−⅜
Do. 6% Cum. Pref.	10	6	6	12—13	
Do. 5% Deb. Red	Stock	5	5	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3½—4	
County of London Elect. Sup. Co. Ltd.	10	5		7—8	
Do. 6% Cum. Pref.	10	6	6%	10¼—10¾	
Do. 4½% Deb. Red	Stock	4½	4½	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	97—100 xd	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅝—¾	
Do. 6% Cum. Pref.	5	—	—	¾—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—66	
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	88—91 xd	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7⅛—8⅛	−¼
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N'Tng Hill E.L. Cos. Db. Rd.	Stock	4	4	96—100	
London Electric Supply Corporation	3	2½	—	⅞—1⅜	
Do. 6% Pref.	5		6	4¾—4⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¼—4½	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—4⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	84—89	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	5½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	94—97	
Newcastle-upon-Tyne Elec. Supply.	5		2½%	4⅞—5⅜	
Do. (fully paid)	4	8	2½%	3⅜—4½	
Do. 5% Pref. Do.	5	5	5%	5—5½	
Do. Do.	4	5	2½%	3⅞—4⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5¾—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	7¼—8¼	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	¼—⅜	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2¼—2⅜	
South Metropolitan E. L. & P. Co.	1	2½	—	⅞—⅞	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5%	¼—1	
Do. 5% Cum. Pref.	5	5	5%	1¾—2¼	−⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	7⅞—8¼	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3%*	68—70	
Do. 4% Preferred	Stock	4	4%	86—88	
Do. Deferred	Stock	2	—	50—53	+1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross. Eust. & Hamp. Pp. Db.	Stock	4	4%	85—87	
City and South London Cons.	Stock	4½	1½%	32½—33½	
Do. 4% Perp. Deb.	Stock	4	4%	98—101 xd	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	¾—1	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	7¾—8¼	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	½	½%	37—38	−1½
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—78	
Metropolitan District	Stock	—	—	12¼—13½	−1
Do. 6% Perp. Deb.	Stock	6	6%	123—125	−1
Do. 4% Deb.	Stock	4	4%	82—86	
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—28	−1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	52—57	+2
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	91½—92½ xd	−1
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅜—⅝	+1/16
Do. 5% Cum. Pref.	1	5	—	1/16—1⅛	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93 96	
British Electric Traction Co., Ltd.	10	—	—	⅞—1½	
Do. 6% Cum. Pref.	10	6	6%	3½—4	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	+1
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75 xd	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4½	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. 1907	DIVIDEND PAID. 1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	12¼—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Street Tramways Co.	4	4/6	2½%	⅜—⅞	
London United Trs., Ld., Cm. Pf.	10	5	—	½—5⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—75	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	½—⅝	
Do 3½% Mort. Deb.	100	3½	3½%	95—100	+8
Potteries Electric Traction Co. Ltd.	1	4	—	¼—¼	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	92—95	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜—5⅛	
Do. 6% Cum. Pref.	10	6	6%	9¼—10½	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	77—81	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1⅜	
Do. 6% Cum. Pref.	5	—	—	2¼—3⅜	−⅛
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	8½%*	57—60	−1
Do. 6% Pref. Ord.	Stock	6	6%*	102—103	
Do. Def. Ord.	Stock	1	—	17½—18	+1
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	88½—90½	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3¼	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13¼—13⅜	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	99½—102½	
Do. do. (Mauritius Sub.)	25	4	4%	99½—101¼ xd	−2
Eastern Ext. Australasia & China	10	7	5%	12⅜—12⅝	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½%*	135—138	
Do. 3½% Pref.	Stock	3½	3½%*	84—86	
Do. 4% Mort. Deb.	Stock	4	4%	103¼—105½ xd	+1½
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	56—59	−1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅞—1⅛	+
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	117—119	
Do. 6% Cum. 1st Pref.	10	6	6%	10¼—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	102—104	
Western Telegraph Co., Ltd.	10	7	6%*	13½—14	
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	7/32—11/32	
Do. 6% Cum. Pref.	1	6	7%	1/16—1/8	
Babcock & Wilcox, Ord.	1	20	16%*	34½—81/8	
Do. 6% Pref.	1	6	6%	1¼—1⅝	
British Insulated & Helsby Cables, Ltd.	5	10	8%*	6¼—6⅜	
Do. 6% Cum. Pref.	5	6	—	6—6⅞	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	+1
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	+1/8
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	—	
Do. 6% Pref.	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9¼—10¼ xd	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅛	
Do. 6% Cum. Pref.	1	6	6%	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	—	⅝—13/16	
Do. do. (fully paid)	5	4/2	—	1¼—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	1⅛—1⅛	
Do. 7% Cum. Pref.	2	7	—	1¼—1½	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7—7⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16¼—17½	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	¾—1	
Do. 6% Cum. Pref.	5	6	8/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	72—76	

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ELECTRICAL EQUIPMENT OF A LARGE STEEL WORKS

A DESCRIPTION is given in the *Electrical World* (New York) of the equipment in course of erection at the new steel works of the Indiana Steel Company, at Gary, Indiana, which is a fine example of a large steel works using electrical power entirely derived from gas engines driven by blast-furnace gases. When complete the works will comprise 16 furnaces. Very complete arrangements are made for removing dirt from the gas which passes necessarily through two dry-dust catchers, two water "scrubbers," and a Thiessen rotary washer.

The sixteen blast furnaces produce about 44,900,000 cu. ft. of gas per 24 hours, equivalent, when used in gas engines, to 500,000 b.h.p. Of this quantity approximately 30 per cent. is taken for heating the hot-blast stoves, 7½ per cent. is diverted to steam-boiler furnaces, 5 per cent. is consumed by various auxiliaries or lost in the process of cleansing, 12½ per cent. operates the gas-engine-driven blowers, and 45 per cent. supplies the electrical power station.

In the power station, which is 966 ft. long and 105 ft. wide, are installed 17 horizontal, twin-tandem, double-acting gas engines, running at a speed of 83⅓ r.p.m., 15 of which are designed for coupling to alternating-current generators and two to be connected to direct-current generators. The former are 25-cycle, three-phase, 2,300-volt machines, and the latter deliver current at a pressure of 250 volts. The engines have a rating of 4,000 h.p., and the generators are rated at 2,000 kw., but they are capable of carrying continuously 30 per cent. overload. The 17 units were built complete by the Allis-Chalmers Company. The gas engines are said to be the largest in the world to operate on blast-furnace gas. The floor space occupied by each engine is 70 ft. × 44 ft. The cylinders are 44 in. × 54 in. stroke, the crank pins are 20 in. in diameter, the shaft is 30 in. in diameter in the bearing, and the fly-wheel is 23 ft. in diameter, and weighs 200,000 lb.

The electricity generated will be distributed throughout the works and used to operate the heavy induction-motor-driven rolls, some of the motors for which are as large as 6,000 h.p., the tilting and feed tables for the various passes, the hot saws, hot and cold pull-ups, hot rolls, transfer tables, straightening and drilling machines, cold saws, elevators, conveyors, pumps, and other machinery. In order to deal with variations of load and to take advantage of as much of available power in the gas at all times, a large battery installation has been put in. The control of the battery charge and discharge in respect to the 250-volt direct-current bus-bars is effected by means of two motor-driven boosters, the field excitation of which is controlled by a carbon regulator with its solenoid in series with the total output of the direct-current generators. The fluctuations of load on the alternating-current circuit are transmitted to the battery by means of a split-pole converter designed to hold the constant alternating-current voltage while permitting a sufficient range of direct-current voltage to cause the battery to charge from or discharge into the alternating-current circuit through the converter. The field control of this converter, to effect this variation in direct-current voltage, is accomplished by a special alternating current-direct current exciter, which corresponds to the energy component of the alternating-current output from the alternators.

The motor equipment in the various mills is very extensive. In the open-hearth buildings the travelling and fixed cranes are electrically operated. There is a 125-ton crane in the casting department and another in the charging side, and the ladles used in pouring off are rated at 80 tons. The rail mill is equipped with 12 sets or stands of roll trains, all operated at varying speeds by General Electric alternating-current motors, some of which are of the largest sizes ever constructed for industrial service. These are housed in a separate bay, running parallel with the rolls. The rotors are 20 ft. in diameter, and have a speed of 83 r.p.m. All of the motors are connected directly to the roll trains by regular mill coupling. The aggregate driving capacity is 24,000 h.p. Although the motors are provided with fly-wheels and operate in one direction, provision is made for reversing in case of necessity. The control system has been worked out with the greatest nicety, all operations being under the instant control of the operator by means of a master controller.

In the rail mill a number of Cutler-Hammer automatic remote-control devices are installed, the most interesting of which are those designed for the control of the elevating and tilting tables, the bloom shear and the transfer. The elevating table on the 48-in. blooming mill, weighing about 250,000 lb., is supported on bell cranks which are connected to a rotating crank driven by a 250-h.p. motor running at 150 r.p.m. By means of automatic controlling devices the movement of a master lever starts the table from the low-level position and raises it to the highest level, where it is automatically stopped. In lifting the table from the low to the high level, the rotating crank moves through an arc of 180°, and, on throwing the master lever to the reverse position, the crank revolves another 180° in the same direction, bringing the table to the low level once more. The operation of raising or lowering the table can be accomplished in a period of two seconds, which is quite remarkable when the masses to be accelerated, slowed down, and stopped are considered. Its arrangement is similar to that of the elevating table, one end being pivoted and the other end supported on a bell crank. The tilting table is driven by a 150-h.p. motor controlled by a controller similar to that designed for the elevating table.

Automatic controllers installed in connection with motors on the transfers make it possible for the operator to transfer the rail from one table to another by a simple throw of the lever, the motor being automatically stopped after the transfer has been completed. For the operation of cranes, tables, and other apparatus, in and about the rail mill, requiring direct current, two 500-kw. synchronous motors driving direct-current generators have been installed.

LOCAL NOTES

ABERDEEN: *Trackless Trolley System.*—The possibility of the trackless trolley for certain outlying districts, is being considered in Aberdeen. The Tramway Committee have before them a report of the recent Manchester deputation which visited the Continent.

AMBLE: *Electric Lighting Order.*—The Board of Trade have revoked the Amble Electric Lighting Order of 1902.

AUSTRIA: *Electric Power Supply.*—A Reuter telegram from Vienna states that some English, French, and Hungarian capitalists have combined to build an electric power station at Fiume with a capacity of 36,000 h.p. to supply Abbazia, Fiume, and the Dalmatian towns with electric power and light. The cost of the installation is said to be about £1,000,000.

BACUP: *Tramways.*—Considerable progress is being made with the construction of the tramway system, most of the track work having been completed.

BATH: *Purchase of Electric Light Works.*—The special sub-committee which has had in hand the negotiations with Mr. Schenk for the purchase of the municipal electricity undertaking, has reported that satisfactory information has been provided as to the constitution and arrangements for capitalisation of the Bath & District Electric Supply Co., and also as to the local representations on the board of directors of the company.

BOMBAY: *Tramway Company.*—An additional 1,000 kw. turbo-generator is being installed by the Brush Electrical Engineering Co. The Brush Co. is also building a new power station for the Tramway Co. at Kussara.

BO'NESS: *New Generating Plant.*—An additional 300 kw. generating set, together with the necessary switchboard additions, was put into operation by the National Electric Construction Co. last week.

BRADFORD: *Fog Signalling on Tramways.*—Major Pringle will shortly visit Bradford in connection with some apparatus invented by Mr. C. J. Spencer, for use upon the tramways in foggy weather.

BRUSSELS: *International Exhibition.*—An International Exhibition is to be held at Brussels during the year 1910. The exhibition will be of an official character, and will receive the support of the Belgian Government, being under the control of the Belgian Department of Industry and Labour. The company formed for the financial and commercial arrangements has a capital of £106,000 divided into 2,650 shares of £40 each. His Majesty's Government, as well as those of France, Germany, the Netherlands, Spain, Italy, Greece, Persia, Bolivia, the Dominican Republic, Haiti, the Republic of Ecuador and Peru, have already decided to participate officially in the exhibition, and it is also hoped that the Governments of other European nations will join the movement.

BURSLEM: *Electric Lighting Charges.*—A good deal of discussion has been taking place in consequence of certain remarks by the Local Government Board inspector recently regarding the scale of charges now in force for the electricity supply. The Electricity Committee now recommend "That the question of the scale of charges for electricity be deferred until the decision

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of the Local Government Board on the recent application for sanction to a loan had been received, and that a special meeting of the Committee be held as soon as such decision has been received."

CAMBERLEY: Electric Lighting.—With reference to the proposal of the Aldershot Gas Co. to apply for a Provisional Electric Lighting Order for this district, the local Chamber of Commerce has passed a resolution urging the Council to apply for such an Order itself.

CHATHAM: *Noisy Tramways.*—Complaints have been made to the Chatham and District Light Railway Co., with regard to the noise of their cars on curves. The Company reply that the only way in which this noise can be moderated is by increasing the radii of the curves.

CHICHESTER: *The Electrical Undertaking.*—A commencement has been made with the laying of mains by the Chichester Electric Light & Power Co.

CHRISTCHURCH (N.Z.): *Tramway Receipts.*—It is stated that the loss to date from April 1st, the commencement of the financial year, upon the municipal tramways system, is £309.

DOUGLAS (I.O.M): *Electric Tramways.*—The question of electrifying the Douglas Bay Tramways is to be put before the Council at an early meeting.

DUBLIN: *Electric Lighting Loan.*—A loan for £15,000 has been arranged with the National Association Friendly Society at 3¾ per cent., repayable in 30 years, for electric lighting purposes.

DUDLEY: *Purchase of Tramways.*—A sub-committee has been formed to consider the negotiations for borrowing the money for the purchase of the tramways. The Corporation will promote a Bill next session for carrying out the proposed arrangements with the British Electric Traction Co., and for confirming the proposed lease.

ECUADOR: *Telephone and Telegraph Systems.*—An American Consular report states that a telephone service is maintained in the city and suburbs, with long-distance connection with Guayaquil and other cities of the Republic. The long-distance service to Guayaquil is being reconstructed with modern equipment, and it is also reported that the city service will, at an early date, be replaced with new and modern telephones.

ELLAND: *Tramways.*—The West Yorkshire Tramways Co., which hold Parliamentary powers for constructing tramways between Halifax and Huddersfield, viâ Elland, have reported to the Council that the delay in commencing the construction is due chiefly to the disturbed state of the money market. The whole of the debenture capital, however, is now assured, and a considerable portion of the share capital also, but until the whole of the share capital has been either underwritten or subscribed, it was out of the question for any start to be made. The company has already expended £10,000 upon the project, and assure the Council that it will not be allowed to lapse.

ERITH: *London Power Bills.*—The promoters of the London & District Electricity Supply Bill have communicated with the Council, stating the terms upon which they would be prepared to enter into a contract for a supply of electrical energy in bulk. The Electrical Engineer has reported upon this offer, and the Electric Lighting and Tramways Committee now report to the Council that they think the proposal will be beneficial to the district.

GATESHEAD: *Tramway Receipts.*—The total receipts of the Gateshead & District Tramways Co., from January 1st, 1908, to date, amount to £43,818 against £43,665 for the corresponding period of 1907.

GILLINGHAM: *Wiring and Fitting.*—A sub-committee has under consideration the question of wiring and fitting houses let on a weekly tenancy.

GLASGOW: *Tramways Receipts.*—Since the commencement of the financial year on June 1st, the number of passengers carried on the Corporation tramway system is 93,531,344, and the receipts £380,553, against 95,545,097 and £387,029 respectively for the corresponding period of last year.

HANWELL: *Condition of Tramway Track.*—On behalf of the Board of Trade, Col. Yorke has inspected the track of the London United Tramways Co. in Hanwell. Col. Yorke has come to the decision that there are defects in the system, and would report that it was in a bad condition, and that certain repairs had been hurriedly carried out before his visit.

HASTINGS: *Sunday Trams.*—At the last meeting of the Corporation it was decided, in deference to the strongly expressed wish of the ratepayers, to agree unconditionally to the running of tramways on Sundays by the tramway company.

LONDON: *London County Council Tramways.*—An agreement has been come to between the City Corporation and the Highways Committee of the London County Council with regard to the widening of Bishopsgate Street Without, and the laying of tramways up to Liverpool Street. The County Council are to contribute £156,950 to the cost of the necessary street widening, the total cost of which is estimated at £313,900. It is calculated the widening will take about two years to complete.

London County Council Tramways Guide.—Messrs. Bell, Immison, Ltd., of Southport, have made an offer to the Council to issue the tramway guide free of expense to the Council on condition that the proceeds of sales be the property of the company. Subject to one or two modifications, this arrangement is recommended to the Council by the Highways Committee.

Battersea: London Building Acts.—In respect to a suggestion from the Borough Council as to the insertion of clauses in a General Powers Bill for the removal from the operation of the London Building Act, 1894, of electric service boxes placed in the public way by metropolitan electric lighting authorities, the London County Council have replied that they are of the opinion that the matter is one to be considered when the question of the general amendment of the London Building Acts is being dealt with, rather than in connection with a General Powers Bill. The suggestion has accordingly been noted for future consideration.

Hampstead: Street Lighting.—The Lighting Committee reported at the meeting on Thursday having considered the advisability of converting 100 incandescent street gas lamps in the Borough to electric metallic filament lamps. At present, however, they are not satisfied that the proposed change would be advantageous to the Council.

Kensington: Expenses of Delegates.—The Borough Council recently sent a circular letter to the other Borough Councils, asking their support in urging the London County Council to insert in a General Powers Bill a clause giving the Borough Councils power to incur reasonable expenditure in respect of the attendance of members and officials at electrical and other technical conferences having a bearing upon the performance of their duties. Of the 28 Metropolitan Borough Councils, ten signified being in favour of the proposal, six intimated that they were against the proposal, ten decided to take no action, while two had not passed any resolution on the matter. These facts were communicated to the County Council by Kensington Borough Council, and the hope was expressed that as only six of the Councils were adverse to the proposition, the Spring Garden authority would see their way to insert the suggested provision in their General Powers Bill of next Session. In reply the clerk to the County Council has written stating that his Parliamentary Committee regret that in the absence of any general desire on the part of the Metropolitan Borough Councils for the legislation in question, the committee could take no action to promote same.

MALVERN: *Trackless Trolley System.*—A syndicate proposes to apply for Parliamentary powers to authorise the use of the trackless trolley system in and around Malvern. If the powers are granted, the Malvern District Electric Traction Co. will be formed, and the scheme is being placed before the Council with a view to obtaining a supply of electricity. The matter has been referred to the Streets Committee.

OXFORD: *Tramway Question.*—The Tramways Committee are understood to be in favour of recommending the City Council to adopt a firm attitude towards the National Electric Construction Co. in connection with their proposal to substitute a combination of the conduit and overhead trolley system for the surface contact system originally contracted for, together with a reduction in the rent which the company has to pay. Whilst inclined to agree to the altered mode of traction, the Tramway Committee object to the reduction in the rent.

PANAMA: *Electrical Imports.*—A British Consular report, in giving a list of the principal articles of trade imported during the second half of 1907, draws attention to the fact that this shows many commodities in which the British Empire is not represented so well as it should be. Included in this list is electrical apparatus.

PERTH: *Prepayment Meters.*—A Committee has been appointed to consider the desirability of introducing penny-in-slot meters for electricity supply.

PRESTON: *Accident at Messrs. Dick, Kerr & Co.'s Works.*—In connection with the death of J. E. Johnson, who was killed at Messrs. Dick, Kerr & Co.'s works in September, the sum of £300 is to be granted to the dependents of the deceased.

RHONDDA: *Tramway Inspection.*—Col. Druitt, on behalf of the Board of Trade, inspected the final tramway route of the Council's system last week.

RHYL: *Light Railway Project.*—Mr. Stephen Sellon has had an interview with the Urban District Council with regard to a light railway scheme. It was stated that the Llandudno and District Tramways Construction Co. is prepared to undertake the work, and to take electrical energy from the Council. A proposal is to be made that the Council shall give its consent to the scheme, which will include a line to Prestatyn.

SALE: *Tramways.*—Notice is given of a proposal to lease the tramways in Sale to the Manchester Corporation for a term of 35 years, commencing July 30th, 1906. The amount of rent payable is progressive from £795 in 1906 to £1,410 in 1931. For each of the following ten years the rent and terms are to be agreed.

SANTANDER: *Electrical Works.*—New electric power works for public and private supply were opened in June last.

SOUTH AFRICA: *Victoria Falls Power Co.*—It is stated that an action has been commenced against the Rand Mines, Ltd., claiming specific performance of an agreement by that company to give the Victoria Falls Power Co. the preferent right of supplying power in bulk at rates equal to those quoted by any other competing power company.

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SOUTHAMPTON: *Electric Lighting Extensions.*—An application is to be made to the Board of Trade for an Electric Lighting Provisional Order for North and South Stoneham.

SPAIN: *Bilbao Coke Ovens.*—A British Consular report states that during 1907 the Altos Hornos de Vizcaya Company built 25 additional coke ovens of the Semet-Solvay pattern. This company now have 244 coke ovens, viz., 144 Carvés system at Sestao and 100 Solvay system at Baracaldo. The electrical charging of the coke ovens at Sestao continues to give satisfaction, the whole quantity of coal to be carbonised in a single operation being introduced in one movement as a single homogeneous. pressed mass, the resulting coke being very much harder than that charged by the ordinary system.

Electrical Trade.—The same report states that in the north of Spain buyers are so accustomed to deal with German and Swiss firms only in the electrical machinery trade that it is difficult to make them believe that similar goods are manufactured in the United Kingdom; and the only practical way for securing any share of this trade is for British firms to combine to open branches in Spain carrying representative stocks, and with a staff of technical experts who can speak Spanish. The electrical machinery and motor trade in Spain possesses considerable potentialities, but British industry must adopt aggressive tactics to derive advantage from them.

Electric Lighting.—All the electric lighting companies in Bilbao and neighbourhood, with the exception of the Co-operativa Electrica (with 1,500 consumers), have united as one company under the name of Union Electrica Vizcaina, with a capital of 18,000,000 pesetas (£639,430), of which 16,000.000 pesetas (£568,383) have been issued.

SPALDING: *Electric Lighting Provisional Order.*—The Board of Trade has asked the Council what steps it proposes to take with regard to putting into force their Electric Lighting Order of 1905, before coming to a decision with regard to its revocation. The matter has been referred to the Gas Committee.

STOURBRIDGE: *Electric Lighting.*—A special meeting of the Council was held on Saturday to consider the question of electric lighting. A report upon the subject stated that for eight or nine years the Council possessed an Electric Lighting Order, but did nothing with it, the various Councils being unable to make up their minds whether to work it or lease it to a company. Twelve months ago it was leased to the British Electric Traction Co., and the matter had been in abeyance until a suggestion was made by the Midland Electric Corporation for Power Distribution for the cancellation of the Order of 1899, and the grant of a new Order on the application of the Council, all costs of which will be paid by the Midland Corporation. This arrangement between the Midland Electric Corporation and the British Electric Traction Co. was discussed at some length. Eventually the meeting was adjourned until next Wednesday.

SWEDEN: *The Electrical Industry.*—In a report upon the trade of Gothenburg during the year 1907, the British Consul states that the electro-technical industry enjoyed an intensive activity. The numerous large power works, resolved on in 1905, were begun in 1907, and the work was pushed on so well that some of the generating stations have been able to begin supplying current, while the others should be finished in the course of 1909. A large number of electrical works were completed last year in various towns, while new buildings or reconstructions have been decided on in other communities. Among other schemes may be mentioned the supply of electricity in Warburg, generated at an adjacent waterfall, whilst great activity is being displayed in laying down the electric plant at the River Lagan, which will give a general supply in Halmstad and other towns.

TORQUAY: *Electricity Undertaking.*—At the last meeting of the Council, it was announced that the final audit of the accounts for the past year showed a profit of £3,000. The new plant is being installed very rapidly, and the whole cost of it is being met out of revenue.

Tramway Extension.—A communication from the National Electric Construction Co., asking for the consent of the Corporation to an extension of the tramways to Paignton, has been referred to the Tramways Committee.

TURTON (near Bolton): *Electric Lighting.*—It has been decided to apply to the Board of Trade for an electric lighting provisional order.

WALLASEY: *Tramway Extensions.*—In connection with the proposed tramway extensions, estimates have been provided for alternative routes, the figures being £93,530 and £83,160. The Tramways Committee recommend the adoption of the latter.

WALSALL: *Electric Signs.*—The Electricity Committee has resolved to charge firms taking electric current for the purpose of illuminated signs at motor rates, provided they agree to keep the sign illuminated until midnight on six nights a week, and pay for the cost of renting a separate meter.

WATFORD: *Extension of Electricity Area.*—The Council have given notice of their intention to deposit a Bill in Parliament next session to authorise an extension of the area of supply for electric lighting and power purposes, to include portions of Cassiobury Park. The Bill will also include powers for wiring of houses, &c.

WEALDSTONE: *The Electric Lighting Order.*—The North Metropolitan Electric Power Distribution Co. have notified the Council, in reply to a communication, that as they are at present engaged with electrical undertakings in Tottenham, Edmonton, and St. Albans, involving a capital expenditure of over £78,000, they regret their inability to proceed with the Wealdstone Electric Lighting Order, but hope to be able to do so during next year. The Council have decided to recommend the Board of Trade to consider the question of revoking the Company's Order.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRIDLINGTON.—A condensing plant is to be installed at an estimated cost of £1,100.

COLCHESTER.—An overhead cable is to be laid from the generating station to Hythe Quay at an estimated cost of £675.

HULL.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £24,000 for the purposes of the electrical undertaking.

LOUGHBOROUGH.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £2,500 for the purpose of the electrical undertaking.

LONDON: *Hammersmith.*—The Finance Committee of the London County Council recommends a loan of £10,000 for electric lighting purposes at 3¾ per cent. per annum, repayable in 20 years.

NEW ZEALAND.—A loan of £17,000 for extending the city electrical plant, including the cost of changing over to the three-wire system, the provision of two additional generating units, one balancer set, extra panels, and alterations to switchboard, alterations to connections, extension of distributors, 250 new wattmeters, foundations and new wing to building, and other necessary plant and materials has been sanctioned.

ST. HELENS.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £10,426 for the purposes of the electricity undertaking. There was no opposition.

S. AFRICA.—A public meeting has been held at Port Elizabeth to sanction the borrowing of £25,000 for electric light extension.

STORNOWAY AND LEWIS.—An electric lighting scheme, making use of water power, is under consideration. Mr. J. V. Bennett, consulting engineer of Edinburgh, is interested in the matter.

TORONTO.—It is stated that tenders will shortly be invited for a portion of the work in connection with the construction of the municipal electrical undertaking.

TYNEMOUTH.—A Local Government Board inquiry has been held last week into an application by the Corporation for sanction to borrow £4,251 for the purposes of the electricity undertaking.

Miscellaneous

ARGENTINE.—The construction of the following telegraph lines has been sanctioned:—(*a*) From Rio de las Piedras to Anta and Rivadavia; (*b*) from Ledesma to Oran; (*c*) from Salta to Cachi, Molinos and Poma. A sum of 150,000 pesos (about £13,000) has been set aside for this work.

AUSTRALIA.—Tender forms, specifications, &c., in connection with a call for tenders for the supply of cable-repairing plant required by the Postmaster-General's department may be seen at the Commercial Intelligence Department of the Board of Trade. Tenders to Deputy Postmaster-General, Melbourne, by January 26th.

BELFAST HARBOUR.—The Belfast Harbour Commissioners, before taking any further steps in connection with the proposed use of electric current for pumping the Hamilton graving dock, and electrically-driven pumps at the new graving dock, are consulting Messrs. Preece & Cardew as to a visit to the place.

CHATHAM.—Tenders are invited for stores for the Borough Surveyor's Department, including electric lamps, &c. Particulars from the Borough Surveyor, and tenders to the Town Clerk by November 19th.

DARLINGTON.—Tenders are invited by the 19th inst. for the erection of an electrically-driven centrifugal pump at the new water tower, Harrogate Hill. Particulars from the Town Clerk.

DOVER.—Two dozen chilled cast-iron electric car wheels are to be purchased at a cost of £32 8s.

GT. NORTH OF SCOTLAND RAILWAY CO.—Tenders are invited for the supply of stores, including electric lighting material, from Jan. 1st, 1909. Particulars from the Stores Superin-

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tendent, 80 Guild Street, Aberdeen. and tenders by November 23rd.

HASTINGS.—A Local Government Board in quiry is shortly to be held concerning an extensive scheme of street electric lighting.

LEICESTER.—Tenders are invited for supplying and fixing transformer and metal filament lamps in four pavilions at the North Evington Infirmary for the Guardians. Particulars from the Clerk, and tenders by the 16th inst.

LONDON: *London County Council.*—The Council invites tenders for the roadwork and platelaying required for the electrification, on the conduit system, of the existing tramways from King's Cross *via* Pancras Road, Great College Street, and Kentish Town Road, to the western end of Prince of Wales's Road, and of the authorised tramways in Crowndale Road. Particulars from the Clerk, and tenders by November 17th.

London County Council.—An expenditure of £25,900 is recommended for the construction of the authorised tramways in Streatham High Road, and the reconstruction of the tramways in Woolwich Road.

The Highways Committee recommend an expenditure not exceeding £2,100 for the provision of ploughs for 175 cars.

MANCHESTER.—The Tramways Committee invite tenders for the supply of two steel boilers for heating purposes, also hard drawn copper trolley wire. Particulars from Mr. J. M. McElroy, General Manager, and tenders to the Chairman of the Tramways Committee by Nov. 17th.

SPAIN.—The *Gaceta de Madrid* of October 27th contains a copy of a Bill to be laid before Parliament authorising the Deputacion Provincial of Guipuzcoa to establish and work during a period of 35 years an inter-urban telephone system.

WAKEFIELD.—The Wakefield & District Light Railway Co. invite tenders for stores during the year ending December 31st, 1909, including the following:—Armature coils, &c., arc lamp carbons, carbon brushes, cables and wires, electric lamp fittings, &c., insulating materials, &c. Particulars from the manager, and tenders by Nov. 19th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—School, Marner Street, Bow and Bromley. T. J. Bailey, Architect to L.C.C. Education Committee.

N.E.—Higher Grade School, Lauriston Road, South Hackney, 320 places (£11,773). T. J. Bailey, Architect to L.C.C. Education Committee.

Adaptation of Hoxton House, Hoxton, for temporary special school (£487). T. J. Bailey, Architect to L.C.C. Education Committee.

Two two-storey factories, Hackney. Architects, Hodson & Whitehead, 7 Finsbury Square, E.C.

Addition to warehouse, Hackney. Contractor, N. Fortescue, 215 Mare Street, Hackney.

N.W.—Proposed additions to Isolation Hospital, Willesden. W. J. J. Stewart, Medical Superintendent.

S.W.—Workshop at St. James's Road, Upper Tooting, branch workhouse. F. W. Piper, Clerk to the Wandsworth Guardians.

683 tenements and 53 lock-up shops (£150,000), near Marlborough Square, Chelsea, for Trustees of Sutton Estate. Architect, E. C. P. Monson, 182 High Street, Acton.

W.C.—Additions to Homœopathic Hospital, Queens Square and Great Ormond Street, W.C. Architect, E. T. Hall, 54 Bedford Square, W.C.

PROVINCES.

BIRMINGHAM.—Fire Station, Albion Street (£9,870). Builder, Thos. Elvins, Maden Road, Soho Hill.

BOURNEMOUTH.—Municipal Buildings (Amended Scheme, £19,560). Borough Surveyor, F. W. Lacey.

BRIGHOUSE.—School (£10,000). James Parkinson, Clerk to Town Council.

BURNAGE (Manchester).—School (500 places), for Education Committee. Sir Wm. Henry Talbot, Town Clerk.

CARDIFF.—Tenders are invited for installing the electric light in the Cardiff Museum. Particulars from the Town Clerk, and tenders by December 1st.

CHESTER.—Refuse Destructor (£10,966), at Electricity Works. J. H. Dickson, Clerk to Town Council.

DUDLEY.—High School for Girls, Prior Road. Surveyor to the Corporation.

LOUGHBOROUGH.—Technical Institute. Architects, Barrowcliff & Allcock, Town Hall Chambers.

LUTON.—New buildings and alterations and additions to sick wards at Workhouse. Architects, Gotch & Saunders, 55 George Street.

LYMINGTON (HANTS).—New school (£2,783). Clerk to Hampshire Education Committee, Winchester.

MANCHESTER.—Extension of Royal Exchange buildings. The Secretary.

NORWICH.—Secondary school and alterations to building, Eaton Road. Clerk to the Education Committee.

NUNEATON.—School (780 places). F. S. Clay, Clerk to Urban District Council.

SWANSEA.—Proposed new Art Gallery. Architect, Mr. Moxham (Wilson and Moxham), 39 Castle Street.

YEADING (UXBRIDGE).—Re-erection main block and wards of Smallpox Hospital. Builder, J. S. Brown, Hillingdon Heath.

TENDERS RECEIVED AND ACCEPTED

DUNDEE.—The tender of Messrs. Westwood & Sons for the wiring of the Central District School at £76 has been accepted.

KINGSTON.—The tender of Messrs. Siemens Bros. & Co. for cable, at £213, has been accepted.

LONDON: *City of London.*—The Guardians have placed an order with Pinching & Walton for one gross of 16 c.p. electric lamps at £5 5s.

Holborn.—The Council has received the following tenders for the electric light installation at the High Holborn Library:—John Bolding & Sons, Ltd. (accepted), £78; Barlow Bros. & Co., £196; Comyn Ching & Co., Ltd., £175; D. Hulett & Co., Ltd., £118; Marryat & Place, £170; Foote & Milne, Ltd., £101.

London County Council.—The following tenders have been received for the reconstruction of the bridge, carrying Mare Street, Hackney, over Regent's Canal in connection with the electrification of the Whitechapel Road to Stamford Hill tramways:—Dick, Kerr & Co. (£4.216 19s. 4d.), Cleveland Bridge and Engineering Co., Ltd. (£4.400 13s. 5d.), Alfred Thorne & Sons (£4.485 19s. 10d.), Andrew Handyside & Co., Ltd. (£4,566 14s. 1d.), Heenan & Froude, Ltd. (£4.652 2s. 11d.), John Cochrane & Sons (£4.833 8s. 5d.), Westminster Construction Co. (£4.960 14s. 1d.), John Mowlem & Co., Ltd. (£5.000). The tender of Messrs. Dick, Kerr & Co. is recommended for acceptance, subject to their giving preference to men resident in the County of London.

The tender of Messrs. Millars' Karri & Jarrah Co., Ltd., amounting to £1,012, for the supply of 100,000 Jarrah wood blocks required for use in the tramways department has been accepted.

ONTARIO.—The tenders for the electrical equipment and apparatus required by the Hydro Electric Power Commission are now being checked by the engineers. The Toronto correspondent of the *Standard* states that the tenders of the General Electric Co. of Canada and the Westinghouse Co. are the most favourably received, and there is a probability that the contract will be divided between these two companies.

PRESTON.—The tender of Messrs. Foster & Co. for a tramway shelter at the Penwortham Bridge terminus, has been accepted at £68.

SHEFFIELD.—A contract has been placed with the Warner Engineering Co. to equip twelve tramcars with their non-parallel axle trucks.

STALYBRIDGE, HYDE, &c.—The tender of Messrs. E. Wood & Co., Ltd., of Salford, has been accepted for the supply and erection of ironwork in connection with the boiler-house extensions.

WALSALL.—The Council have accepted the following tenders in connection with the electricity undertaking:—Templer & Ranoe, Ltd., 16-inch atmospheric exhaust valve for condensing plant, £27 5s.; Worthington Pump Co., Ltd., two 24-inch sluice valves, £42; John Spencer, Ltd., 24-inch exhaust steam pipes, £133 10s.; Lacy-Hulbert & Co., Ltd., portable air compressor for blowing dust out of the armatures, £49 10s.

COMPANIES' MEETINGS AND REPORTS

BERGMANN ELEKTRICITATS-WERKE A.G., BERLIN.—At an extraordinary meeting of the shareholders of this company, it was decided to increase the capital to 21,000,000M. by issuing 7,000 shares of the value of 1,000M. each.

BERLIN ELEKTRICITATS-WERKE.—The report, which will be presented at the annual meeting on November 30th next, recommends a dividend of 11 per cent. on the ordinary shares and 4½ per cent. on the preference shares. The number of customers have increased from 2,363 to 2,543, and the connected kilowatts from 14,907 to 17,538. The total useful output for the past year amounted to 155 million units, or 13 million units more than last year.

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LANCASTER AND DISTRICT TRAMWAYS CO.—The report for the year ended September 30th shows a gross profit of £5, and after meeting interest on loans, &c., there is a debit balance of £1,301. Negotiations are proceeding between the company and the Corporation for the acquisition of the undertaking.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—At the half-yearly meeting, on Tuesday, the report and accounts, given in our last issue, were adopted. Sir John Wolfe Barry, K.C.B., who presided, referred to the decision of the Australian Government to lay and work cables of their own between Tasmania and the mainland, which will have the effect of compelling the company to close its Tasmanian stations and remove the two existing cables unless a new arrangement is come to with the Government. This, however, he regarded as very remote, as the company was receiving from that Government nothing but unfair competition and continual attempts at oppression.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire-bars, quoted on Tuesday night, net c.i.f. port of arrival was £66 10s. to £67 5s. (last week £64 to 64 10s.).

AGENCY.—Mr. Harry Nance, 4 Church Street, Cardiff, is now representing for South Wales and West of England :— Pritchetts & Gold, Ltd. (London); Arc Lamps, Ltd. (St. Albans); Fuller Electrical & Manufacturing Co. (London); Birmingham Lighting Co. (Birmingham); Wm. Wadsworth & Sons (Bolton); Nalder Bros & Thompson, Ltd. (London); Newtons, Limited (Taunton); Ward & Goldstone (Manchester); Sunbeam Lamp Co., Ltd. (Gateshead-upon-Tyne).

CANADIAN INQUIRY.—The following was among the Canadian inquiries received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., this week :— "A New Brunswick correspondent wishes to secure the commission agency of some United Kingdom makers of telegraph wire, cables, &c."

CUSTOMS DUTIES.—The Board of Trade are in receipt, through the Foreign Office, of a copy of a Decree of the Provisional Governor of Cuba, reducing the Customs duty on wire and cables for the transmission of electricity, protected by lead tubes and other insulating covers, from 7·50 to 2 dollars per 100 kilogs.

THE DAVIES WATER-TUBE BOILER.—Mr. J. P. Davies, the inventor of the water-tube boiler, Patent No. 903 of 1907, and of other water-tube boilers, has obtained a declaration from the Chancery Division of the High Court in the action of Davies *v.* The Davies Patent Boiler, Ltd., 1908 D, No. 652, that he is entitled to the Patent No. 903 of 1907, free from all claims on the part of the defendant company, and that the company are not entitled to any interest in any invention in relation to boiler or boiler tubes made by Mr. J. P. Davies since November 14th, 1906, and an injunction restraining the company from setting up any claim thereto.

DISSOLUTIONS OF PARTNERSHIPS.—The partnership between V. C. Hemsley and Richard Ord, trading as Hemsley, Ord & Co., electrical engineers, 37 South Sherwood Street, Nottingham, has been dissolved.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.— A meeting of the X Accumulator Co., Ltd., will be held at the offices of Messrs. E. Littlejohn, Wilson & Co., 85 Gracechurch Street, London, E.C., on November 18th, at 12 noon. Particulars of claims should be sent to Mr. W. J. Webb, liquidator, 18 Leadenhall Street, London, E.C.

Notice of a first and final intended dividend of 1 3-16d. in the £ is given in the bankruptcy of W. Wardle, electrical engineer, 14 Osborn Road, Levenshulme, Manchester. The dividend is payable on November 13th at the official receiver's office, Byrom Street, Manchester.

Notice of an intended dividend is given in the bankruptcy of W. T. Garnett, Barkerend Mills, Bradford. The last day for receiving proofs is November 19th. The trustee is Mr. E. Musgrave, 1 Bank Street, Bradford.

The X Accumulator Co., Ltd., is to be wound up voluntarily. Mr. W. J. Webb has been appointed liquidator.

MESSRS. SIEMENS BROS.' INTERESTS IN AUSTRALIA. —The *Australian Mining Standard* states that an agreement has now been concluded between the various branches of Siemens' firms by which their export business will be organised on definite lines, so that the interests of the various British and German firms will not conflict in the various parts of the world in which they do business. The firms concerned are :- Messrs. Siemens Bros. and Co., Ltd., of Woolwich and London; Messrs. Siemens Bros.' Dynamo Works, Ltd., Stafford and London; Messrs. Siemens Schuckertwerke, Berlin, Nuremberg, &c.; Messrs. Siemens & Halske, Berlin and Nonnendamm; Gebruder Siemens & Co., Berlin and Lichtenberg. This amalgamation, which represents a combine of nearly £12,000,000, has been arranged so that the whole of the industrial world has been allotted between the English and German interests.

SMALL TRANSFORMERS.—We are informed that the Firth Engineering Co. have made special arrangements for a largely increased output of small transformers for metal filament lamps, and have practically trebled their automatic winding machines. Particular attention is devoted to the testing as well as to the manufacture of this apparatus, and the firm are now able to give quick deliveries of small transformers in any quantity for any requirements.

LE CARBONE, LTD.—This firm, of Levallois-Perret, near Paris, who were awarded a Grand Prix for their exhibition of carbons of every kind at the Franco-British Exhibition, have issued a handsome souvenir of the Exhibition in the shape of a square medallion of moulded graphite of artistic design.

MISCELLANEOUS CITY NOTES

BRUCE PEEBLES & CO.—The scheme of reconstruction was formally approved in the Court of Session in Edinburgh on Tuesday. The scheme provides for the incorporation of a new company with a capital of £250,000 in £1 shares, to take over the property and assets of the existing company. Each debenture-holder is to receive a 5 per cent. mortgage debenture of the new company, and each ordinary creditor will receive for the sum for which he would rank, to the extent of ⅜ an unsecured 6 per cent. debenture, and ⅝ fully paid shares of the new company. Creditors of less than £10 may elect to receive 5s. per £1 on their claims in cash. The £5 preference shareholders in the old company are to have allotted to them three £1 shares of the new company paid up to the extent of 13s. 4d., whilst the £5 ordinary shareholders will be allotted £1 shares paid up to the extent of 10s.

MEXICAN LIGHT & POWER CO.—A circular has been issued, asking for proxies for a meeting to sanction the issue of new ordinary capital. The *Financial News* states that the Mexican Tramways Co., with which an amalgamation was nearly carried through, has guaranteed the issue of about £1,000,000 of debentures, ranking after the debentures now quoted, which will be used either for the purpose of the combined undertaking should the amalgamation take place, or for the purposes of the tramway companies alone.

REES ROTURBO MANUFACTURING CO., LTD.—Subscriptions have been invited during the week for an issue of 85,000 preference shares of £1 each at par in the Rees Roturbo Manufacturing Co., which, it will be remembered, has been formed to acquire the business of Messrs. Thomas Parker, Ltd., of Wolverhampton.

WEST INDIA & PANAMA TELEGRAPH CO.—Dividends of 6s. per share on the first preference shares for the half-year to June 30th, and 12s. per share on the second preference shares on account of dividends accrued to June 30th, have been declared.

APPOINTMENTS AND PERSONAL NOTES

Mr. S. Cameron Gibson, Borough Electrical Engineer at Nuneaton, has been presented with a handsome silver electric kettle and electric water heater by the staff at the electricity works on the occasion of his marriage, which took place recently. He is also the recipient of a marble chiming clock, suitably engraved, presented by the Town Council officials and staff.

COMPANY MORTGAGES

Particulars of the following mortgages and charges have been filed :—

LEAMINGTON & WARWICK ELECTRICAL CO.—Particulars of £35,000 debentures, created by resolutions of September 21st, 1906, and July 20th, 1908, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the whole amount being now issued. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

LEICESTERSHIRE & WARWICKSHIRE ELECTRIC POWER SYNDICATE.—Issue on September 8th, of £150 debentures, part of a series of which particulars have already been filed.

A. REYROLLE & CO.—Particulars of £20,000 debentures, created by resolution of April 17th, 1907, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £500. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

NEW PUBLICATIONS

Report of Brakes Committee of the Tramways & Light Railways Association. (London : The Association.) 10s. 6d.

"Dynamo, Motor, and Switchboard Circuits for Electrical Engineers," by W. R. Bowker. Second Edition. (London : Crosby Lockwood & Son.) Price 7s. 6d.

"Transformers for Single and Multiphase Currents." By Prof. Gisbert Kapp. Second Edition. (London : Whittaker & Co.) 10s. 6d.

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NEW COMPANIES

JAMES BUCKLEY.—This company was registered on October 24th, with a capital of £1,000 in £1 shares, to carry on the business of decorators, painters, sanitary, electrical, mechanical, and heating engineers, contractors, gas, steam, and water fitters, plumbers, glaziers, metal workers, &c. Registered office: 10 Greenacres Road, Oldham.

E. GOOSSENS, POPE & CO.—This company was registered on October 19th, with a capital of £1,000 in £1 shares, to acquire the business of electrical lamp manufacturers and merchants carried on by Emile Goossens, F. R. Pope, and M. W. O'Connell, as "E Goossens, Pope & Co.," and to carry on the same and the business of electricians, electrical engineers, &c. The subscribers are:—F. R. Pope, The Priory, Harlesden Road, N.W., electrical engineer; M. W. O'Connell, 35 Nicoll Road, Harlesden N.W., electrical engineer. Private company. The number of directors is not to be less than three nor more than four: the first are E. Goossens, F. R. Pope, and M. W. O'Connell. Qualification, £150. Registered office, 5 Arthur Street, New Oxford Street, W.

MARRYAT & McNAUGHT, LTD.—This company was registered on October 29th, with a capital of £5,000 in £1 shares (2,000 pref.), to take over the business of an electrical engineer carried on at Askew Villas, Askew Crescent, Shepherd's Bush, W., and to adopt an agreement with H. Harryat and C. J. McNaught. Private company. H. Marryat and C. J. McNaught are joint managing music directors. Registered office: Askew Works, 31A Askew Crescent, Shepherd's Bush, W.

NORTHERN ELECTRICAL & VENTILATING CO.—This company was registered on October 20th, with a capital of £5,000 in £1 shares (1,000 preference), to acquire the business carried on at Liverpool by C. P. Titherley and C. P. L. Titherley, as the "Northern Electrical & Ventilating Co." The subscribers are:—C. P. Titherley, The Limes, St. George's Road, Wallasey, electrical contractor; C. P. L. Titherley, Langtree, Piercefield Road, Freshfield, Lancs. Private company. The number of directors is not to be less than two nor more than five: the first are C. P. Titherley and C. P. L. Titherley, each of whom may retain office while holding 100 ordinary shares. Remuneration (excepting managing director, if any), as fixed by the company. Registered by T. T. Hull & Son, 22 Chancery Lane, W.C.

OLIVER, CLARK & CO.—This company was registered on October 21st, with a capital of £2,500 in £1 shares, to acquire the business of electrical and general engineers, smiths, metal workers, &c., carried on by A. J. Mileson, at 20A Goldhawk Road, Shepherd's Bush, and 24A St. Mark's Road, North Kensington, W., as "Oliver, Clark & Co." The subscribers are:—A. J. Mileson, C. O. Clark, T. H. Norman, A. S. Woodhead, W. G. Johnson, Grace Newson. Private company. The number of directors is not to be less than two nor more than five: the first are C. O. Clark (managing director), A. J. Mileson, and W. G. Johnson. Qualification, £25. Remuneration of ordinary directors as fixed by the company. Registered by Alfred H. Atkins, Ltd., 27-28 Fetter Lane, E.C.

SKEWEN FOUNDRY & ENGINEERING CO.—This company was registered on October 23rd, with a capital of £5,000 in £10 shares, to carry on the business of ironfounders, steel makers and converters, smelters, tool makers, manufacturers and factors of metal appliances, apparatus and goods for railway, tramway, telephone, electric and motor traction, &c. Registered by Alfred H. Atkins, Ltd., 27-8 Fetter Lane, E.C.

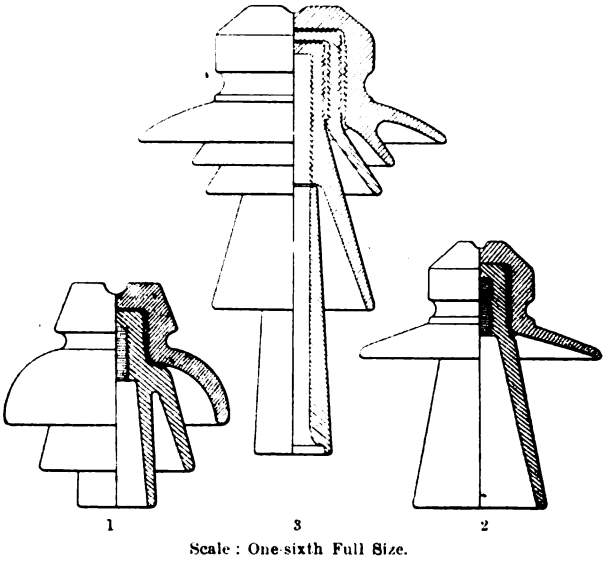
J. E. WOOD & CO.—This company was registered on October 23rd, with a capital of £500 in £1 shares, to acquire the business of hydraulic, electrical, and general engineers, &c., carried on by J. E. Wood and A. T. Richards at Radford Boulevard and Player Street, Nottingham. The first directors are J. E. Wood (permanent managing director), and A. T. Richards. Registered by Alfred H. Atkins, Ltd., 27-8 Fetter Lane, E.C.

Metropolitan Association of Electric Tramway Managers.—At a meeting of the members of the above Association held on Friday last, Mr. Blain was re-elected chairman, and Mr. Goodyer honorary secretary. A communication from Sir E. R. Henry, Commissioner of Police, was read with regard to various metropolitan public carriage licensing matters. The hon. secretary was directed to send a reply thereto. The chairman reported the result of an interview which the hon. secretary and himself recently had with several of the metropolitan Members of Parliament at the House of Commons, regarding licensing matters. A discussion ensued, and it was ultimately agreed to furnish the various Members of Parliament with the information they specially asked for.

Birthday Honours.—A knighthood has been conferred upon Prof. J. J. Thomson, F.R.S., president-elect of the British Association, and Cavendish Professor of Experimental Physics, Cambridge. It is also interesting to note that Mr. Luke White, the Chairman of the House of Commons Committee now dealing with the London Electric Power Bills, has had the honour of knighthood conferred upon him. Sir Charles McLaren, Chairman of the Metropolitan Railway Co., has been made a Privy Councillor.

BRITISH-MADE PORCELAIN INSULATORS

AMONG their exhibits at the Manchester Electrical Exhibition, Messrs. Bullers, Ltd., showed a fine collection of all kinds of porcelain articles for electrical purposes. An interesting feature of their exhibit was that they have high-tension insulators under test at very high pressures. They fitted up an arrangement so that the insulator could be shown tested under a shower of water to show its behaviour under the severest rains. Our representative saw three 10,000-volt insulators of different design under test. The first one, shown in the illustration marked No. 1, actually flashed over at 72,000 volts, which dried



Scale: One-sixth Full Size.

PORCELAIN INSULATORS.

it so that when switched on again it stood this pressure for a considerable period. When water was turned on to such an extent as to represent more than the severest of tropical thunderstorms, it only broke down at 50,000 volts. This insulator was designed for use in Mauritius, and No. 2 is an alternate design got out by Messrs. Bullers themselves, of a slightly cheaper construction, but equally efficient. The third type illustrated has a sleeve over the bolt. Although there is surface leakage over the inner end of this sleeve, it is found that the addition increases considerably the voltage that the insulator will withstand without flashing over, as the spark cannot travel right across from the inner petticoat to the belt, but has to go round the indirect path. This insulator took 72,000 volts when tried without flashing over, and when under a shower of water broke down at 64,000 volts.

Wireless Telegraphy.—The wireless telegraph station in the North Basin of the Buenos Aires Docks has been opened to public service. There are other stations at Rio Santiago, Recalada Ponton, and Rada lighthouse. Messages can be transmitted within a radius of from 500 to 800 kilometres. A De Forest wireless telegraph station has been erected at Colon (Panama), and is under the control of the United States Navy Department. Under favourable atmospheric conditions, communication is said to have been made with Guantanamo, Cuba.

Electricity in the Timber Industry.—In a Paper read before the Electrical Association of New South Wales, an attempt to apply electric power to the hauling of logs from the bush to a sawmill was described. A small generating plant was installed on a creek, and power was distributed within a radius of three miles. The logs were hauled along with wire ropes by means of a portable winding gear. As the routes had to be surveyed and broken up into a number of practically straight runs with sheaves at each change of direction, the expenses connected with the work were found to be very heavy, and finally, owing to shortage of funds, the scheme was abandoned.

Telegraph Traffic.—The submarine cable between Kotonon and Grand Bassaon failed on October 29th; telegrams for the Ivory Coast are being forwarded by the best means. The El Arich route between Adana and Beyreuth and between Alep and Beyreuth became interrupted on the 9th inst., and on the same day the cable between Zanzibar and Mombassa ceased working. Communication between Pontianak and Saigon is still interrupted. There is reason to believe that an understanding has been arrived at regarding the reopening of the Port Arthur-Chefu cables, which have been closed since March 9th, 1904, the time of the Russian-Japanese War. The El Arich route was again restored on November 10th, 1908.

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LONDON ELECTRIC POWER BILLS

Proceedings before House of Commons Committee

CONSIDERABLE progress has been made with the opposition against the London and District Electricity Supply Bill since our last issue, the cases for the majority of the municipalities who have petitioned against the Bill having been heard and good headway made with the company opposition. The Board of Trade report on the Bill has not yet come under discussion.

Our report last week completed the case for the promoters of the Bill. The opposition has crystallised into a number of classes, all more or less distinct in their interests in relation to such a scheme as this. In all there are thirty-eight petitions against the Bill, of which only nineteen are supported by the appearance of counsel, and it may be mentioned that there are something like 55 authorised distributors in the area scheduled in the Bill. The present opponents may be classified as follows: borough councils, with such special cases as Marylebone and Westminster; the companies who are appearing in two bodies owing to the disagreement which led to the deposit of the two Bills by the East End and West End companies respectively, which will come before the Committee later; the City of London Corporation, counsel for which always argue a special importance, unappreciated, in effect, by Committees generally and distinctly so by Lord Cromer's Committee when it dealt with these Bills; the Middlesex County Council, in whose area there is already a power company; and finally, the superfluous opposition of a Mr. W. Gentry Bingham, who is presumably an unauthorised representative of the general public with an excess of spare time and a scheme for the creation of an authority on the lines of the Water Board for dealing with the question in conjunction with the traffic problem. The absence of any railway, water, and similar companies is explained by the presence of clauses in the Bill for their protection.

The borough councils and local authorities who have placed their cases before the Committee are: Marylebone, Battersea, Croydon, Woolwich, West Ham, St. Pancras, Shoreditch, Southwark, Hornsey, Finchley, Chiswick, Bexley, Beckenham, Stepney, and Hammersmith. Evidence was called on behalf of each as to origin and progress of their undertakings, and estimates were given showing the price at which the present authorised distributors will be able to supply by the time the power company gets into working order. In every instance these worked out to the advantage of the distributor; it was also shown that by reason of the existence of the necessary buildings, new generating plant can be installed at a less capital cost than that given in the promoters' estimates. All this evidence, however, is a replica of that given before Lord Cromer's Committee in May and June, and the details need not be repeated. A feature of the evidence was the production of tables to counteract those handed in by the promoters, but as in most cases they were based upon different assumptions, or there was some little detail which rendered direct comparison between the two impossible, the result was always confusing, or, at any rate, there was a confusion of ideas as between the witness and the cross-examining counsel, which served no useful purpose. Some reference may, however, be made to the general effect of the speeches, and to some hints by the Chairman as to the lines upon which the Committee intend to deal with the problem, assuming the preamble of the Bill is passed. In the first place it is to be regretted that counsel for the opponents have not yet realised, in spite of it being repeatedly pointed out to them, the futility of the contradictory argument that on the one hand, the passing of the Bill will set up unfair competition, and on the other that the authorised distributors can supply at cheaper rates than those proposed. One after another have the opposing counsel got up and placed this argument before the Committee, only to be asked by the chairman how could the Bill create unfair competition, or, indeed, any competition at all, if the authorities are able to supply at cheaper rates. The answers, for the most part, have been an evasion of the question, and counsel seemed relieved that the point should be allowed to drop. One new point, however, is that the local authorities, who, through their representatives, seem almost to take it for granted that the Bill will be passed in some form or other, are now asking for an absolute veto against the entry of the power company into their areas. Mr. Vesey Knox, K.C., who appeared for Hornsey, Finchley, Chiswick, Bexley, and Beckenham, was almost alone in attempting to adduce arguments against the scheme which were not repetitions of everything that has been said, and unsuccessfully, before. He argued that a much stronger case was made out in favour of Mr. Merz's Bill of 1905, for he now admitted that a state of affairs then existed with regard to electric supply which was sadly in need of reform, although, by the way, he denied it at the time. During the interval, however, he claimed that much of this had been remedied, and it was not worth while disturbing the present rate of progress by passing the Bill. In common with other counsel, he complained that the fact of these power Bills being before Parliament for several years had tended to retard the normal progress of the existing undertakings, manufacturers preferring to await developments in the hopes of getting a very much cheaper supply in the near future. But even when the company was in full working order, the total saving shown by the promoters' estimates was only ¼d. per unit. The Chairman here suggested that the promoters admitted that some of the stations would not receive so much benefit as others, so that in some cases there would be considerable savings. Mr. Knox agreed, but stated that all this was on the assumption that the promoters' estimates were correct. Mr. Hammond was known to be a most sanguine statistician; in fact, he went so far as to call him the standby of the Parliamentary bar, his hopeful estimates presumably leading to the promotion of many Bills which would otherwise not have been proceeded with.

In answer to those who asked for exclusion from the area, the Chairman stated that the Committee would not take into consideration the cutting out of any central portion of the area, but would deal with the scheme as a whole. There might, however, be exceptional circumstances why certain districts on the borders of the area should be excluded, and these would be the subject of special consideration. Similarly, reference has been made to the clauses regarding supply arranged by Mr. Merz with several authorities, and the absence of them in this Bill, commented upon. On this point the Committee take the view that even if such clauses were produced, they would not sanction them in relation to particular districts. Clauses of this character would be made applicable to every authority in the area. In fact, the chairman's remark made it clear that the Committee does not favour the insertion of such clauses in the Bill, and that it would probably reject them even if produced by agreement between the promoters and the authorised distributor. The Chairman has also rather intimated that the discussion upon the Board of Trade report should be postponed until the clauses are reached, if this is done, as he has limited the remarks of opposing counsel on the purchase clause. With regard to the local authorities, which admittedly are in special circumstances, it may be said that the Westminster City Council does not now oppose, the promoters having agreed to safeguard the City Council's rights of purchase. The Westminster City Council is more favourably situated than many councils, for, in addition to being able to purchase the greater portions of two or three companies which supply their area, they have the right to purchase the generating station of the Central Electric Co., which is outside. The special circumstances surrounding the Marylebone undertaking have also been placed before the Committee, whilst the promoters have not failed to impress upon the Committee, in cross-examination, the enormous loss upon the Woolwich undertaking, which has entailed a rate of no less than 8d. in the £. Attention has also been called to the possibility of the power company conspiring with the existing companies to so mix up affairs that it would be doubtful what the local authority would purchase.

On Friday, the opposition of the eight companies who are promoting the London Electric Supply Bill was opened by Mr. Balfour Browne, K.C., who appeared to be in his most belligerent mood toward his legal brethren representing the promoters. He rested the major portion of his case upon unfair competition, calling attention to the fact that the competition now existing was between companies working under the Electric Lighting Acts, and subject to all their restrictions. The now familiar heap of canvassers' reports of the County of London Electric Supply Co. were again produced as testifying to the "push" which is exercised by the company, and we were given to understand that the same applies to all the companies represented by Mr. Balfour Browne. Evidence on this head was given by Mr. H. B. Renwick, of the County Company, and by Mr. A. F. Harrison, of the City Company. The companies have carried out a canvass in order to arrive at the horse-power of machinery in the County of London not driven electrically, as a test of the accuracy of Mr. Merz's figure of some 500,000 h.p. The canvass of the companies gave a result considerably less, and in comparing it with the figures given by the present promoters Mr. Balfour Browne gave as the total for the whole area, the actual total for the County of London. This led to an interruption by Mr. Fitzgerald, with the result that no fewer than four different figures were being repeated in a cross conversation between counsel, and it is doubtful whether the Committee, in the end, were clear as to who was responsible for any of the totals in question. One of the Committee later asked a question concerning the competition in the City between the City Co. and the Charing Cross Co., and was told there was an agreement between the two not to quote below an agreed minimum price. A point in the evidence of Mr. C. P. Sparks, who followed,

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was that he disagreed with the railway witnesses for the promoters, and asserted that the supply to railways was of such a special character that the railway companies would decide to erect their own generating stations for the sake of the greater reliability, or, at any rate, any supply company would be compelled by the railway company to erect special plant for the purpose.

The Committee did not sit on Monday, but on Tuesday Mr. Sparks continued his evidence, and was followed by Mr. J. S. Highfield, the Chief Engineer to the Metropolitan Electric Supply Co. The effect of this evidence was that, from an intimate knowledge of the conditions prevailing in the area scheduled by the Bill, it would be commercially impossible to work such a bulk supply undertaking. Bulk supply in itself would be impossible for the reason that authorised distributors would not agree to deal with the company, knowing that it had powers to compete for their individual consumers, so that either the powers of competition would have to go, or they would be destructive to the scheme. It was stated that there is installed in the present generating stations in the area 83,000 kilowatts of plant not actually in use, and it was computed that during the next five years there might be a gradual increase of the present demands of a further 25,000 kw. Thus there was no need for a new power station. Mr. Highfield said that, speaking from actual experience, he had found that the actual saving from the use of metal filament lamps was 33 per cent., against the theoretical saving of 70 per cent. Neither Mr. Sparks nor Mr. Highfield found fault with the scheme from an engineering point of view, in this respect it was on the most up-to-date lines, and would be an ideal proposal if no supply was at present being given. The opinion was expressed, however, that in order to make the scheme a successful one, a large proportion of the existing undertakers would have to be ruined and the power company undertake a large distribution business. At the same time it was pointed out that the estimates put before the Committee by the promoters included a very inadequate amount for distribution purposes, another argument in favour of the existing companies' contention that the whole proposition is ill-conceived. On the question of the railway load, Mr. Highfield emphatically supported Mr. Sparks that it would be necessary for the plant, to deal with this, to be entirely independent of the ordinary load. Although a good deal of reference has been made to the North-Eastern Railway, it was pointed out to the Committee that this only represented a load of 4,000 kw., whereas, if the promoters' estimates were right, the railway load in London would amount to 25,000 kw. Both witnesses regarded "linking up" as a perfectly sound solution of the question to be dealt with in London, owing to the very large amount of spare plant not now in constant use and the facilities for extensions at extremely low cost. Although the Willesden station of the Metropolitan Electric Supply Co. is run practically as two stations in order to avoid inconvenience from breakdown, Mr. Highfield asserted that no amount of subdivision of the generating plant could guarantee immunity from breakdown, as, for example, a boiler explosion would be bound to affect the whole of the buildings. Some stress was laid upon the possibility of the use of gas engines and oil engines of large size in the near future, which it was contended would upset the whole of the promoters' estimates.

Mr. J. D. Fitzgerald, K.C., in his cross-examination, made a good deal of the fact that although the Metropolitan Co. held bulk supply powers over a very large area, only one supply of this character was being given, namely, to Acton, and that at a very high figure. The reply was that this only demonstrated the difficulties of bulk supply, and strengthened the case for the opposition to the Bill, but Mr. Fitzgerald preferred to have it that the price was the determining factor. The Metropolitan Co., however, for instance, after a careful consideration, had come to the conclusion that it would be a bad business policy to lay trunk mains everywhere in the hope that business would come along. They are therefore adopting the plan of endeavouring to secure distributing powers in addition to bulk supply powers, and are making arrangements to take over Provisional Orders. In a long argument as to the benefit which the gas mantle has conferred upon the gas industry, Mr. Highfield refused to admit that this was so. He said it was one cause of the improvement in the demand for gas recently, but there had also been a great development in cooking and heating by gas, and he maintained the view that for some years at any rate there was not likely to be a great increase of revenue from lighting due to the use of metal filament lamps. In many areas, he said, there was likely to be a permanent decrease owing to the fact that there was little, if any, room for expansion. Mr. Fitzgerald took the opportunity of making it clear in his cross-examination that the saving which it was estimated the existing authorities would make by taking a supply in bulk from the power company had been arrived at after allowing for a reasonable reduction in the existing costs, during the next two or three years, by which time the power company would be in operation. This point had not previously been brought forward, and the opponents themselves seem almost to have overlooked it.

Mr. J. Conacher, General Manager of the Metropolitan Electric Supply Co., was the next witness, and handed in a number of tables showing the commercial position of all the company undertakings in the area. The Chairman, however, requested that the details should not be given in evidence, but placed upon the "notes" for reference in case any figures should be challenged.

It is hoped to complete this Bill, and commence the London Electric Supply Bill, by Tuesday.

The General Committee of the National Liberal Club has passed the following resolution regarding the London and District Electricity Supply Bill:—"This committee is of opinion (1) that the purchase clauses of the London and District Electricity Bill now before Parliament should be amended so that the undertaking may be acquired by the central local authority within twenty years upon equitable terms, such terms not to include anything for goodwill or prospective profits. (2) That such necessary alterations or additions be made to the Bill as will prevent the purchase, amalgamation, or creation of agreements contrary to the interests of consumers between the existing electrical undertakings, whether municipal or company, and the new company. (3) That a Bill should be introduced by the Government making the central local authority the purchasing authority for all existing electrical undertakings, whether municipal or company, in the area covered by this Bill within the same period of twenty years."

CATALOGUES AND PAMPHLETS RECEIVED

GEARING.—A collection of leaflets from the "Buffoline" Noiseless Gear Co., Ltd., of Levenshulme, Manchester, call attention to their high-class gearing made both in metal and their own special "buffoline" leather and ordinary raw hide. These buffoline pinions are particularly suitable for electrical driving, and are made from buffalo hide treated so as to withstand the effects of oil.

RADIATORS.—A new list issued by Messrs. Falk, Stadelmann & Co., Ltd., of 83-87 Farringdon Road, London, E.C., describes and illustrates over twenty designs of "Aureola" electric radiators. These are all of the luminous or glow-lamp pattern, and are fitted with either two or four lamps, consuming 250 watts each. The designs illustrated include portable radiators for standing in any position in a room, and radiators for placing in the fireplace.

SCREW CUTTING LATHE.—A leaflet from John W. Perkin, of Lord Street Works, Leeds, describes an improved pattern of 3½ in. centre, sliding, screw-cutting, and boring lathe. Great rigidity and accuracy are claimed for this design of lathe. The leading features are the swiveling back-geared headstock, the position of the leading screw, and the method of casting bed and tray in one piece.

SWITCHGEAR.—Three new pamphlets have been issued by Messrs. Reyrolle & Co., of Hebburn-on-Tyne, relating to their special systems of high-tension switchgear. One of these describes in detail the highly original and well-thought-out system of ironclad switchgear which they have developed, and which was described and illustrated in ELECTRICAL ENGINEERING, July 2nd, page 24. Another is devoted to the Merz-Price protective system employed in connection with this gear to a large extent on the large power-distribution systems in the north (see ELECTRICAL ENGINEERING, Vol. III., page 763), and the third points out the advantages of this kind of switchgear for mining work, and goes into the general requirements of colliery work in the way of switchgear, with descriptions and illustrations of various forms of apparatus particularly designed for mining work.

"The Central."—The current number of this publication, the magazine of the Central Technical College, Old Students' Association, contains several interesting and well-illustrated articles on engineering subjects, including a description of the method of construction of a main sewer for the City of London and some notes on the chemistry of fuels and their calorific value. Other articles deal with water rheostats for the artificial loading of large high-voltage generators, and a little known form of belt-gearing of French origin. Dr. C. V. Drysdale contributes an article on recent developments in light production, in which some recent tests on the quartz mercury vapour lamp are described. To those who have at any time been connected with the College, the most interesting reading in the magazine is, without doubt, the "Old Student Notes," which feature, we are pleased to see, has increased in length. A photograph of a group of the secretaries, captains, &c., of the various social and athletic clubs of the College is contained in the magazine, and a few of the recently published engineering works are reviewed. A list giving the ages and requirements of several old students who want change of employment has been drawn up by the Old Students' Association Employment Agency, and sent round in the form of a leaflet with the magazine.

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SUMMARY

REDUCTIONS are notified in the price of Osram and Sun Tantalum lamps. (Page 664.)

THE Highways Committee of the London County Council, in a report upon the G.B. surface contact system on the Aldgate to Bow tramways, recommend, in accordance with the report of Mr. W. M. MORDEY, that half a mile of the track should be overhauled and the studs modified in accordance with drawings prepared by Mr. MORDEY, who expresses the opinion that this, together with certain other modifications, will result in making the working of the system practicable. The cost of this is estimated at £500, which the "G.B." Surface Contact Co. will bear in the first instance, but the Council will refund the amount should the Board of Trade sanction the reconstructed line. The experiment will consist of running one or two cars over the length of line in question at night, especially under trying conditions of weather and track. Certain experiments are also recommended by Mr. MORDEY with the contact-brushes and collector. Unfortunately Mr. Mordey's full report has not been made public. The recommendation has been adopted. (Page 665.)

THE following books are reviewed in this issue:—"The Principles of Alternating Current," by E. T. Larner; "Logarithms for Beginners," by C. N. Pickworth; and "Fowler's Mechanics' and Machinists' Pocket Book and Diary for 1909." (Page 665.)

THE method adopted in Berlin for the control of the street arc-lighting from the generating stations is described. With this system it is possible to control any number of arc lamps of equal burning life and connected to the same point on the mains, by means of a single control conductor between the main switch-pillar at the point of connection and the central station control-board. (Page 666.)

IN his address as Chairman of the Newcastle Local Section, Mr. A. L. E. DRUMMOND gave a general review of recent progress in the electrical industry, and made special reference to the increase in the limit of capacity for a given speed of electrical machinery. (Page 666.)

AT the meeting of the Institution of Electrical Engineers on Thursday last, tributes were paid by Mr. W. M. MORDEY and Prof. JOHN PERRY to the memory of the late Prof. AYRTON, and a resolution of condolence to Mrs. AYRTON and the other members of the family was passed by the meeting. (Page 667.)

AN address delivered by Mr. G. F. PILDITCH as Chairman of the Dublin Local Section of the Institution of Electrical Engineers, dealt chiefly with the question of electric supply in residential districts. The author considered such matters as the prospect of improving the load factor, and of reducing the cost

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of services. Publicity matters and methods of charging were also dealt with. (Page 668.)

THE Oxford Corporation has refused to vary the terms of the original agreement with the National Electric Construction Co., for the contruction of electric tramways in that city. This agreement provides for the installation of the Dolter surface-contact system, or some other similar system, to the satisfaction of the Corporation, and for the payment of an annual rent. The company wished to be relieved of using a surface-contact system, and to instal a combined conduit and overhead system, and they further asked for a reduction in the rent payable to the Corporation. (Page 668.)

THE works of Messrs. Clarke Chapman & Co., at Gateshead, is interesting as an example of a works originally driven by steam, where the opportunities of cheap electric power supply are now taken full advantage of, as well as on account of the electrical and other engineering work carried on there, especially in the direction of the applications of electricity to marine purposes. (Page 669.)

A FRICTION-DRIVE device applicable for attachment to small high-speed motors to enable these to be used with large slow-speed ventilating fans is described. A total efficiency equal to that of a slow-speed motor fan is claimed. (Page 670.)

A 6,500-kw. 12,000-volt three-phase generator which has been installed at Niagara was described by Mr. B. A. BEHREND in a paper read before the American Institute of Electrical Engineers at their summer meeting this year. The mechanical construction of the rotor is dealt with at length in the Paper, and we reproduce a complete section drawing and several curves showing the performance of the machine, which were included in the Paper. (Page 671.)

SOME particulars of low voltage lighting installations carried out at Cambridge are described. Double-wound transformers and concentric wiring with uninsulated return were employed. (Page 672.)

IN a Paper read before the Birmingham Local Section of the Institution of Electrical Engineers, Mr. S. P. SMITH drew attention to the sources of failure and incorrectness of the method of testing alternators on short-circuit due to BEHREND, and modifications of that method, and then described an improved method by which the actual full-load conditions can be exactly imitated by supplying the total losses and the temperature rise and efficiency accurately obtained. In this method all the poles are fully excited, but they are grouped into "motor" and "generator" poles. The necessary difference between "generator" and "motor" voltages is obtained by having nearly twice as many "generator" poles as "motor" poles. In the discussion which followed the Paper, Dr. W. E. SUMPNER pointed out that the method described was not new; Mr. R. A. CHATTOCK doubted whether the results of such a test would be accepted by consulting engineers and others; Mr. EVEREST spoke in favour of the method in which the losses are obtained separately by no-load and short-circuit tests; and Dr. M. KLOSS suggested that the method described by the author should be adopted as the standard method by the Institution of Electrical Engineers. Mr. SMITH'S reply was postponed to the next meeting. (Page 673.)

AMONG the specifications published on Thursday last by the Patent Office is one by E. R. GROTE and THE FOSTER ARC LAMP AND ENGINEERING CO., LTD., in which a form of carbon electrode for flame arc lamps, with two or more hard cores, is described. A specification by G. BERRY relates to a modification of the well-known "Berry" series transformer distribution system, and another by the BRITISH THOMSON-HOUSTON CO., LTD., covers a method of constructing rotors for induction motors, whereby the advantages of open slots are obtained without the attendant disadvantages. Details in processes for manufacturing metal filaments are dealt with in specifications by H. ARON & A. GEIGER and W. D. COOLIDGE respectively, and P. GRAETZER has patented a further development of the cable and wire connector described in last week's issue. A patent taken out by SIEMENS BROTHERS DYNAMO WORKS, LTD., and E. O. KIEFFER covers a method of construction for commutators for high-speed machines, by which efficient cooling of the commutator is obtained. Short abstracts of the above are given in our Patent Record. Among the expiring patents is one by F. N. CONNET and W. W. JACKSON relating to meter mechanism, and another by R. T. and J. G. GLOVER for a prepayment meter. (Page 675.)

THE Bill embodying the proposals for a general tax on electricity and gas in Germany has now been drafted, and we publish this week a summary of the Bill and of the official explanatory memorandum. The taxation of not only electrical energy and gas, but also lamps and burners, is proposed. Electricity for power and heating, as well as that for illuminating purposes, is to be subject to the tax, whether used privately or sold to the public. The probable total revenue from the tax has been estimated at £2,500,000. (Page 677.)

THE case against the London and District Electricity Supply Bill was concluded on Tuesday morning, and the reply of counsel for the promoters was commenced at once. This reply on the part of the Hon. J. D. Fitzgerald was still being delivered when we went to press. The Parliamentary Committee of the London County Council have issued a report dealing with the Bills in which protest is made against the clause in the Board of Trade report upon these measures, which refers to the purchase of the undertaking of the London and District Electricity Supply Bill. The Parliamentary Committee of the London County Council state that in view of the instructions by the House of Commons to Sir Luke White's Committee, relating to the other two Bills, which give rise to questions of considerable importance, they are giving the whole matter their careful consideration. Counsel has been retained by the London County Council to discuss the Board of Trade's report with the Committee when it comes up for consideration. (Page 678.)

THE Prime Minister has agreed to receive a deputation from the London County Council on the question of the establishment of a London Traffic Board on November 26th.—The Paddington Borough Council has refused to consent to the construction of tramways from Harrow Road to Maida Vale.—In connection with the construction of tramways in the Eltham district, the Astronomer Royal has objected to the use of overhead wires owing to the possibility of interference with the instruments at the Greenwich Observatory.—The Rhyl Council have approved of the light railway scheme proposed by the Llandudno and District Tramways Co.—Agreements have been sealed between the Grimsby Corporation and the Admiralty for a supply to the wireless telegraph station at Humberstone.—The Tynemouth Corporation have retained Messrs. Handcock and Dykes to report upon the electric lighting undertaking.—Telegraph wires in Aberdeen have been transferred underground in about 200 thoroughfares.—A number of 50 c.p. Nernst street lamps in Barnes are to be changed to 100 c.p. Osram lamps. (Page 679.)

THE Auckland (N.Z.) Council propose spending £4,800 in additional consumers' services. Cable to the value of £300 is required at Clacton. A loan of £150,000 is to be applied for by the Glasgow Corporation for the purposes of the electricity undertaking.—The Yarmouth Corporation are applying for a loan of £2,000 for public lighting.—Local Government Board inquiries have been held at Hounslow, £7,088, and Wolverhampton, £6,000. A loan of £4,900 has been sanctioned to the Surbiton Council by the Local Government Board.—Tramcar trucks and tramcar resistances are required by the Manchester Corporation. (Page 681.)

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THE Anchor Cable Co. are inviting subscriptions to an issue of £50,000 4½ per cent. debenture stock at 125.—The Lancashire Power Constrution Co. are creating debenture stock to the extent of £150,000. (Page 683.)

SOME notes are given on the reconstruction of the San Francisco tramway system after the earthquake and fire of 1905, including the conversion to the overhead trolley system of most of the lines formerly worked by electric traction. (Page 683.)

A LETTER received from Mr. K. FAYE-HANSEN, of the British Westinghouse Company, criticises the views expressed in Mr. A. H. DYKES'S recent article as to the relative advantages of balancer-, auto-, and double-winding transformers for low-voltage lighting installations, and finds fault with some of his figures. (Page 664.)

THE London Electrobus Co. have issued a statement with regard to the working for the period from July 15th, 1907, when their 'buses were first placed upon the streets, until October 15th of this year. This shows that the average takings of the 'buses have been 14d. per 'bus mile. The total number of passengers carried to date on the company's 'buses was nearly 3,000,000, and the statement referred to includes some figures comparing the results of the company with those of the London General Omnibus Co. and the London County Council tramways. During the first twelve months of the company's operation the earnings only exceeded the operating expenses by £743, which was not sufficient to meet establishment and other expenses of the company. For the last three months, however, the earnings have exceeded the operating expenses by £1,526. (Page 685.)

THE first of the four American three-phase locomotives which are to be used on the system of the Great Northern Railroad in the Cataract Tunnel has been delivered. It is driven by four slip-ring induction motors, with rotor rheostatic control. Current will be obtained from a water-power station, and the water-wheels will be allowed to slow down and lower the frequency on heavy load to assist in the starting of the locomotives. (Page 685.)

THE first annual report of the Special Traffic branch of the Board of Trade, which was constituted last year, has been issued by Sir Herbert Jekyll, who has charge of this Department. The report is intended as a supplement to the report of the Royal Commission on London Traffic, and deals with the progress that has been made since the latter was published. The formation of a special Traffic Board is favourably commented upon, and a scheme of amalgamation and co-ordination of the existing locomotion facilities in London and Greater London is strongly advocated. (Page 686.)

MR. MORDEY'S report to the L.C.C. on the "G.B." system is favourable to a further trial, after modifications have been made in the construction of the studs and the collectors, with the apparent aim of reducing leakage and surface sparking. Unfortunately only the recommendations in Mr. Mordey's report have been made public, but we publish this week all the information that is available. The technical details have been suppressed for the present, but we gather that he thinks that the magnetic permeability of the stud head is deficient, and may be improved by the substitution of steel of better magnetic quality than the iron at present in use. It appears that the object to be gained by this is better contact with the collector (which, it will be remembered, is a flexible chain magnetically attracted into contact with the stud surface), and thereby a diminution of the visible sparking which has been much complained of. The change will not make a proportionate difference in the actual working of the switch movement itself, because by far the greater portion of the path of the effective magnetic flux is in air, or its magnetic equivalent, paving, concrete, and subsoil; but any small improvement in the permeability of that path is to the good, not only for the more certain switching "on," but for more certain switching "off." The other suggested alteration published is in the insulation of the collector, in which the wooden coverings, and hemp suspension ropes are to be made impervious to moisture by soaking in paraffin wax, or something analogous. We can only express the hope that this soaking will have the good effect that is anticipated. It is very likely that the condensation of the report does Mr. Mordey an injustice, and is the reason for the absence of any specific recommendation to remedy the heavy surface leakage from the studs which has been alleged. The reticence with regard to the details of Mr. Mordey's experiment and report is quite comprehensible in view of the political situation on the L.C.C. and the commercial interests at stake, as well as the possibility of the report containing technical criticisms of that part of the work due to the permanent officials of the Council; but as the document in question is a report from an impartial expert of the highest ability and reputation, it is surely time to make public the technical facts, and the results of the tests which so experienced an investigator has made. In tramway circles very divergent stories are afloat as to what actually happened in the Mile End Road, and for the general information of the industry the truth should be made known. Those who have studied the subject are curious to ascertain whether it is possible to make a surface-contact system work efficiently in London; a good trial is to be given to a system which has already passed satisfactory working tests in a provincial town, and it is desirable, in the interests of progress, to know what actual difficulties have been met with under the more exacting conditions of London traffic. We are glad that, as a result of Tuesday night's debate in the Council, a further trial will be given, and we trust that a sensible advance towards good and safe working will result therefrom.

THE Royal Commission on London Traffic recommended the creation of a special permanent Board to deal with the whole subject of London public transport by methods of oversight and control with considerable executive powers. Although no such body has yet been formed and invested with the necessary authority, the Board of Trade appointed a special department to watch the conditions and to record the changes which come about. The effect is to continue and keep up to date the work of the Royal Commission, and as it must be supposed that the work is intended to serve a useful purpose, the inference is that the Government recognises that sooner or later authority must be given to someone to carry out the functions suggested by the Royal Commission, and that it will help a good deal to maintain the record. Otherwise the Traffic Authority may easily spend its early years in revising the Royal Commission's statistics. The first report of the London Traffic Department appears to follow these lines, as it reads very much like an additional volume of the Commission's report, chronicling the changes of the last three years, and drawing such inferences from the statistics as may indicate desirable future developments. The changes

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recorded are very important. Twenty-six miles of new tube railways have been opened. Sixty-eight miles of steam railways have been electrified. An additional twenty-six miles of tramways have been electrified by the London County Council. Eighty miles of new electric tramways have been provided in outer London. Over a thousand motor-omnibuses and a large number of motor-cabs have been introduced in London. Kingsway, Aldwych, the new Vauxhall Bridge, and the Rotherhithe Tunnel have been opened. The South London tramways have crossed the river at Vauxhall and Westminster, and now join up to the North London system *via* the subway. The yearly journeys per head in Greater London have increased from 200 in 1901 to 300 in 1907. It is clear, as the best traffic experts have always maintained, that in London travelling is mainly a matter of facilities. The report alludes to the financial results of the tubes, and of the electrified underground railways, as disappointing. This is somewhat premature. The time has not yet come at which the traffics are stationary, and at which the best possible arrangements as to fares and services can be said to be attained. On the contrary, the traffic returns show pretty general increases, and frequent changes in services, and increase of through booking and other facilities, show that the companies are not yet satisfied that they are making the best of their undertakings. Finally, the most potent contribution to traffic on these lines comes from new habits and shifting of population, which take time to bring about. The tramway development is reported on much more favourably. The good progress made is an argument for extending tramway benefits throughout London, and it cannot be long before such neglected districts as Kensington and Bayswater, not to mention the sacred City, will realise that the tramway is a boon to be invited, not an evil to be repelled. The facilities given by the City Corporation in respect to the crossing of Blackfriars Bridge, and the extension of the northern lines to Liverpool Street, are proof that this knowledge is penetrating in quarters which have hitherto only appreciated the drawbacks of tramways. Such "peaceful penetration" is the most satisfactory, but wofully slow. It is most unfortunate for London that municipal and even Imperial politics have made the London Traffic Board a question of party warfare, and it is most fervently to be hoped that the present Government will deal with the subject in a broad-minded and business-like way, considering only what is needed for the greater good of Greater London.

REDUCTION IN THE PRICE OF OSRAM AND TANTALUM LAMPS

THE large demand for Osram lamps have enabled the manufacturers to introduce several economies in their manufacture, with the result that from Monday last considerable revisions have been made in the list prices, which are now as follows :—

100–135 volt 28 and 35 watt	3s. 6d. each.
100–135 volt 55 watt	3s. 9d. each.
200–260 volt 50–65 watt	4s. 9d. each.
25 volt pear-shaped 10–16 watt ...	2s. 6d. each.
50 and 55 volt	3s. 0d. each.

All other existing terms and conditions of sale continue in force.

Similarly, the makers of the Tantalum lamp notify reductions in the price from 3s. 6d. to 3s. for the following :—65–75 and 100–160 volts, 32 c.p., ordinary spherical bulb Tantalum lamps, and 100–160 volt, 50 c.p. sun Tantalum lamps, both bell and spherical shape bulbs.

G.B. SURFACE CONTACT SYSTEM IN LONDON

Further Experiments to be Made

AT the meeting of the London County Council on Tuesday, the report of the Highways Committee (given on the opposite page), recommending further experiments in connection with the G.B. surface contact system in the Mile End Road, was agreed to after some discussion.

Sir JOHN BENN moved the following amendment to the Committee's report :—"In view of the failure of the stud system of tramways on the Aldgate to Bow Road, the grave state of revenue to date, and the continued public inconvenience, the recommendation be referred back to the Committee, as the Council is of opinion that the conduit system of electric traction should be installed forthwith." The speaker stated that he was fortified in this view by the fact that the Council's tramways officers did not think Mr. Mordey's suggested alteration could be carried out at the cost which that gentleman had estimated.

Mr. H. H. GORDON seconded the amendment in a long and highly technical speech, in which he contended that the G.B. system was quite unsuitable for engineering reasons.

Sir GEORGE TAUBMAN GOLDIE compared Mr. Gordon's speech to a Paper before the Institution of Civil Engineers, and considered its effect was rather lost upon a Council not composed of electrical experts. He said that the Council, having engaged a leading engineer to report on the matter, must follow his guidance. In supporting the Committee's recommendation, moreover, he rather thought Sir John Benn had entirely overlooked the enormous difficulty of installing the conduit system on the road in question.

Captain HEMPHILL regretted that the Chairman of the Highways Committee had not taken up a fighting attitude towards the Stepney Borough Council, who had stood in the way of more than one Highways Committee in refusing to give its consent to the overhead system.

After some further discussion, the amendment was rejected by a majority of 18, and the Committee's recommendation was adopted.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 19TH.

Royal Society.

4.30 p.m. Meeting at Burlington House, Piccadilly, London. Among the Papers down for reading are the following :—(1) "Note on Horizontal Receivers and Transmitters in Wireless Telegraphy," by Prof. H. M. Macdonald, F.R.S.; (2) "Note on the Effect of Hydrogen on the Discharge of Negative Electricity from Hot Platinum," by Prof. H. A. Wilson, F.R.S.

Institution of Electrical Engineers.

8 p.m. Extra meeting at 25 Great George Street, Westminster. Col. R. E. Crompton, C.B., the retiring President, will distribute the premiums awarded for Papers read during the session 1907–8. Mr. W. M. Mordey will then deliver his Presidential Address, and afterwards hold a reception in the library.

FRIDAY, NOVEMBER 20TH.

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. Meeting at the Sunderland Literary Society, Fawcett Street, Sunderland. Paper to be read :—"The Electrical Equipment of Cranes," by J. Brentnall Duckett.

TUESDAY, NOVEMBER 24TH.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Meeting at the Municipal Technical School, Whitworth Street. Paper to be read :—"Central Station Design," by J. H. Baxter.

WEDNESDAY, NOVEMBER 25TH.

Institution of Electrical Engineers: Newcastle Local Section.

7.15 p.m. Annual Dinner at the rooms of Messrs. Tilley & Co., Blackett Street.

Institution of Electrical Engineers: Leeds Local Section.

7.15 p.m. Meeting at the University. Paper to be read :—"Comparison of Natural and Induced Draught Systems," by W. N. Y. King.

THURSDAY, NOVEMBER 26TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster. Paper to be read :—"Domestic Electric Supply (including Heating and Cooking) as Affected by Tariffs," by W. R. Cooper.

FRIDAY, NOVEMBER 27TH.

Electro-Harmonic Society.

8 p.m. Concert (Ladies' Night) at King's Hall, Holborn Restaurant.

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THE "G.B." SURFACE-CONTACT SYSTEM IN THE MILE END ROAD

THE Highways Committee of the London County Council have now reported on the working of the "G.B." surface-contact system upon the Aldgate to Bow tramways. It will be remembered that these lines were opened for traffic in June, 1908, but on July 28th–29th, 1908, the Highways Committee reported that the results obtained from the working of the system as it then existed were such as to show that it would not be practicable to continue the use of the system consistently with the safety of the public using the roads and the efficient working of the tramways, and that arrangements had been made, therefore, for the electric cars to be withdrawn temporarily. In the circumstances, the Council decided to obtain expert advice to enable it to determine whether it would be practicable, consistently with public safety, to render the system safe and efficient. Mr. W. M. Mordey, as the result of very full investigation of the whole matter, has reported that in his opinion all the defects which have shown themselves in the working of the "G.B." system on the Aldgate to Bow tramways are remediable, and that the working of the lines may be made efficient and safe. Mr. Mordey suggests that to demonstrate the practicability of giving effect to his suggestions the following course should be adopted :—(1) A length of not less than half a mile of the track should be overhauled and the studs modified. (The modifications are fully described in Mr. Mordey's report.) All studs should be tested to a definite standard of working, electrically and mechanically, before being put back on the track. (2) One or two cars should be run over this length of track at night, especially under trying conditions of weather and track. (3) Each car should be fitted with extra contact brushes, connected alternatively to a resistance shunt and to a condenser in order to try both methods. The presence of live studs should be insured by adding to the mud on the road at a sufficient number of points to enable a thorough trial to be made. (4) The collector should at first be used as it is now, then with two exciting coils only. The wood coverings of the collector should be made impervious to moisture by soaking in hot paraffin wax or other suitable impregnating material. The wire and hemp suspension rope should be treated in the same way. Mr. Mordey does not think it necessary to change the whole of the stud heads for this trial. About 50 cast-steel heads should, however, he states, be put in mainly for finding how much they improve the contact with the collector—by reason of the better magnetic quality of the steel. The time which would be occupied in making the experiment that Mr. Mordey suggests would not exceed a few weeks.

The modifications proposed will not, it is stated, alter the chief features of the system.

The licensors have been furnished with a copy of Mr. Mordey's report, and they have expressed their willingness, if so desired, to adopt the suggestions contained in that report; and they further state that they will be prepared to adapt and work, at their own cost, an experimental length of line, provided the Council allows the equipment and use of not more than four of its cars for the purpose, and undertakes to repay to them the cost incurred in giving effect to the expert's suggestions, if the Board of Trade sanction the use of the system as so modified.

The report continues that in giving effect to this arrangement care will be taken to secure that as far as possible all risks of danger to the public will be avoided by the experimental car being run in the night-time when the traffic in the thoroughfare is slight; and, in selecting the portion of the route to be used for the experiment, regard will be had to the requirements of the present horse-car services on these lines, which will be maintained until permanent electric services along the whole route can be instituted. The total cost of the experiment will be about £500. A supplemental agreement with the necessary parties to give effect to these proposals, and also to clear up certain outstanding matters in respect of work already done under the contract for car equipments, is recommended, and the following are the main heads of such an agreement :—

(1) The licensors at their own cost to make the necessary alterations to about half a mile of track and provide and fix equipments to such number of cars to be provided by the Council, not exceeding four, as may be necessary to enable the licensors to make further experiments at their own cost with the system under the direction and in accordance with the requirements of Mr. Mordey and to his satisfaction. The Council to provide the necessary electric power.

(2) In the event of the Board of Trade issuing its unqualified certificate for the permanent use of the system on the Aldgate to Bow Bridge line the licensors to be repaid the cost of the work, such cost not to include any sum for the services of the licensors, nor any profit on the cost to the licensors of the work or on the labour. Any dispute to be settled by arbitration.

(3) The works and experiments to be completed within a period to be fixed by the agreement. The running experiments to be of such a nature and extent as Mr. Mordey may consider expedient. The times of the experiments to be arranged not to interfere with the running of the horse-car service.

(4) The licensors to indemnify the Council against all claims arising out of the works and experiments.

(5) The chief officers of the Council to be afforded facilities for inspection of works.

(6) A payment of £1,000 on account of materials supplied under the contract for car equipments, dated December 20th, 1907, to be made to the company, and any disagreement as to further payment under that contract to be settled by arbitration. The licensors to use such of the said materials as may be suitable for the further experiments and make an allowance to the Council therefor.

REVIEWS OF BOOKS

The Principles of Alternating Current. By Edgar T. Larner. 132 pp. 7½ by 4¾ in. 68 illustrations. (London : Crosby Lockwood and Son.) 3s. 6d.

THERE are many text-books which, like the present one, aim at giving a clear knowledge of the first principles of alternating-current theory to those who have not had the advantage of a mathematical training, but we do not think that the present author can claim to have produced a work much more lucid than some of those already existing. It is very important that the student who plunges into alternating currents with the severe handicap of a complete lack of knowledge of mathematical methods should, at the very beginning, realise some sort of physical conception of a magnetic field, of the effect of one magnetic field on another, and of the reaction between a current-carrying wire and a magnetic field. Looking at the question from this point of view, we feel inclined to criticise the first figure of the book, which seems to indicate some misconception on the part of the author of what happens when a conductor cuts through a magnetic field. The magnetic lines are shown yielding to the conductor and eventually closing round it. According to the recognised nature of magnetic fields, the lines would not yield to the conductor unless it carried a current. They can be distorted only by the influence of another field, such as that which would be present round the conductor only if it carried a current, but is not shown in the figure. Again, as a line of force always tends to shorten itself, it will not curl round even a current-carrying conductor, and meet at the other side, but will snap across the intruding conductor after a certain amount of yielding. These may seem mere details, but once a reasonable physical conception of such phenomena has been obtained, the student's way is easy, and it is certainly a mistake to bring him up to the idea that magnetic lines of force will yield to a mere piece of metal. The author follows his introduction with the usual rules for the direction of induced currents and a few remarks on units. Mechanical analogies are used to much advantage in explaining the simplest phenomena as well as those which are more difficult to grasp. After dealing briefly with Helmholtz's equation, the first chapter concludes with some notes on the effects of inductance and capacity. In Chapter II. simple harmonic motion is explained, and the graphical representation of quantities by means of vectors is introduced in the next chapter. In Chapter IV. alternating currents are dealt with, and in the following chapters the calculations relating to circuits containing inductance and capacity are explained and illustrated by numerical examples. The book is well arranged, and a large number of exercises, without, however, any answers, are included.

Logarithms for Beginners. By Charles N. Pickworth. Second Edition, 42 pp. 7¼ in. by 5¾ in. (London : Whittaker and Co.) 1s.

IN preparing a second edition of this well-known book on logarithms, the author has taken advantage of the opportunity offered for correcting a few numerical errors; otherwise, the work is unaltered. It is doubtful whether a more practically useful work on logarithms than the one under review exists, and, on account of the concise and lucid manner in which the methods and reasons of the various operations are explained, the book is admirably suited for those students who are obliged to teach themselves. A judicious use of italics and heavy type and careful arrangement in chapters and paragraphs, have considerably added to the value of the work.

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Fowler's Mechanics' and Machinists' Pocket Book and Diary, 1909. Edited by W. H. Fowler. 448 pp. 3¾ in. by 6 in. (Manchester: Scientific Publishing Co.) 6d.

ALTHOUGH this new pocket book has been brought out primarily for the use of fitters, turners, foundry-men and apprentices, it will be welcomed by many other classes of workers. The sections include a large and up-to-date collection of rules, references, and tables, the elementary principles of mensuration, geometry, and trigonometry, a description of the various materials used in machine construction, and the principles of machine tool design. A large amount of information concerning machine tools, including screw-cutting lathes, drilling and boring machines, planers, &c., is also given. The application of electric driving to these and other machine tools is dealt with, and other sections are devoted to belt and wheel gearing. In a section entitled "Shop Practice," much helpful information is given, and another useful section is that dealing with the proportion of machine tool parts. The whole is profusely illustrated with line drawings. This book should have a large circulation, especially amongst the more intelligent class of workmen and workshop apprentices.

REMOTE CONTROL OF STREET LIGHTING IN BERLIN

THE method adopted by the Berlin Elektricitäts-Werke for the remote control of the public arc lighting is described in an article by R. Mylo in a recent issue of the *Elektrotechnische Zeitschrift*. This system, which has been developed by the Allgemeine Elektricitäts-Gesellschaft, of Berlin, permits of any number of arc lamps of equal burning life, and connected at one point on the mains, being controlled from the central station by means of a single conductor. The accompanying diagram shows the connections in the local switch-pillar and also at the central station. In this diagram four groups of four arcs in series are shown connected to the three-wire continuous-current mains through the circuit-indicators *A*, *B*, *C*, and *D*, and the switch contacts *E* and *F*. Two groups are shown connected between the positive outer and the neutral, and two between the negative outer and the neutral.

When the lamps are switched off, the main switches, *E* and *F*, are in the position shown dotted, and the indicator solenoid *K*, being connected between the neutral and the positive main, the needle points to "out." To switch the lamps on, the attendant in the central station puts the switch, *H*, to the "on" contact, and this causes a current to flow through the closing solenoid, *L*, of the main switch, which is instantly closed. So long as all the arc-lamp circuits are complete, current flows from the negative main through all the series coils of the

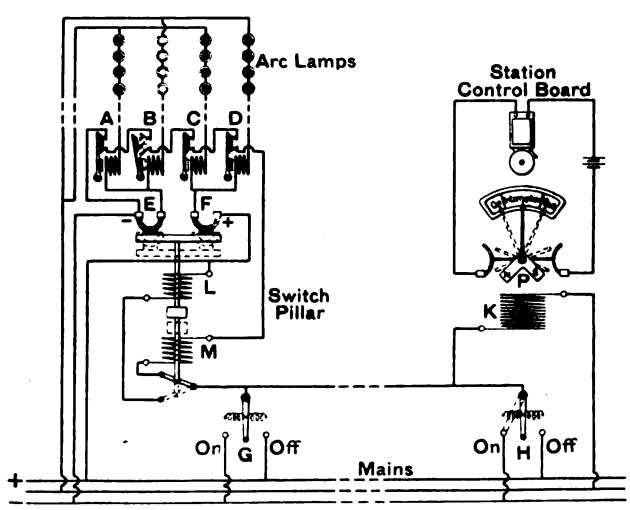

DIAGRAM OF CONNECTIONS IN SWITCH PILLAR AND AT CENTRAL STATION.—(ONE GROUP OF ARC LAMPS EXTINGUISHED.)

circuit indicators, *A*, *B*, *C*, and *D*, the coil, *M*, and the indicator solenoid, *K*, to the neutral main. As the current through the solenoid, *K*, is thus reversed, the other pole of the permanent magnet, *P*, will be attracted, and the indicator will point to "on." The attendant then releases the switch, *H*, which automatically springs back to the neutral position.

If an interruption in any one of the arc lamp circuits occurs, the magnet of the corresponding circuit indicator looses its magnetism, and the armature falls away, thus breaking the indicator circuit. Although this current normally flows through the opening solenoid, *M*, of the main switch, its cessation has no effect on the latter. The indicator in the station, however, points to "interruption," as, in consequence of there being no current in the solenoid *K*, neither pole of the permanent magnet, *P*, is attracted, and the pointer swings to the mid-position. This closes a bell circuit, as shown in the diagram, and the attendant is notified of the interruption. The accompanying diagram shows the circuit in the above condition—namely, all the lamps switched on, but an interruption in one arc-lamp circuit.

In order to switch the lamps off, the attendant at the central station puts the switch, *H*, to the "off" position; this causes a current to flow through the opening solenoid, *M*, with the result that the main switch is opened. Directly the contacts, *E* and *F*, are broken, the circuit-indicators, *A*, *B*, *C*, and *D*, loose their magnetism, the armatures fall away, and the indicator circuit is broken. It is established again, but with current in the reverse direction, when the small switch at the bottom of the main-switch plunger reaches the lower contact; the station indicator then points to "out," as explained before. In the case of a permanent interruption due to a fault in one of the arc lamps, a man is sent to the corresponding switch pillar, and then, with the aid of the control switch, *G*, can soon see in which group the faulty lamp is, by observing the circuit indicators. To prevent simultaneous use of the two control switches, *G* and *H*, the man at the switch pillar warns the central station attendant by telephone. Every switch-pillar is connected by telephone to the station. This system, which has been in operation in Berlin for some long time, is said to have given every satisfaction.

THE DEVELOPMENT OF THE ELECTRICAL INDUSTRY

THE first meeting of the 1908–9 session of the Newcastle Local Section of the Institution of Electrical Engineers was held at Armstrong College on Monday, when Mr. A. L. E. Drummond, the chairman of the Section, delivered his inaugural address. Mr. Drummond dealt first with the present position of the telephone industry. To-day the National Telephone Co. has 1,450 exchanges, with 450,000 subscribers' instruments and 1,100,000 miles of wire. The present position of the Post Office telephone system is that it has 30,000 subscribers' instruments. Municipal telephones have, he said, been a failure, as the remaining two municipalities now possessing their own systems—Hull and Portsmouth—have only 2,500 and 2,600 subscribers respectively.

After supporting the principle of the message rate system of charging, Mr. Drummond referred to the education question as applied to engineers. It was, he said, a moot point whether a young man qualifying for engineering should go straight from school to a technical college or to a shop, or whether a combination of these two methods should be adopted. The third alternative was probably the best, but under present conditions it was difficult to work properly in practice. Speaking on commercialism in engineering, the Chairman remarked that business is not sentimental. Designers and producers aim at bringing out the best article at the lowest prices, and commercial training had better be included in a student's curriculum than some subjects now considered obligatory. Turning to the developments of the past year, Mr. Drummond mentioned the important increase of power supply on Tyneside. The great station at Carville had increased fourfold in capacity during the last four years, having now the greatest output of any power station in Europe. Closely allied with this was the subject of turbines. Twenty-four years ago Parsons introduced his 10-h.p. engine. Nineteen years ago the first lighting station turbine was installed in the central station of the Newcastle & District Electric Lighting Co., Ltd. Seventeen years ago came Prof. Ewing's historic tests, and at a later date the turbine sets at the Manchester Square station, London, saved its reputation by abolishing the serious trouble experienced in the vibration caused by reciprocating engines. Interesting in this connection was the increase of size for a given speed of electrical machinery. Thirteen years ago the largest dynamo had an output of 120 kw. and a speed of 3,000 r.p.m. It was now possible to obtain 500 kw. at the same speed, and we could obtain 1,500 kw. in a single dynamo. In alternators the capacity had increased in the same period from 1,000 to 4,000 kw., and in the near future greater improvements could be expected as the conditions of overload, heating, and regulation were more exhaustively studied.

Underground Telegraph Wires.—In reply to a memorial from the Association of the Chambers of Commerce of the United Kingdom, making recommendations in favour of underground telegraph wires being laid to Land's End, the Postmaster-General states that in his last report he expressed the hope that the underground lines would reach Penzance during the current financial year, and he trusts no very long time may elapse before it is completed to Porthcurno, the point from which the Eastern Telegraph Co.'s cables start.

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THE LATE PROFESSOR AYRTON

Tributes by Mr. W. M. Mordey and Prof. John Perry

THE meeting of the Institution of Electrical Engineers on Thursday last, at which Mr. W. M. Mordey was to have delivered his presidential address, was adjourned in consequence of the death of Prof. W. E. Ayrton, F.R.S., Past President, after speeches by Mr. W. M. Mordey and Prof. J. Perry.

Mr. W. M. MORDEY said :—Gentlemen, to-day many of us gathered round the grave of our revered past president, Prof. Ayrton, and joined, with the representatives of other societies in which he was interested, and in connection with which he did work perhaps as valuable as he has done for this society, in paying a tribute of respect to his life. We meet here to-night, not to inaugurate, in the usual way, a new session—our thirty-eighth session—but to mark officially, as the Institution of Electrical Engineers, our sense of the very great loss that we and electrical engineering and electrical science have sustained, and to send to Prof. Ayrton's family a message of our deep sympathy. In him we have lost one of our most useful and distinguished members. This is not an occasion when any account need be given of his life or of his work; the time for that will come later, but I may remind you that since this Institution was founded he has been one of the mainstays of it. He was elected a member in 1872, when the Institution was the Society of Telegraph Engineers. After twenty years of strenuous work to further the objects of this Institution, he became president, and before and ever since then his efforts have been continuous in furthering the objects that we all have at heart. For five years, from 1897 to 1902, he filled the office of treasurer, and the establishment on a sound foundation of the finances of the Institution is very largely due to the work that he did during that period. As for his usefulness, I need hardly refer to it. I have looked through our Journal and found that, during the 36 years of his membership, he has read before us 32 papers, most of them in conjunction with his old friend and colleague, Prof. Perry; but that was only a very small part, even of his written work. We lose in him one of the small band of learned teachers who have done so much to establish electrical engineering on the firm foundation upon which it rests. His early work in particular was especially useful. It was his idea to experiment always, to aim at accuracy and at measurement. These were the three words that express the leading idea of the practical work which he did at a time when he and a few others really placed practical electrical engineering measurement on a firm engineering basis. His work does not die with him; it lives in particular, I think, in his pupils and the men who learned from him to imbibe, not merely ordinary knowledge, but the principles of earnestness and endeavour, and the effort to be of service to their fellows, which was his great characteristic. His name is known all over the world; in fact, in every country where electrical engineering is known at all his name is known, and equally his pupils are all over the world. I think we may all claim to be his pupils. For myself, I attended his evening classes in 1881, and I think I am proud to say I have been his pupil ever since. This occasion is a sad one, but it is not proper that we should look entirely on the sad side. I think, as I ventured to say the other day with regard to his master, Kelvin, that whilst we deplored his death, we were glad that we could feel thankfulness for his life and for his work. We have lost a man who, I am sure, will always be looked upon as one of the founders of electrical engineering in this country, and I think that I cannot do less than say, in closing these remarks, that our last thoughts of him should be one of thankfulness for his life and for his example. Before closing the meeting I will call on Prof. Perry, his old colleague and friend, to speak, and then I will ask you to join with us in a resolution of condolence to his family.

Professor JOHN PERRY, F.R.S., said :—Gentlemen, I do not like very much to speak on this occasion. My partnership with Prof. Ayrton was for fifteen years, and we had a close friendship of over one-third of a century. My pride in having been Prof. Ayrton's partner and in sharing credit with him for work published in our two names warps my judgment. In Prof. Ayrton we have suffered a great loss. The service which we demanded from him as a member, and as a member of the Council, was a labour of love. It was seldom, so long as his health allowed, that he let any business, however important, interfere with his attendance, not merely at the general meetings, but at meetings of the Council and the Council committees of this Institution. The work of our Council has gradually become very complex, but to that work he brought an intelligence and keenness which perceived at once the essential point in every question, and a very large experience of the world. His love for the work gave a scope for that energy, that earnestness, that untiring industry, that hatred of inaction, which were his intense characteristics. But he also had a love for this Institution which was characteristic of Latimer Clark and General Webber, the love of the nurse or mother for the son who has gradually grown up to splendid manhood. I was privileged to assist Prof. Ayrton in his scientific work in Japan and England. When I arrived in Japan in 1875 I found a marvellous laboratory such as the world had not yet seen elsewhere. Fine buildings, splendid apparatus, intelligent students, and a never resting keen-eyed chief, of great originality and novelty; these were what I found in Japan. I am only occasionally energetic; he was always working at fever heat. I often expressed my annoyance at getting half the credit when about 20 per cent. of it was my fair share, and when we got back to England things went on in the same way. He arranged a laboratory of a quite different type at Finsbury, and later he arranged what is now, in my opinion, the finest laboratory in the world at Kensington, a combination of the ideas of Japan and Finsbury. He worked incessantly, and I continued to get half the credit, until at length the thing was insupportable, and I forced a rupture. He was at Kensington doing all the work; I was at Finsbury; and we met rather to discuss his results than for me to do anything. I hope you will forgive this apparent criticism; it is history. My self-respect caused me to force a rupture. But I was not angry; I loved and respected him all the time, and after a while I let him know this. I let him see that it had been the only course of action that was possible. Except for a few months, therefore, during exactly one-third of a century we were always the best of friends. He was not only a scientific experimenter, but he was a telegraph engineer, and, indeed, even in 1879 what we may call an electrical engineer. Educationally, the methods which he used at Finsbury were quite a new departure. Hitherto professors had experimented at the lecture table while the students looked on; but Prof. Ayrton held a brief not merely for the more clever, but also for the average student. Lectures were given, but what made them so intensely interesting was the illustrative experimental work which the student had to do with his own hands. His students learned by doing rather than by listening. Also he never aimed at creating a perfect engineer. He aimed at creating a learner, a man who would learn engineering when he had the chance, a man whose education would go on until he died. His methods have been adopted in every technical college in this country, not only in electrical, but also in mechanical engineering, and in other applications of science. Every one of his numerous inventions was schemed and studied, designed and experimented with, altered and used. Often after proving successful a thing was dropped because there was other and much more interesting work to look after. This is all old history now, but many of these inventions will be found to be essential parts of the most modern electrical machinery. I do not mention his later work with Mr. Mather, Dr. Sumpner, and others, because I know less about it. I speak of the pioneer time. If these things are forgotten, what does it matter? Ayrton, the pioneer, had a pleasure as pioneer which few people experience in this world. He was despondent towards the end, but he was despondent not because his work was forgotten—that was nothing—he was despondent because his failing body would not respond to his vehement spirit. He worked hard until he could work no longer, and when he knew that he could work no longer he died—heart-broken. Mentally he was strong until the end. He rests at last. He could not be restful living.

Mr. W. M. MORDEY then moved the following resolution :—

"That we, the President, Council, and Members of the Institution of Electrical Engineers, desire to convey to Mrs. Ayrton and to the other members of Professor Ayrton's family an expression of our deep sorrow at the death of Professor Ayrton, our revered Past President, and assure them of our deep sympathy in their bereavement."

After the resolution was carried by the members standing in their places, the meeting adjourned.

At the meeting of the Dublin Local Section of the Institution of Electrical Engineers on November 12th, a vote of condolence with the family and friends of the late Prof. Ayrton was passed.

A similar vote of condolence was also passed at the meeting of the Newcastle Local Section on Monday.

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ELECTRICITY SUPPLY IN RESIDENTIAL DISTRICTS

THE address by Mr. George F. Pilditch, as Chairman of the Dublin Local Section of the Institution of Electrical Engineers, which was delivered at the meeting of the section on November 12th last, dealt chiefly with the question of electricity supply within purely residential districts. Perhaps of all the adverse conditions under which such undertakings have to work, said the author, their poor load factor is the most vital. There cannot be much demand for energy for power purposes unless, of course, it be used for tramways, but that is seldom the case, as the tramway system is rarely a purely local concern. Practically, then, the only apparent means of improving the load factor is by an extended use of electric heating apparatus and cooking utensils. In almost every case current for heating and cooking purposes can be obtained at quite a reasonable figure, and yet consumers cannot be persuaded to make use of it, because of the high initial cost of the apparatus. It can be demonstrated that the current consumed for cooking purposes is not by any means an expensive item; but so long as people are asked to pay such prices as 40s. for a frypan, 24s. for a kettle, 22s. for a flat-iron, and so forth, the prospect of such articles becoming of general use is almost hopeless.

Another adverse condition is the fact that in almost all residential districts the houses are situated some distance from the road, with the result that the cost of the services from the supply mains is out of all proportion to the revenue yielded. In Rathmines, for instance, the average length of cable used per house is about 55 ft., and the cost of the services on the solid system works out at about £7 each. This is a very big outlay, as in some cases the revenue per consumer only amounts to about £1 or 25s. per annum, the average revenue being about £6. The cost has been brought down to an average of about £5 10s. per service in Rathmines by using steel-armoured cable laid direct in the ground, but a very much cheaper service than that is wanted for small consumers.

Few undertakings supplying residential districts are wealthy enough to support a separate publicity department. Yet it is absolutely necessary that the advantages of the use of electricity should be constantly brought before the notice of the residents. I tried the effect some time ago in Rathmines of distributing 2,000 copies of a pamphlet, but only three residents asked for further particulars. I then tried the effect of putting on a canvasser to follow up the pamphlet, and for this purpose I selected the meter reader, who was well acquainted with the district, and able to give reliable information as to the consumption for the different classes of houses. The remuneration for canvassing was made dependent upon the results. This method has been attended with great success.

As an accessory to the canvassing, however, there seems to me to be a well-defined necessity for some sort of educational literature, such as that which the London undertakings are issuing regularly. A production of this kind is expensive, but something could be done in this way on the co-operative principle, so that the benefit of a system of literature distribution regularly and thoroughly carried out could be obtained on economical lines.

I am bound to confess that I do not believe in local electrical exhibitions. I would prefer to see something in the nature of permanent showrooms, where the local wiring contractors could exhibit their fittings under proper conditions in co-operation with the supply authority. At the same place accommodation should be provided for the collector and canvasser, so that inquirers could get all information they desire. An occasional demonstration of electrical cooking might be given with advantage.

A further difficulty is that the majority of houses are held under yearly or, perhaps, three-yearly tenancies. The tenants are therefore not prepared to spend money on the wiring. On the other hand, the landlords will not spend money on having their houses wired so long as they can continue to let them without doing so. A cheap form of wiring would get over this difficulty to some extent, but in order to make any real headway it must be possible for the supply authorities to put in installations free of cost, and to charge a small rental for the use of the same.

This brings me to the tariff question. For lighting purposes I am strongly in favour of a flat rate, particularly in residential districts. The average consumer wants to be able to switch on as many lamps as he requires at any time, and to know that so long as they are in use they are consuming electricity at a definite price per unit. It is also less difficult to obtain new consumers if you can offer them the supply at a fixed rate per unit.

As regards the probable effect of metallic-filament lamps on electricity supply undertakings, I do not think there will be such a serious falling off in the demand as some engineers anticipate. From some records in Rathmines which show the difference in consumption in seven shops, due to the use of metal-filament lamps, we find that in only two cases has the decrease in consumption approached anything of a serious nature. In three of the five remaining cases it is practically the same as when carbon-filament lamps were in use, and in the other two there has been a decided increase in the consumption. The net result of the undertaking is a loss of 77 units, but, on the other hand, every account that is reduced by means of more economical lamps becomes of immense service to the canvasser, as it forms an excellent bait for prospective consumers.

THE DOLTER SYSTEM AT OXFORD

AT a special meeting of the Oxford City Council last week some important letters from the National Electric Construction Co. with regard to the tramways in Oxford were presented, together with a report upon them by the Tramways Committee. It will be remembered that, when a few years ago the National Electric Construction Co. received Parliamentary powers to convert the horse tramways in Oxford to electric traction, the agreement between the company and the Corporation provided for the installation of the Dolter system, or, if the Corporation were not satisfied with this, for any other system of traction, except the overhead system. The company also bound itself under the agreement to pay certain annual sums to the Corporation by way of rent. In pursuance of this agreement a deputation from the Corporation was taken to inspect the Dolter system at Hastings and Torquay, but the Corporation were advised that the deputation was not satisfied as to the working of the system in these two places. Since then little progress has been made with the negotiations, but the company under date September 22nd inform the Corporation that they are now in a position to proceed with the financing of the City of Oxford Electric Tramways, Ltd., to enable the electrification of the tramways to be taken in hand, but that before any progress can be made the Corporation and the company must be agreed as to the system. With regard to the decision of the Corporation not to accept the Dolter system, the company agrees that there are defects in the system which cannot be overcome, and they, therefore, do not ask the Corporation to change their expressed opinion against the Dolter system. With regard to Torquay, the letter further states that an alteration in the system at an early date is not a remote contingency. After considering the effort made by the London County Council to adopt the "G.B." surface-contact system, the National Electric Construction Co. state they are forced to the conclusion that they are left with only two systems to consider, namely, the overhead and the conduit, but in view of the expenditure upon the latter they ask the Council's consideration of a scheme involving the use of the conduit system in the centre of the town and the overhead system outside, and at the same time ask for a reduction in the rental to about £800 per annum. The letter contains estimates of the various systems, in which the cost of the Dolter system for the 14 track miles which have to be dealt with is put at £120,160; the cost of a combined conduit and overhead system at £140,000; and the cost of an overhead system throughout at £100,000. These figures, however, do not include feeders, which would be the same upon any system. With regard to the rental the company point out that they are afraid that even £800 is in excess of what they could pay. Assuming, however, that £800 per annum were agreed upon, this would represent a reduction of £300 per annum for the first three years, £500 per annum for the next three years, and £700 per annum for the remaining years of the agreement upon the original sum agreed as the rent to be paid to the Corporation.

The Tramways Committee in presenting their report upon this correspondence recommend the Council to refuse to vary the existing arrangements, and further suggest that counsel should be asked to advise the Corporation whether it is necessary to take any steps at the present time to protect the interests of the Corporation.

After a lengthy discussion the Tramways Committee's report was adopted.

NEW PUBLICATIONS

Electrical Laboratory Course, by R. D. Archibald and R. Rankin. (London: Blackie & Son, Ltd.) Price 1s. 6d.

Proceedings of the American Institute of Electrical Engineers, November. (New York: The Institute.) Price 50 cents.

Fowler's Mechanical Engineer's Pocket Book, 1909. Edited by William H. Fowler. 11th edition. (Manchester: Scientific Publishing Co.) Price 1s. 6d.

Metric Equivalent Tables. (London: The Central Translation Institute). Price 3d.

Journal of the Institution of Electrical Engineers, October. (London: E. & F. N. Spon, Ltd.) Price 5s.

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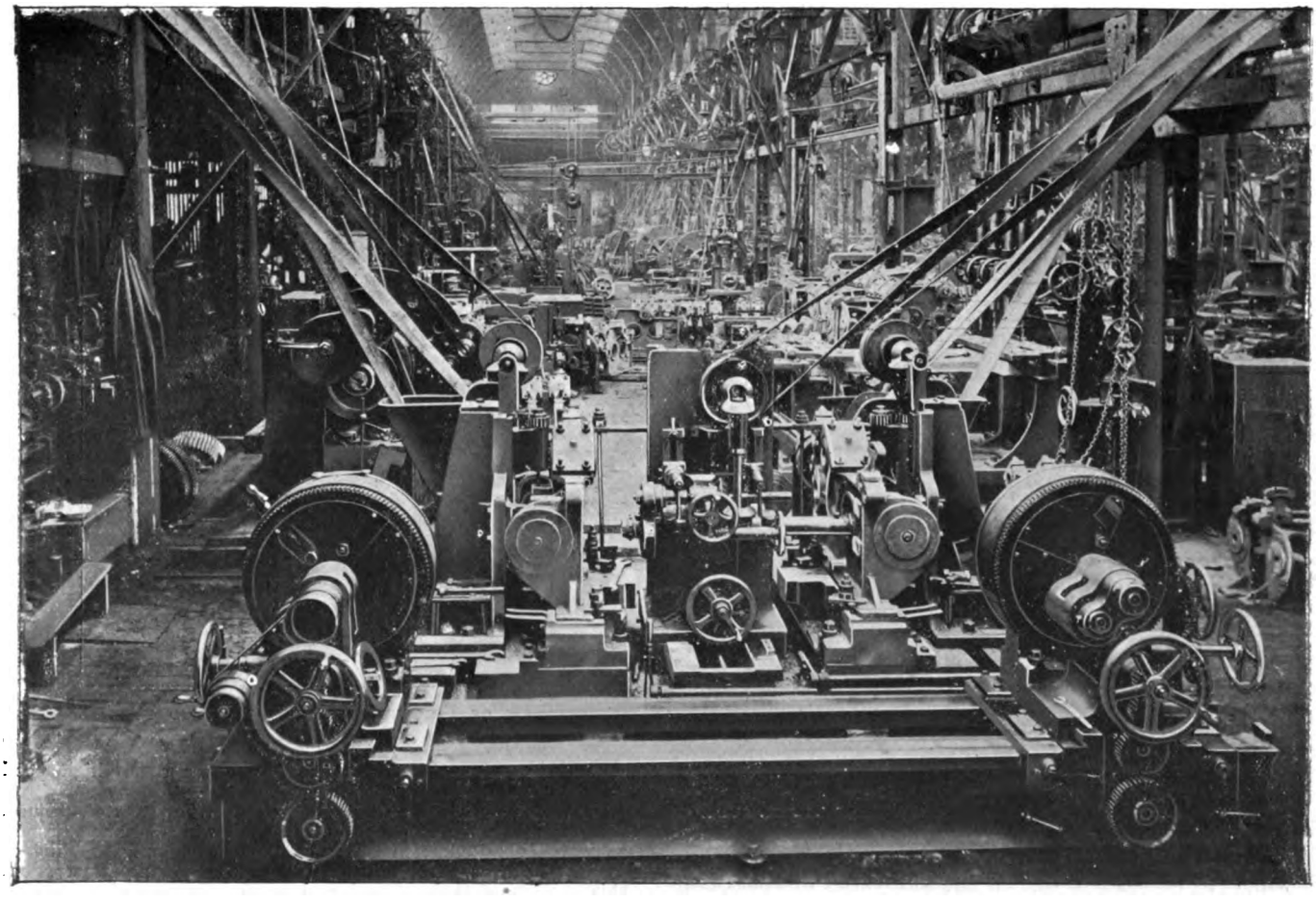
A VISIT TO THE WORKS OF MESSRS. CLARKE CHAPMAN & CO., LTD.

ON the roll of Tyneside firms which have taken such a prominent part in the development of ship equipments the name of Messrs. Clarke Chapman & Co., Ltd., occupies an honourable place, inasmuch as this firm has for many years been one of the pioneers in designing ships' winches and capstans, both steam and electric. At the present time it obtains a considerable share of Admiralty and general mercantile orders in these classes of goods, together with such manufactures as searchlights, coal hoists, and other accessories. In addition to this, their trade in boilers, both for marine and land use, and their water-tube boilers and pumps for all purposes, manufactured under the Woodeson patents, have rendered their name so well known as to be standard.



A Bay in one of the Machine Shops, showing Side Frame Boring and Drilling Machine in Foreground.

The present works of the firm have been in existence, with additions and alterations, since 1863, and it is therefore interesting to ascertain how electricity has been adapted for use in their extensive shops. It should be prefixed that the development of the works power of this establishment traces the progress of electrical equipment of workshops. Originally the motive power was derived from detached steam units working on longer or shorter lengths of shafting; when a direct-current three-wire supply at 240 and 480 volts was obtainable from the Gateshead power station of the Northern Counties Electricity Supply Co., Ltd., Messrs. Clarke Chapman availed themselves of it. Later, when this portion of the Northern Counties undertaking became merged into the general scheme of electricity supply throughout the northern portion of Durham, and operated by the County of Durham Electrical Power Distribution Co., Ltd., a three-phase supply was introduced into the works, and in many cases alternating-current motors operating at 440 volts are now being used.

The latest sub-station contains two static transformers, converting from 6,000 to 440 volts, and fed by duplicate lead-covered cables laid solid in the ground. These are fed from different points on the system, so that a failure of supply on any section will not put the sub-station out of commission. The cables are fitted with Merz-Price protective gear, while, in addition, the transformers have Brown-Boveri overload relays. The high-tension switchgear is of the Brown-Boveri type, while the low-tension board was made by the B.T.-H. Co. This latter consists of seven panels, two devoted to the transformers, three carrying the power circuits of the works, the remaining two being extra panels.

In the shops the majority of the lathes and heavy tools are driven from the direct-current supply, the three-phase power being used on the cranes and on the more recent extensions to the shops. As an example of the machinery which is electrically driven may be mentioned a fine milling and gear-cutting machine, made by Reinecker, of Chemnitz, which is in almost constant operation hobbing manganese bronze double- and treble-threaded gear-wheels which are used in the Clarke Chapman electric winches, in which both the

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hob and the wheel are positively driven. These oil-immersed wheels are a standard feature of this firm's design, as, although the efficiency is not quite so high as single spur-reduction, a speed ratio can be obtained with a single pair of members that would have to be negotiated by two or three spur gears. This is an important point in connection with electrically-driven winches, and, taking into account that a 68 per cent. efficiency can be obtained in a double-threaded wheel, leads to the adoption of this type.

Another most interesting special machine—to chose one out of hundreds installed by the firm for their particular class of work—is a machine for milling and drilling the side-frames of steam-driven winches with one setting of the work. This machine is shown in the illustration on p. 609, and its operation is an instance of standard repetition work of large size that it would be hard to beat. Yet another application of electric power, which is of special interest, is a Thomson welder, installed in the blacksmith's shop for the purpose of operations such as the welding of lever handles, eccentric rods, &c., for the winches, windlasses, &c. It is capable of taking bars up to 3-in. diameter, and at the time of our visit the welder raised two pieces of 1½-in. round bar to a fluxing condition and united them in such a way that one or two strokes of a hammer completed the operation in 3½ minutes. Most severe tests have been applied to these welded parts, and the material at the weld has always been found of the same strength and nature as before welding.

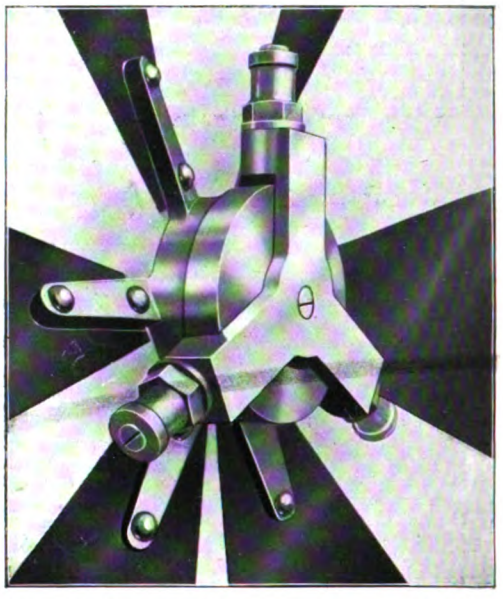
The artificial lighting of the shops is accomplished, as a rule, by means of open-type arc lamps, and in places where the hanging position of the lamp above ground is small, as in the case of side bays and galleries of the electrical shop, good diffusion is obtained by means of large whitened screens placed immediately above the lamps.

Messrs. Clarke Chapman & Co., Ltd., are, of course, not entirely electrical engineers, as their output of feed pumps, steam winches, and water-tube and other types of boilers testifies, but the applicability of electricity to marine purposes has led to the development of an extensive electrical manufacturing department. Much of the work is to Admiralty specification, and includes coal hoists for battleships, capstan gears, switch and regulating gear of special Government type, and searchlights, either of the ordinary or Suez Canal pattern, and having either hand or automatic control. They had also at the time of our visit a large amount of work passing through the shops destined for the mercantile marine, such as direct-coupled lighting sets, together with various orders for land installations. Among these latter could be mentioned an electric winch, destined for Messrs. Yarrow's new yard, a winch to be used in one of the shipyards of the Clyde Valley, lifting up to two tons at 200 ft. per minute, and a warehouse installation for China. A rather interesting piece of work then being finished was a turn-over capstan, the design of which permits of the complete opening up of the working parts for inspection without the necessity for getting down into the capstan box or dismantling any portion of the gear. Another object of interest was a special starter of the tramway-controller type, which this firm fits to some of its winches and hoists. Other particular objects of interest were the main, forward- and after-capstan gears, both electrically driven, for H.M. battleship *Defence*, and after-capstan gear for H.M. battleships *Temeraire*, *Superb*, and *Bellerophon*.

It will be seen from the above notes, which represent the impressions gained during a somewhat hurried visit to these works, that Messrs. Clarke Chapman & Co., Ltd., in developing along the lines of the needs of the shipbuilding industry, have built up a very flourishing and specialised industry of great interest, and hence the important part which electricity plays both in the power equipment and in the commercial output of the firm is a very encouraging sign of the times to electrical engineers interested in marine work.

SPEED REDUCTION COUPLING FOR ELECTRIC FANS

IN order that the best results may be obtained from a large propeller fan for ventilating purposes, it is necessary that the fan should rotate at a comparatively slow speed. At high speeds such a fan would not only be noisy, but the extra power absorbed would nearly all be wasted in churning up the air, instead of being utilised in imparting an increased velocity to the air. There is thus a most economical speed for any given fan, and for fans of about 30 in. diameter this speed is in the neighbourhood of 200 revs. per min. As the power required is very small, and small low-speed motors are necessarily heavy and expensive, it has been usual to run fans at higher speeds than the above, with the result that the continuous hum due to the churning of the air is in many cases unbearable. To enable a fan to be run at a low speed from a small high-speed motor, some form of silent and inexpensive reduction gear is necessary, but, in view of the difficulty in producing such a gear, a slipping coupling may be used. The latter, though not as efficient as a true reduction gear, enables a cheap high-speed motor to be used with a low-speed fan.



VIEW OF FRICTION COUPLING ATTACHED TO FAN.

The Glover-Lyon Ventilating Co., Ltd., of Caxton House, Westminster, have brought out a device, which, though termed a "Frictional Reduction Gear," is really a slipping coupling or a friction drive. As shown in the accompanying illustration, this consists of three arms keyed to an extension of the motor shaft. Morganite carbon brushes, contained in box brush-holders fixed to the extremities of these arms, bear on a phosphor-bronze ring attached to the hub of the fan blades. The relative speeds of the brushes and ring can be varied by increasing the pressure on the brushes. A 30-in. fan is to be seen at the company's show-rooms coupled to a 200-volt 1/10 h.p. motor running at 750 revs. per min. The fan rotates at only 200 revs. per min. The power actually utilised in driving the fan is thus only a little more than one-quarter of the power supplied by the motor, the rest being wasted in friction between the brushes and the ring. In consequence of the small total output of the motor, however, the ring does not get hot, and the energy wasted is said to be justified on account of the saving in capital cost. An overall efficiency equal to that of a slow-speed motor fan is claimed.

Rugby Engineering Society.—At the first conversazione of this Society, which was held at the Town Hall, Rugby, on Friday, November 6th, a large collection of scientific apparatus was exhibited, including various models lent by several well-known manufacturing firms. A series of lantern lectures, each of which lasted only fifteen minutes, was delivered by different members.

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A LARGE THREE-PHASE ALTERNATOR AT NIAGARA

IN a Paper read by Mr. B. A. Behrend before the American Institute of Electrical Engineers at their summer meeting this year, a large generator is described which is included in a new generating plant of considerable magnitude completed recently at Niagara Falls. This station is the new plant of the Niagara Falls Hydraulic Power & Manufacturing Co. A number of large direct-current generators to be used for the manufacture of aluminium have been installed in this plant, each generating unit consisting of two direct-current generators connected to 11,000-h.p. turbines. A large alternating-current generator, one of an aggregate of three wound for 12,000 volts, has also been installed in this station. The power house is located at the foot of the falls, on the American side, below the old power house of the Niagara Falls Hydraulic Power & Manufacturing Co.

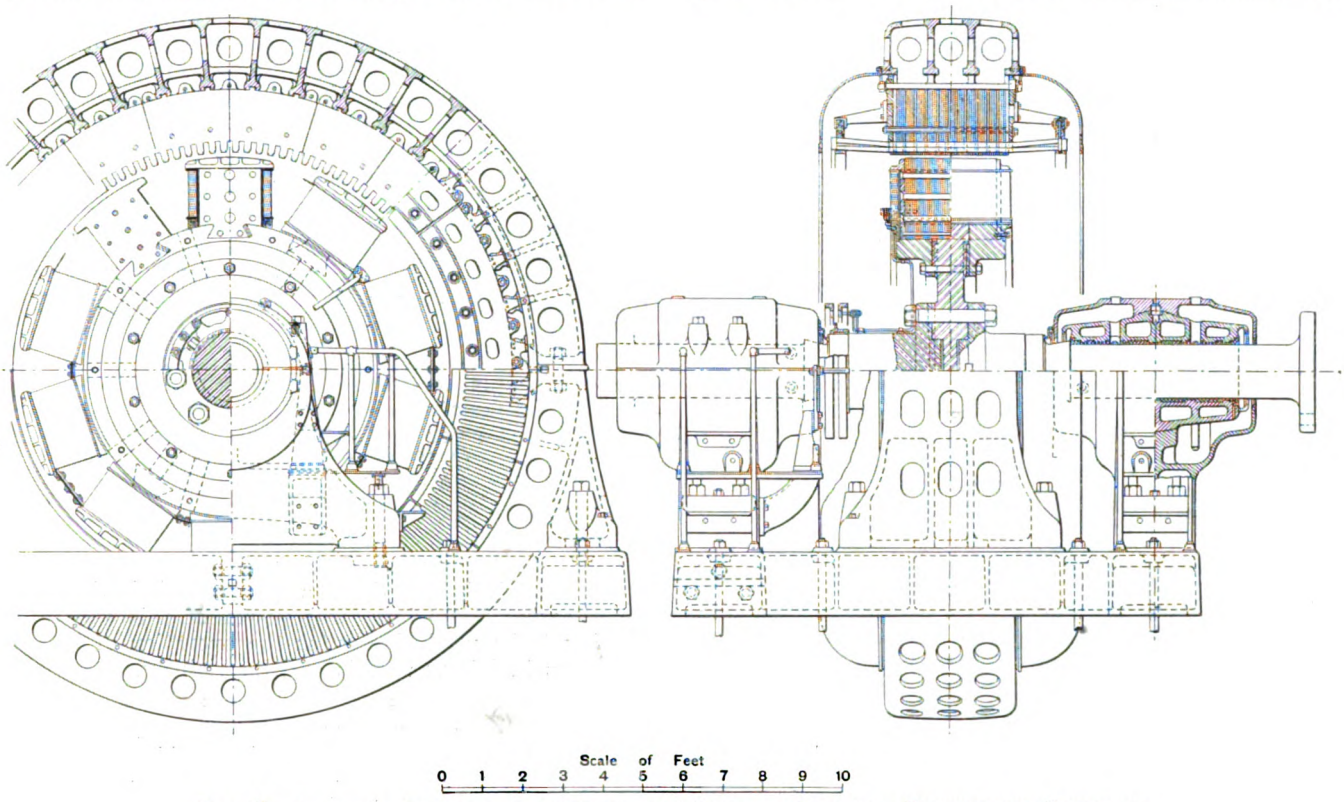

FIG. 1.—ASSEMBLY DRAWING OF 6,500-KW. 12,000-VOLT, 300 R.P.M. THREE-PHASE GENERATOR.

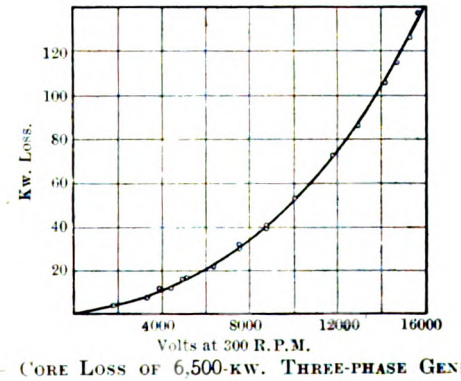

FIG. 2.—CORE LOSS OF 6,500-KW. THREE-PHASE GENERATOR.

The generator which is described in his Paper offers a number of interesting features, and is remarkable among the generators at Niagara Falls on account of its speed of 300 rev. per min., which is greater than the speed of any of the other large generators installed in the power houses at the falls. The generator is wound for 12,000 volts, three-phase, 25-cycles. The waterwheel is mounted on a horizontal shaft, and has a capacity of 11,000 h.p. The generator is rated at 6,500 kw., with a capacity for continuous operation of 7,500 kw. The runaway speed of the waterwheel is given as 506 revolutions; the generator, therefore, had to be designed to be safe at this speed. The experience which has been gained from the design of generators for direct connection to steam turbines has greatly minimised the difficulties of a problem like the one under consideration. Nevertheless, 11,000-h.p. generating units are neither so plentiful nor so readily designed and built as not to afford considerable interest.

The design and construction of this interesting unit, and the electrical characteristics, are illustrated by the accompanying drawing and curves. An assembly drawing showing the most important details is given in Fig. 1. The construction of the rotor is as follows:—A disc of nickel-steel, without a hole in the centre, forms the middle part of the revolving element. Two nickel-steel rings are mounted on each side of this web, and are bolted and keyed to it. The nickel-steel used for this

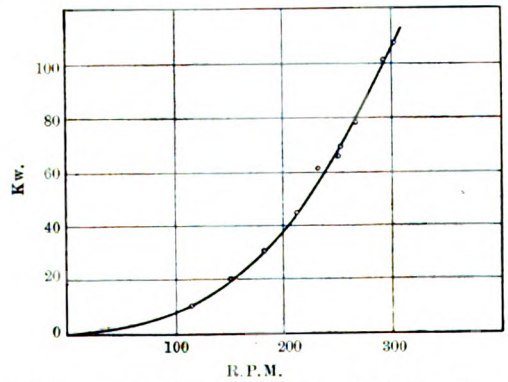

FIG. 3.—FRICTION AND WINDAGE LOSS OF 6,500-KW. THREE-PHASE GENERATOR.

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construction must have great mechanical strength and high magnetic permeability. A nickel-steel containing 3·5 per cent. nickel has been used for this purpose. Its elastic properties are:—Elastic limit, 50,000 lb. per sq. in.; ultimate strength, 80,000 lb. per sq. in.;

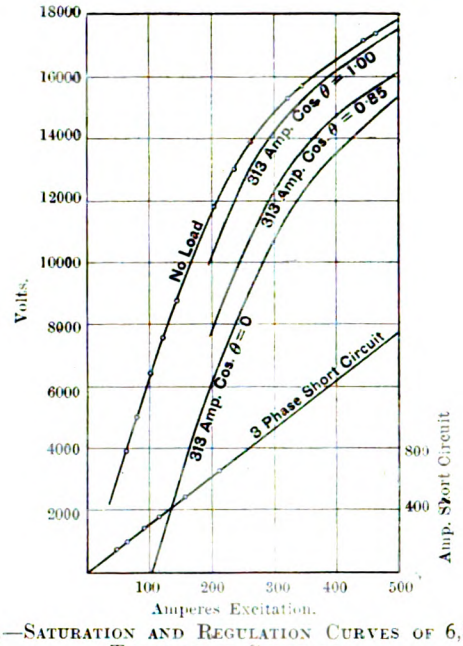

FIG. 4.—SATURATION AND REGULATION CURVES OF 6,500-KW. THREE-PHASE GENERATOR.

elongation, 20 per cent. in 2 in.; reduction of area, 40 per cent. The nickel-steel forgings as used in this construction enable the designer to produce the strongest and lightest construction, as the mechanical strength of the material is great and the magnetic permeability high. The weight of the complete rotor

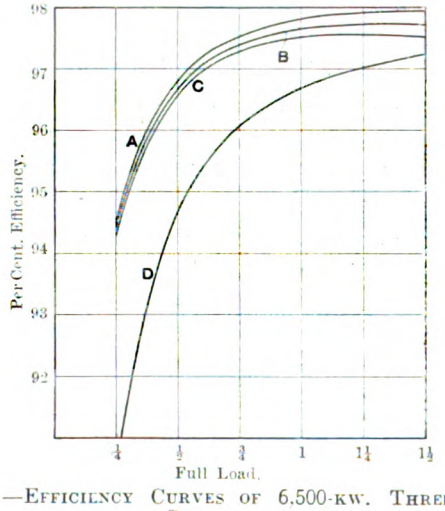

FIG. 5.—EFFICIENCY CURVES OF 6,500-KW. THREE-PHASE GENERATOR.

Efficiency not Including Windage and Friction.
A=6500 Kw. Output at 95% Power Factor.
B= ,, ,, ,, ,, 90 ,, ,,
C= ,, ,, ,, ,, 85½ ,, ,,
Efficiency Including Windage and Friction.
D=7500 Kw. Output at 100% Power Factor.

is only 92,900 lb., and, the bearings being 16 in. by 50 in., the specific pressure is only 58 lb. per sq. in. The weight of the stator is 116,700 lb., and the weight of the entire machine is 275,000 lb.

The following notes upon the theory of elastic stresses in rotating discs and rings are included in the Paper:—The theory of elasticity applied to the radial and tangential stresses in rotating discs shows that the point of maximum stress is at the centre of a disc and at the inside surface of a ring. The correctness of this theory has been demonstrated by experiments with lead discs, the deformation of which, as obtained by measurement before and after the test, readily indicates that the maximum deformation, as shown by the lateral contraction, appears at the centre of the discs or at the inside of the ring from where the metal flows toward the outside portions. The radial stress normal to a free surface must be zero, and, therefore, the maximum stress appears as a tangential stress. In a solid disc the elements at the centre are subject to both radial and tangential stresses. A hole in the centre eliminates the radial stress, and, as is shown by the theory, this doubles the tangential stress. Great mechanical strength and lightness are obtained in this rotor construction, and although it would have been possible to use a hub mounted on a shaft, according to the practice with slow-speed machinery, as the stresses on the inside of the hub would not have been prohibitive, the design adopted for this large generator is elegant and mechanically superior. The electrical characteristics of this unit are well shown in the curves of Figs. 2 to 5. Fig. 2 represents the core-loss which is equal to 75 kw. at 12,000 volts; this is approximately one per cent. of the output. Fig. 3 represents the power necessary to overcome the friction and windage at 300 rev. per min., which is equal to 106 kw. Fig. 4 represents the saturation and regulation curves of the generator with a regulation of 8·4 per cent. at full load and 100 per cent. power-factor at 12,000 volts. The generator is capable of giving 13,000 volts under any condition of load that is likely to occur, should this be required. Fig. 5 shows several efficiency curves. From the tests made regarding the heating of this unit, the temperature will remain within 35 degrees at normal load, and 40 degrees at 7,500 kw. The power of this generator is going to be used chiefly for the operation of induction motors in Niagara Falls and its vicinity.

LOW VOLTAGE WIRING

ON page 583 of our issue of October 29th we published an article by Mr. A. H. Dykes on "25-Volt Wiring," in which the relative advantages of the balancer-transformer, the auto-transformer, and the ordinary double-wound transformer were compared. The use of an ordinary double-wound transformer with a tapping from the centre of the secondary, and concentric wiring with uninsulated return, was suggested in the article.

Through the courtesy of Messrs. Handcock & Dykes we are now able to give a few particulars of two installations in which the wiring has been carried out on this principle. These are an extension to King's College, Cambridge, in which some 150 lights were installed, and the University Library adjacent with 146 lights. Both these buildings were wired on the "Kalkos" concentric system, in which two insulated wires (the outers of a three-wire system) are carried in tinned brass conduit, which is used as the neutral conductor. The supply pressure is transformed down by means of a double-wound transformer to 50 volts between the outers, and the middle point of the secondary winding is earthed and connected with the brass conduit. Twenty-five volt metal filament lamps are employed, and are connected between one of the outers and the conduit. Each circuit has 10-ampere fuses, and 7/20 cable is employed. All the joints in the conduit are soldered, and the same pattern of box is used for the switches, ceiling-roses, and drawing-in boxes. Ordinary 5-ampere Lundberg switches are used.

The lighting of all the buildings of King's College has been converted to either 25 or 50 volts, and in all fifteen or more transformers have been installed. With the exception of the above-mentioned extension, however, the wiring has been left as it was. To avoid the no-load losses of the transformers in the daytime, all

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are switched off at the main board at a certain time at night, and are switched on again at dusk. The wiring in the extension building is all concealed, but in the library it is on the surface. The latter building contains practically no wood, the book-shelves being made of metal. The brass conduit, as well as all the switches, plugs, &c., are fixed to the metal framework of the book-shelves without the use of any wood. It may be mentioned that there are some electrically-heated bookbinding tools in use in this library.

The transformers were supplied by the Foster Arc Lamp & Engineering Co., Ltd.; the contractors for the Library installation were Messrs. Lucy & Co., of Oxford; and Messrs. Baily, Grundy & Barrett, of Cambridge, carried out the work for the King's College extension.

A few particulars of another installation may be of interest. This, although not a low-voltage installation, has been carried out on the same principles as the above. The building in question is Lumley Castle, Durham, the property of the Earl of Scarborough. In this case the supply pressure is 5,000 volts, and a double-wound transformer reduces this to 200 volts between the outers, which are carried in brass conduit connected to the middle point of the secondary of the transformer and earthed. One hundred-volt metal filament lamps are connected between one of the outers and the earthed tube.

THE TESTING OF ALTERNATORS

IN his Paper on the testing of alternators, read before the Birmingham Local Section of the Institution of Electrical Engineers on Wednesday, November 11th, Mr. S. P. Smith pointed out that although the Hopkinson method of testing electrical machinery was applicable not only to continuous-current machines, but also to alternating-current generators, motors, and transformers, it cannot be regarded as a method suitable for testing large alternators in a practical test-house, as it seldom happens that two similar machines are available at the same time. This has rendered it necessary to divide a single large alternator electrically into two units, namely, into a generator unit and a motor unit, and to circulate power between these units. For this purpose various methods have been proposed, of which, however, only a few have been successful in practice. The author had had, he said, an opportunity of extending certain methods of his own by numerous tests on large alternators, as a consequence of which a satisfactory and practical method has been developed.

Before describing his own method, the author referred to that of Behrend, which consists merely in splitting up the field into two halves. The full-load exciting current is then passed through each branch, and by gradually reducing the current in the one branch, the current in the short-circuited armature coils can be raised to the full-load value. Now, it is at once obvious that, with the armature on open-circuit under these conditions, the magnetic pull on the generator side will be much greater than that on the motor side, but since the internal angle of lag is almost 90° the armature ampere-turns on short-circuit are almost entirely direct in their reaction on the main field, the distorting effect being practically *nil*—that is to say, the generator field will be weakened and the motor field strengthened. This effect, it has been maintained by some, will equalise the motor and generator poles, and therefore remove all magnetic out-of-balance. A resultant pull must exist, however, in order that a current can flow in the armature as, as soon as the motor pull equals the generator pull, the flux in the motor portion equals that in the generator, and no current can flow owing to both E.M.F.'s being equal and opposite. This resultant magnetic pull may not be serious in the case of slow-speed alternators, but with high-speed machines the method becomes dangerous, and in some instances is absolutely prohibitive.

As an illustration of this, the author described a test which was made on a large three-phase generator built by Messrs. Siemens Brothers' Dynamo Works, Ltd., Stafford. This machine was built for 3,900 kilovolt-amperes 6,600 volts 342 amperes at cos $\phi = 0{\cdot}9$, there were 12 poles, and the speed was 500 revs. per minute. This, with a bore of 250 cms., gave a peripheral speed of 65 metres per second or 13,000 ft. per minute. An attempt was made to test the machine by Behrend's method. It was found, however, that even when 100 amperes were sent through the generator exciting coils and 50 amperes through the motor exciting coils the magnetic unbalancing was so great as to make it absolutely impossible to run the machine at anything like full speed owing to the severe vibrations of the stator on its bed. What the vibrations would have been like with the proper field currents—namely, 172 amperes in the generator half *versus* 15·8 amperes in the motor half (as afterwards determined by a modification of the above method explained below)—it would be difficult to contemplate.

In a modification of Behrend's method developed by the author a few years ago, the field is still split up into two halves, but the motor or weakly-excited poles are symmetrically interspersed amongst the generator or strongly-excited poles, so that the whole revolving system is balanced with respect to the shaft. Mechanically this method has proved quite satisfactory, even in the case of the above high-speed machine which was tested in this way. For this purpose poles 1, 2; 5, 6; 9, 10; formed one circuit, and was excited with 15·8 amperes; this was the motor half. The other group, consisting of poles of 3, 4; 7, 8; 11, 12; formed the generator half, and was excited with the full-load exciting current of 172 amperes. Under these conditions the full-load current circulated through the short-circuited armature, and the pull was zero, with respect to the shaft, since all poles were symmetrically balanced. Electrically, however, the results obtained by this method are not satisfactory for the following reasons:—In the first place, since only half of the field coils carry the full-load current, it is obvious that the proper heating will only occur on these poles, whilst the heating of the motor poles which never carry more than 10 to 20 per cent. of the normal exciting current is quite negligible. What the effect of this might be in the case of an open-type alternator, it is difficult to estimate, but, in the case of a totally enclosed machine this is a most important factor. Again, many machines which have to be tested by some such method as the above have an exciter, which must also be tested at the same time, and it is quite clear that the Behrend method is of very little use for testing the latter machine. Finally, although with the full-load armature current we get the proper copper loss in the stator, it still remains a question whether the temperature rise of the latter will be correct on account of the core losses not being the same as under actual full-load conditions. Only the core losses under the generator poles are anything like the actual, those due to the motor poles being of very little consequence. By comparing the temperature rise of the stator core when tested by Behrend's method with that under actual conditions, the temperature rise of the core was found to be little more than half that on full load, and the temperature rise of the copper was somewhat less than on full load.

From the foregoing it will be quite clear what are the essentials in any method of testing in order that the results shall be valid. Above all, it is highly important *that there is no dangerous resultant magnetic pull with respect to the rotor shaft.* This is the chief mechanical consideration. Electrically, the requirements are *full-load exciting current with full-load armature current and full-load core losses.* When these conditions are fulfilled, correct heating and losses in all parts of the machine are obtained, whence both the temperature rise and efficiency can be accurately found. At the same time, the exciter (if any) will be tested under normal conditions.

The author then proceeded to describe his own method, by means of which the above conditions can always be accurately fulfilled, unless the number of poles is too limited. In this method all the poles are in series and carry the full-load exciting current, hence full heating of the rotor is obtained, and the exciter works under normal full-load conditions. For the purpose of a clear explanation, the example of a 48-pole machine may be taken. Of these 48 poles, four groups were reversed, these groups consisting of two sets of 4 poles diametrically opposite, and two sets of 5 poles at right angles to these. Hence in all there were 18 poles reversed and 30 poles connected as for normal working. The latter were the generator poles and the former the motor poles. Thus there were 30 generator poles *versus* 18 motor poles. Under these conditions, full-load current flowed through the short-circuited armature when full-load exciting current was sent through the field coils, hence, provided the heating of the armature core is correct, there is little doubt about the heating of the stator copper, consequently the criterion of the test is the stator iron loss or core heating.

Some curves were shown by the author, which gave the results of two tests taken on the above machine on a dead load of 470 kw. at unity power factor, and two by using the author's method—that is, 18 motor poles *versus* 30 generator poles. These

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curves showed that the temperature rise obtained by the author's test was the same as on actual load. In addition to this, the iron loss was measured on open circuit, both when the machine was excited with the poles normally connected and when 18 were reversed, by reading the input to the driving motor. This was found to be approximately the same in each case.

In the above test the rotor was opened at 8 places, but it could equally well have been opened at 4 places, provided the proper ratio of motor to generator poles were maintained. An experiment was made to see if it were possible to reverse all the 18 poles in one group, so that the rotor need only be opened in 2 places. On open circuit the machines ran quite smoothly with full-load exciting current in the field coils, but as soon as the armature was short-circuited the machine shook badly and the test had to be discontinued. The reason of this out-of-balance is quite clear, namely, armature reaction. From this it is seen that it is essential to have the rotor balanced, even in slow-speed machines, and for this purpose the minimum number of openings in the rotor is four, namely, two diametrically opposite groups reversed.

As a starting-point for the predetermination of the number of poles to be reversed we have *the E.M.F. induced by the resultant flux must equal the impedance volts*, or, in other words, the E.M.F. induced in the generator section must exceed that induced in the motor section by an amount equal to the reactance volts on full load, in order that full-load current may flow in the short-circuited armature. Hence if x = number of pole-pairs in generator section, y = number of pole-pairs in motor section, E_g = E.M.F. induced by one pole-pair in generator section, E_m = E.M.F. induced by one pole-pair in motor section, and E_r = reactance volts on full load, we have:—

$$x \,.\, E_g - y \,.\, E_m = E_r.$$

To find E_g and E_m we have merely to take the algebraic difference or sum of the field ampere-turns and the stator ampere-turns, and from the open-circuit characteristic read off the corresponding E.M.F.'s per pole-pair. This is due to the fact that the cross-magnetising effect on short circuit is practically zero, and the armature ampere-turns can be regarded as entirely magnetising or demagnetising, as the case may be. In order to solve the equation we have only to find some further relation between x and y. Now, it is obvious that, owing to the reduction of the flux wherever there are consequent poles, namely, at the openings, the sum $x+y$ will be less than p, where p is the number of pole-pairs in the machine. Virtually, at every opening, one pole—made up of two half-poles—is lost, neglecting for the time being the effect of saturation and armature reaction; consequently—

$$x+y=p-q$$

The effect of armature reaction at the pole openings, however, cannot be neglected, and a correction will have to be made for this. At the pole openings the back ampere-turns can be regarded as superposed on the exciting ampere-turns. Now, at every opening the armature reaction acts on a pole-pair; hence from the open-circuit characteristic must be read off the E.M.F. per pole-pair corresponding to the back ampere-turns. This E.M.F. must be then added to the motor voltage, which it assists. It has been found that the magnitude of this E.M.F. may be found with sufficient accuracy by taking half the difference of E_m and E_g. That is to say, if $\frac{1}{2} E_r$ denotes the voltage at each opening due to armature reaction, then $\frac{1}{2} E_r = \frac{1}{2} (E_m - E_g)$ or $E_r = E_m - E_g$; hence with q pairs of openings the voltage added to the motor section will be $q \,.\, E_r$. Thus:—

$$x \,.\, E_g - (y \,.\, E_m + q \,.\, E_r) = E_s.$$

All the necessary factors for solving the above equation can now be determined, and it is possible to predict how many poles have to be reversed for testing a machine under any given conditions.

To find the efficiency of an alternator connected in the above manner one has merely to measure the input to the driving motor when the alternator is running on short circuit, with full-load current circulating in the stator and normal exciting current in the field coils, then deducting from this the input to the driving motor when running light and uncoupled, the total losses in the alternator and exciter are at once obtained.

DISCUSSION.

Dr. W. E. Sumpner (Birmingham Municipal Technical School) pointed out that the method of testing, described by Mr. Smith, was due to the late Professor Ayrton, and was the subject of a Paper read before the Institution of Electrical Engineers in 1893 by Mr. W. M. Mordey. It was important that the core losses should not be altered by the conditions of the test, but at every opening where the generator and motor sections met, there was a distortion of the field, and consequently a change in the core losses from those occurring under normal conditions. Therefore there should be as few openings as possible.

Mr. R. A. Chattock (Chief Electrical Engineer, Birmingham) remarked that the temperature rise on machines tested by Mr. Smith's method was not quite so high as when tested on dead load. The question was whether such a test would be accepted as conclusive by consulting engineers and others. He also asked whether it were possible to carry out tests at varying power factors by this method.

Mr. Orsettich said that, owing to the consequent poles obtained by the Behrend method, the magnetic leakage was not the same as under normal conditions, and this would affect the core losses. He asked whether the exciting current used was such as would produce full load with unity power factor, and also whether the method was suitable for the testing of turbo-alternators.

Mr. Everest was of opinion that the core losses indicated by this method of test would not be the same as those occurring under ordinary working conditions. The temperature rise with full load could be accurately predetermined from the open circuit and short-circuit runs. If the machine was run on open circuit with an excitation corresponding to that required for full load, the rise of temperature due to heating of the cores could be ascertained. By running the machine on short circuit, the heating of the stator winding due to the resistance of the copper could be determined. From these two tests the total rise of temperature at full or any other load could be calculated.

Dr. M. Kloss (Siemens Bros. Dynamo Works) thought the method of testing most valuable, as it enabled full load tests to be carried out with a comparatively small amount of driving power, and was therefore extremely economical. He suggested that it should be adopted as the standard method by the Institution of Electrical Engineers. It would be useful if other firms would try the method in order to check its accuracy. Although owing to the consequent poles at the openings the frequency was somewhat reduced, yet the core losses determined by this method were rather higher than those occurring in normal running conditions. The method of determining the efficiency by calculating the losses separately always gave too high an efficiency.

Mr. A. T. Bartlett considered such tests quite necessary in dynamo-makers' works in order to check the efficiency of the machine before the regular steam consumption and efficiency tests were carried out. He said that it was well known that the Behrend test did not require the magnet poles to be equally divided. He did not see any difficulty in the measurement of the voltage regulation from full to no load.

Owing to the lateness of the hour the author's reply to the points raised in the discussion was deferred until the next meeting.

Institution of Post Office Electrical Engineers.—On Monday, November 9th, the Right Hon. Sydney Buxton, M.P., H.M. Postmaster-General, at a meeting of the Post Office Electrical Engineers' Institution, presented the medals awarded for Papers read in 1906–7. The Engineer-in-Chief, Major W. A. J. O'Meara, C.M.G., presided, and in the course of an address referred to the benefits which their branch of engineering had conferred. He said that the Postmaster-General had expressed the desire that the Post Office engineering enterprises should be conducted on a commercial basis. The Post Office engineers welcomed this proposal; nothing would give them greater pleasure than to play the same part in the engineering enterprises of the Post Office that the members of their profession played in commercial organisations. Lest, unfortunately, an impression might prevail that the engineers of the Post Office were not interested in the financial side of their work, not only would he draw attention to the fact that Papers on the commercial aspect of the Post Office engineering had been read before this institution, but he would also like to draw attention to Appendix R, page 96, of the Postmaster-General's Annual Report for 1908, where it was shown that the maintenance of the telegraph system in 1898–9 cost £617,616, and had increased in the year 1903–4 to over a million, but since then the expenditure had decreased so that in 1906–7 it was £947,657. The period of the decrease synchronised with that during which the Post Office engineers had become and remained responsible for their own accounting. The estimated expenditure for the present year had again gone up to over a million, but this could be accounted for by a reference to page 31 of the report, where it was shown that various increases of pay had been granted as a result of the report of the Select Committee of the House of Commons under the presidency of Mr. Hobhouse. He then went on to say that there may be some who might ask what has accounting for engineering expenditure to do with engineers? His answer was that it had as much to do with them as the consideration of the materials used by them has to the design, user, and efficiency of the mechanism of the telephone switchboard in which these materials are used. Medals were presented to the following:—Senior Division, Silver Medal, Mr. J. E. Taylor, for a Paper on the propagation of electro-magnetic waves; Senior Division, Bronze Medal, Mr. J. G. Hill, for a Paper on telephone transmission; Junior Division, Silver Medal, Mr. A. O. Gibbon, for a Paper on underground construction in the provinces; Junior Division, Bronze Medal, Mr. J. S. Brown, for a Paper on Post Office lamp signalling trunk exchanges.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Nov. 12th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1907 Patents

23,429. **Arc Lamp Carbons.** E. R. Grote and the Foster Arc Lamp & Engineering Co., Ltd. This specification describes a form of carbon electrode for flame arc lamps, consisting of two or more cores of hard carbon, each of which is surrounded by an equal amount of soft carbon. The arc will burn on only one pair of cores at a time, and will shift to a fresh pair when these are burned down. A longer burning life and a lower loss in the carbons owing to the increased section are claimed. Two claims, eight figures.

23,432. **Series Transformer System.** G. Berry. This invention relates to a modification of the "Berry" series transformer system (see Electrical Engineering, Vol. III., page 197), in which a small transformer used for light loads is short-circuited when the load is large enough to be taken up by the large transformer. According to the present modification, when one main and one auxiliary transformer are used in parallel with any number of large main transformers, the relay for operating the switch mechanism is controlled by the total supply current to all the transformers, and so has fewer turns and less inductance. The small transformer need have only a very small capacity. Two claims, one figure.

1908 Patents

1,770. **Construction of Induction Motor Rotors.** British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*). From the point of view of the designer, closed slots for the rotors of induction motors are better than open slots, since by reducing the reluctance of the air gap, the magnetising current is reduced, and by producing greater uniformity in the air gap, the eddy current losses in the stator teeth are diminished. Thus both the power factor and the efficiency of the motor are improved. Mechanically, however, closed slots are disadvantageous, as the dies required for punching the laminations are more expensive and the cost of winding is greatly increased, since former-wound coils cannot be used. According to the present invention the slots are stamped open, but after winding the core, a sheet of good transformer iron is wrapped round the core. The ends are either rivetted or welded. Slots are cut in the sheet, and the tops of the rotor teeth project through these slots. The sheet may be welded before it is placed on the core, and in this case it is dented afterwards so as to force the rotor teeth through the slots in the sheet. Two claims, seven figures.

15,079, **Manufacture of Metal Filaments.** H. Aron and A. Geiger. This specification relates to a process of decarbonising metal filaments by heating them to a high temperature in a vacuum chamber. No free hydrogen need be introduced, but it is necessary that a small percentage of water vapour should be present. The correct vapour density is obtained by inserting a vessel containing slightly diluted sulphuric acid or potash-lye in the vacuum chamber. One claim.

16,534. **Manufacture of Metal Filaments.** W. D. Coolidge. According to the process described in this specification, powdered tungsten or other refractory metal is mixed with a binder consisting of 42 parts cadmium, 53 parts mercury, and 5 parts lead. This binder gives the necessary ductility and strength, does not combine chemically with the refractory metal, and does not lead to trouble due to contained carbon. The mixture may consist of 30 to 50 per cent. by weight of tungsten. A small percentage of bismuth can be substituted for some of the lead in the alloy binder with advantage. Four claims.

17,456. **Gripping Insulator for Overhead Lines.** O. Graetzer. This is a development of the cable or wire connector described on page 651 of last week's issue. The wire is gripped between balls, which are forced inwards by the insertion of a tubular insulating piece, through which the wire passes, into a conical casing. When the insulator is in the proper position, it is caused to grip the wire, and is then fixed to the support by any suitable means. No binder is required, and it is stated that surface leakage is considerably reduced. Stretching the wire is also a simple matter. Two claims, three figures.

19,891. **Method of Cooling Commutators.** Siemens Brothers' Dynamo Works, Ltd., and E. O. Kieffer. Instead of providing longitudinal passages through the commutator segments or vanes on the under part of the segments, it is proposed, in this specification, to cut longitudinal channels on the undersides of the segments, and to divide the commutator longitudinally in two parts, the parts being connected by fan-shaped vanes. These vanes draw air through the channels from either end of the commutator, and exhaust it where the commutator is divided. Segments with such open channels can be cheaply manufactured; a commutator made in this way is suitable for high speeds. Three claims, three figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

21,463, Bolitho. Aim-recording apparatus.
23,448, Allgemeine Electricitäts Ges. Alternating-current commutator machines.
23,781, Deutsche Beck Bogenlampen Ges. Method of renewing the carbons of arc lamps.
23,950, Woods. Electroliers and ceiling roses.
23,957, Guy & Bennett. Contact breakers for internal combustion engines.
23,991, Theobald. Bayonet joint for lampholders.
23,997 Höveler. Smelting furnaces.
24,002, Chaudoir. Motor controlling apparatus.
24,396, Cowper-Coles. Manufacture of metallic calcium.
24,517, Herrenschmidt. Processes of melting in electric furnaces.
24,879, Baylor. Control of electric motors.
25,286, Brown. Telegraphy.
25,324, Hartnell. Electro-depositing apparatus.
25,970, Ericsson. Telephone receivers.
26,135, Farthing & Steanes. Enclosed arc lamps.
26,940, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Alloys for resistance conductors.
27,157, Maiche. Transformers.
27,488, Ambert. Rail joints.
28,482, Barbour. Brushes or collectors.
28,619, Ekstromer & Ekstromer. Process for the production of a substance from albumenoids for use with secondary batteries.

1908 Patents

72, Eisenstein. Production of undamped electrical vibrations.
282, Chilton, Newton, and Brush Electrical Engineering Co. Turbines.
661, Alexanderson. Dynamo-electric machines
1,779, Duddell. Vibration galvanometers.
3,076, Leon. Incandescent electric lamps.
8,104, Michaud & Delasson. Manufacture of filaments for illuminating and heating purposes.
8,416, Wolfram-Lampen Akt.-Ges. Filaments for electric lamps.
8,481, Benstead. Electric contact makers.
8,679, Pownall. Electric heating and boiling apparatus.
8,956, Benkö. Process for the production of a vacuum.
9,675, Evans. Electricity meters.
9,789, De Sainte-Claire. Variable-speed gear for electric automobiles.
10,769, Tate. Storage battery plates.
12,325, Woodbridge. Electrical distribution.
13,025, Lundberg, Lundberg, & Lundberg. Switches.
14,763, Akt.-Ges. Brown, Boveri, & Cie. Current collectors for electrical machines.
15,590, Sykes & Cooke. Control of traffic on electric railways.
16,986, Soc. Anon. Westinghouse and Brun. Direct-current motors.
18,457, Tucker, Tucker, Hudson, Cissell, Cissell & Rankin. Telegraph keys.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

4,137, Bosch. Electrical ignition.
9,859, Kallmann. Motor starters.
22,105, Hartmann & Braun Akt.-Ges. Speed indicators.
22,168, Kompe. Trolley heads for overhead traction.
22,426, Peyrusson. Insulation of switches.

Expiring Patents

The following patents expire during the current week after a life of fourteen years :—

22,431, of November 20th, 1894. **Integrating Mechanism for Meters.** F. N. Connet & W. W. Jackson. An integrating mechanism suitable for adaption to electricity and other meters.

22,830, of November 24th, 1894. **Prepayment Meter.** R. T. Glover & J. G. Glover. A prepayment meter, the mechanism of which consists of two axially rotatable screw-threaded rods arranged parallel to one another, and a pinion in between which engages the threaded portions of the rods. One rod is rotated by the consumer and the other by the meter mechanism. The pinion operates the valve or switch.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ld.	10	7	5% *	10½—10⅝	+⅛
Do. 4½% Cum. Pref.	10	4½	4½%	9½—10	
Do. 6% Cum. Second Pref.	10	6	6%	10⅝—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E. L. & Power Co., Ld.	5	5⅜	4½*	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—98	
Brompton & Kensington E. S. Co., Ld.	5	10	5%*	6¾—7⅜	
Do. 7% Cum. Pref.	5	7	7%	6¾—7⅜	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½%*	3½—4	
Do. 4½% Cum. Pref.	5	4½	4½%	3⅞—4¼	
Do. 4% Deb. Red	Stock	4	4%	96—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3⅝—3⅞	
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	2⅜—3⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9—9¾	−⅛
Do. 6% Cum. Pref.	10	6	6%	12—13	
Do. 5% Deb. Red	Stock	5	5%	122—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3½—4	
County of London Elect. Sup. Co. Ld.	10	5	—	7—8	
Do. 6% Cum. Pref.	10	6	6%	10¼—10⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	97—100	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	½—1	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	62—67	+3
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4⅜—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E. L. Co.	5	10	4%*	7½—8½	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E. L. Cos. Db. Rd.	Stock	4	4%	96—100	
London Electric Supply Corporation	3	2½	—	⅞—1⅜	
Do. 6% Pref.	5	6	6%	4⅝—4⅞	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—92	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¼—4½	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—4⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	84—89	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	5	2½%	4⅜—5⅜	
Do. (fully paid)	5	8	2½%	4½—5½	
Do. 5% Pref. Do.	5	5	2½%	5—5½	
Do. Do.	5	5	2½%	4⅞—5⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12⅜	
Oxford Electric Co., Ltd.	5	7	2½%*	5½—6¼	
Do. 4% Deb. Red.	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5%*	7½—8½	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	½—¾	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2½—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5%	½—1	
Do. 5% Cum. Pref.	5	5	5%	1¾—2¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	7½—8½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3%*	68—70	
Do. 4% Preferred	Stock	4	4%	86—88	
Do. Deferred	Stock	2	—	50—53	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	85—87	
City and South London Cons.	Stock	4½	1½%	32½—33½	
Do. 4% Perp. Deb.	Stock	4	4%	98—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	111—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—112	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—110	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	3¾%*	7¾—8¼	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—3	
Do. 3% Perp. Pref. Red.	Stock	—	—	3—6	
Metropolitan Cons.	Stock	¼	1%	36½—37½	−½
Do. 3½% Preference	Stock	3½	3½%	84—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—78	
Metropolitan District	Stock	—	—	12½—13½	
Do. 6% Perp. Deb.	Stock	6	6%	123—12[illegible]	
Do. 4% Deb.	Stock	4	4%	82—86	
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—28	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	52—57	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	92½—93½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅞—1⅛	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
Bristol Electric Traction Co., Ltd.	10	—	—	½—1¼	
Do. 6% Cum. Pref.	10	6	6%	3½—4	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	3—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£				
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	8%	13—14	+½
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	¾—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Street Tramways Co.	4	4/6	2½%	⅞—1⅛	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—75	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	½—⅝	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	⅝—⅞	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	95—100	
Potteries Electric Traction Co. Ltd.	1	4	—	½—⅝	
Do. 5% Cum. Pref.	1	5	2½%	½—⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93 xd	−2
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜—5½	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	79—83	+2
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1⅜	
Do. 6% Cum. Pref.	5	—	—	2¾—3⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	58—61	+1
Do. 6% Pref. Ord.	Stock	6	6%*	103½—104½	+1½
Do. Def. Ord.	Stock	1	—	17—17½	−½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	89—91	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13½—13⅝	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	101—103	+1
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	100—102	+½
Do. do. (Mauritius Stb.)	25	4	4%	99½—101½	
Eastern Ext. Australasia & China	10	7	5%	11⅜—12⅝	−½
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½%*	134—137	−1
Do. 3½% Pref.	Stock	3½	3½%*	84—86	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	18	2½%*	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅛—⅛	+⅛
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	117—119	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅛	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	101—103	−1
Western Telegraph Co., Ltd.	10	7	6%*	13—13½	−½
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅛	
Do. 6% Cum. Pref.	1	6	7%	⅛—⅛	
Babcock & Wilcox, Ord.	1	20	16%*	3⅞—4⅛	+⅛
Do. 6% Pref.	1	6	6%	1⅞—1⅞	−⅛
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¼—6½	
Do. 6% Cum. Pref.	5	6	—	6—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	—	
Do. 6% Pref.	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10¼	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅝—¾	
Crompton & Co., Ltd.	3	5	5%	1⅛—1⅜	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅛	
Do. 6% Cum. Pref.	1	6	6%	1—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	½—¾ xd	−⅛
Do. do. (fully paid)	5	4/2	2/6*	1½—2¼ xd	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	85—88	+1
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	−⅛
Do. 7% Cum. Pref.	2	7	—	1½—1¾	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	6¾—7½	−½
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10½—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16½—17½	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red.	100	4	4%	101½—103½	+½
Willans & Robinson, Ord. Shres	1	5	1/-	½—1	
Do. 6% Cum. Pref.	5	6	8/-	2¾—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	70—74	−2

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PROPOSED TAX ON ELECTRICITY AND GAS IN GERMANY

THE Bill embodying the proposals for a general tax on electricity and gas in Germany has now been drafted, and was published, together with a long official explanatory memorandum, as a supplement to last Thursday's issue of the *Elektrotechnische Zeitschrift*. The Bundesrath and the Reichstag will consider the matter this session. In its present form the Bill is divided into five parts. The first of these relates to the imposition of a tax on electrical energy and gas; the second to the taxation of apparatus for illuminating purposes; and the other three to the penalties involved by a disregard of the law, and other administrative details. The following summary deals chiefly with those portions of the first two sections which relate to the taxation of electrical energy and electrical apparatus. For comparison, however, the main points of the clauses relating to the taxation of gas and apparatus for illuminating purposes other than electrical are also given.

PART I.

Taxation of Energy.

Electrical Energy.—All electrical energy consumed in the country, whether for power, lighting, or heating purposes, is to come under the tax. Electrical energy generated and distributed by any person or company, and paid for by the consumers, is to be taxed to the amount of 5 per cent. of the total selling price, but with a maximum amount of 0·4 pfennig (0·048d.) per kilowatt-hour. A uniform tax of 0·4 pfennig (0·048d.) per kilowatt-hour is to be imposed on energy intended solely for the use of the owner of the generating plant, but by arrangement this figure can be reduced to 5 per cent. of the total generating costs per kilowatt-hour, if it can be proved by means of authentic accounts that the figure of 0·4 pfennig exceeds this value; that is to say, if the costs per unit are less than 8 pfennig (0·96d.). The method according to which the costs are to be calculated is to be fixed by the Bundesrath (Federal Council).

Gas.—All combustible gas supplied to, and paid for by, the consumers is to be taxed to the amount of 5 per cent. of the total selling price, with a maximum amount of 0·4 pfennig (0·048d.) per cubic metre. Gas intended for the producer's own use is to be taxed to the amount of either 0·4 pfennig or 0·2 pfennig per cubic metre, according to the calorific value of the gas. As in the case of electrical energy generated by the consumer's own plant, the amount can be reduced to 5 per cent. of the total costs under certain conditions.

The revenue taxed is to be the total income from the consumers, inclusive of the meter rents, and if the charge is paid indirectly, or if the energy supplied is not charged for, a uniform tax of 0·4 pfennig (0·048d.) per kilowatt-hour or per cubic metre of gas is to be imposed, as in the case of consumption by the producer. In the case of gas-driven electric plants the tax will only be imposed once, not both on electricity and gas, and the Bundesrath are to decide whether the energy is to be taxed in the "primary" or "secondary" form.

Exemptions.—Gas, which can be proved to be so poor in quality that it has a calorific value of less than 1,000 large calories per cubic metre at 0° c. and 760 mm. pressure, is to be exempt from taxation. (By this blast furnace gas is exempt.) Also, if the apparatus or engine in which the gas is utilised is directly united with the producing arrangements as in regenerative furnaces, benzine, oil, and spirit motors, acetylene lamps, &c., the gas used is exempt from taxation. Electrical energy generated by a plant with a capacity of not more than 1·5 kw., and gas produced by a plant with a capacity of not more than 1·5 cubic metres per hour, are also exempt. Questions as to whether the nature, quality, or purpose of a gas cause it to be free from taxation or not, are to be decided by the Bundesrath.

Payment of the Tax.—Where electrical energy or combustible gas is generated in the country, the tax is to be paid by the owner of the generating plant, and where the product is brought over the border from generating stations in another country, the person or company who first deals with the product is to pay the tax. In the case of the product being delivered to a third party, who again sells it, this party is to pay a tax in respect of the difference between the price at which he buys the product, and the price he obtains. Payment is to be made quarterly in all cases.

Special regulations.—The Bundesrath is to have power to permit the determination of the amount of the product to be taxed by other means than by direct measurement; in certain cases of stations with a capacity less than 20 kw. or 20 cubic metres of gas per hour, the tax is to be an agreed sum.

The rest of the first section concerns such details as the compulsory announcement of the commencement of operation of a new generating plant, whether public or private; the assistance which must be given to the officials when inspecting the plant and mains; the instalment of approved measuring instruments, the cost of which must be borne by the producer; and other details with regard to meters. In the case of entire consumption by the producer, a small portion of the cost of the meters will be refunded.

PART II.

Taxation of Illuminating Apparatus.

This part of the Bill deals with the taxation of electrical and other illuminating apparatus intended for use in the country, under which heading are included electric glow lamps and the incandescing filaments used in them, incandescent mantles for use with gas, spirit, petroleum, and other gas lamps, carbons for arc lamps, and mercury-vapour and other similar electric lamps.

Amount of the Tax.—The amount of the tax to be imposed on glow lamps and filaments or burners for the same is to be as follows :—

(1) Up to 15 watts, 5 pfennig (0·6d.) per piece.
(2) From 15 to 25 watts, 10 pfennig (1·2d.) per piece.
(3) From 25 to 60 watts, 20 pfennig (2·4d.) per piece
(4) From 60 to 100 watts, 30 pfennig (3·6d.) per piece.
(5) From 100 watts and over, 50 pfennig (6·0d.) per piece.

The amount to be taxed on mantles or other incandescing bodies for gas and similar lamps is to be 10 pfennig (1·2d.) per piece. Carbons for electric arc lamps are to be taxed to the amount of 1 mark (one shilling) per kg. (2·2 lb.). The tax for mercury-vapour and similar electric lamps, 1 mark (one shilling) per piece up to lamps for 100 watts, and a further 1 mark for every further 100 watts or less.

Payment of the Tax.—The tax is to be paid by the manufacturer of the article in question, by means of the use of revenue labels, one of which is to be affixed to the packing of every article which is subject to taxation. In the case of imported goods the importing party must pay the tax at the customs office when the goods are inspected. The use of the above-mentioned revenue labels is not necessary if the articles subject to taxation are counted and notified by a revenue official before they leave the works. The tax paid on articles which have been returned to the manufacturer as faulty will be refunded. All articles subject to the tax must only be allowed to be in circulation in the country in packing which cannot be opened without destroying the revenue label, or some other label where these are not used. The contents of the packet must be given on the outside, together with the name of the manufacturer.

The remainder of this part of the Bill deals with the following details :—Compulsory announcement of commencement of manufacture of articles subject to taxation; assistance which must be given the revenue officials for inspection of the factories and store-rooms; and various other details of administration.

The Bill, if passed, will come into force on October 1st, 1909.

Published together with the Bill itself is a long explanatory memorandum, which contains interesting statistics with regard to the growth of the electrical industry in Germany, and reasons which, in the opinion of the Government, called for the various clauses of the Bill. The following is a brief summary of its contents :—

Most of the sources of revenue to the State show either no increase from year to year, or only a very slight increase, and it was deemed necessary to find some industry which would provide a revenue increasing with the population and trade of the country. The electrical industry appeared to be a suitable one for this purpose, as it has developed to a remarkable degree within the last few years, and promises to grow to still greater dimensions. The number of public electric supply works are increasing rapidly every year, and the number of private works are also increasing to a remarkable degree. Although the tramways have practically all been converted to electric traction, the electrification of the main railways has already been commenced, and this together with the increasing use of electric light will ensure a continued progress of the industry. The fact that there is so much difference between the works costs per unit in various stations, and between the average income per unit shows that there is still room for improvement, and that the lowest average price has by no means yet been reached. For example, the works' cost of electric power in Aachen, Berlin, Breslau, and many other towns is much lower than 10 pfennigs (1·2d.), and in many large towns, such as Achern, Dantzig, Karlsruhe, &c., it is over 20 pfennigs (2·4d.). The average income per unit varies between 20 and 40 pfennigs. With these great differences in the cost of production and in the selling price, it is claimed that a slight tax of a fraction of a pfennig would hardly be felt, although, in consequence of the enormous amount of elec-

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trical energy used for all purposes, would bring in a substantial revenue to the country. However, it seemed hardly justifiable to impose a tax on electrical energy without imposing a corresponding tax on gas, its natural competitor, and for this reason gas has also been brought into the scope of the Bill. This latter industry has also developed remarkably within recent years, especially with regard to heating purposes, and a substantial revenue can also be expected from this source. In both cases the collection of the tax is considered to be a fairly simple matter, as the product can be taxed directly in large quantities at the point of generation. It is added that the figure of 0·4 pfennigs per kw.-hour, which is given as the maximum amount, will hardly be felt, as the lowest price even for power purpose, except to very large consumers, is not much less than 10 pfennigs (1·2d.) per unit. Even in such cases where electrical energy is used in large quantities, as, for example, in the manufacture of steel, it is contended that the imposition of such a small tax will not be felt severely. For example, in the case of a large steel works producing 400,000 tons of steel annually, and producing current for its own use at a cost of 2·5 pfennigs (0·3d.) per unit, the tax would only amount to about 8 pfennigs (0·96d.) per ton of steel. Manufacturers of aluminium, calcium carbide, and other large users will probably find the tax somewhat heavier; for example, it may amount to as much as 3 pfennigs (0·36d.) per kg. of aluminium, which costs about 1·8 mark (1s. 9d.). For tramways, the tax will probably amount to about 0·3 pfennig per car kilometre (0·058d. per car mile).

The probable revenue from the tax has been estimated to be 50 million marks (approximately £2,500,000) on the following considerations:—The total amount of energy bought from generating authorities amounts to about 1,000 million units per annum; that generated for private use about 5,000 million units. These together are estimated to bring in a sum of 17·4 million marks (approximately £870,000). Taking the amounts of gas as 2,500 million cubic metres in each case, a total revenue of 14·5 million marks (approximately £725,000) is expected. The taxes on illuminating apparatus are estimated to bring in a revenue of 23 million marks (approximately £1,150,000), of which the tax on glow lamps will contribute six million marks. The total of the above is 54·9 million marks, but the costs of administration and other expenses are expected to bring the total revenue down to about 50 million marks (£2,500.000).

The remainder of the memorandum contains explanations of the limiting charge of 0·4 pfennig per unit, the reason why one cubic metre of ordinary gas was assumed to be equivalent to one kilowatt-hour of electrical energy, and other details. It is stated that when estimating the tax on energy supplied by a generating station the 5 per cent. is to be estimated on the total income to the company or supply authority from the sale of energy. In comparing the illuminating capacities of electricity and gas respectively, it is stated that about 1,000 candle-hours can be obtained from one kilowatt-hour with tungsten lamps, and that an equal amount of light can be produced by one cubic metre of gas with an inverted mantle. For power purposes also one kilowatt-hour is assumed to be equivalent to one cubic metre of ordinary gas, as although a somewhat larger output can be obtained with the latter, the attendant expenses are greater. Ordinary gas and water-gas are assumed to come under the 0·4 pfennig per cubic metre regulation, and producer gas under the 0·2 pfennig rule, but furnace gases will not be taxed, as their calorific value is below 1,000 large calories per cubic metre.

LONDON ELECTRIC POWER BILLS

Proceedings before House of Commons Committee

On Wednesday last week, at the close of the case of the "Eight Companies" against the London and District Electricity Supply Bill, Mr. Gerald Sander presented the opposition of the Islington Borough Council, which was upon the same lines as that of other Councils in the proposed area. Then followed the four West End companies, viz., the Westminster, St. James and Pall Mall, Kensington and Knightsbridge, and the Notting Hill companies, who are really now in line with the other companies, in that their respective Bills contain the same clauses, and there is now no opposition between the two. The case for the four companies rests upon a somewhat different basis, however, their areas being admittedly residential, and consequently offering no inducement to a power company. The latter retort, however, to use the expression of Sir Hugh Bell, that "We want you"; in other words, the promoters wish to retain the West End area in their Bill mainly for the purpose of supplying the authorised distributors in bulk. This being so, it was put to the committee that the power company, in order to force the authorised distributors to take a supply, would approach the very small power users that were to be found in the West End, and use them as a lever. Mr. Seymour Bushe, K.C., for the companies, urged that the Bill was really a gamble. The whole success of the scheme lay in the promoters securing the authorised distributors, and the Bill would leave the door open for illegitimate pressure to be put upon the present undertakers. Sir Alexander Kennedy, F.R.S., further expressed the opinion that the Bill could not be a success commercially.

For the Middlesex County Council, evidence was called pointing out the undesirability of allowing any portion of Middlesex being included in the area, first, because there is a power company already there, and secondly, because, under the proposed purchase terms, the London County Council would get a "foot in" Middlesex. By the way, the appearance for the first time before the Committee on behalf of the London County Council of Mr. Freeman, K.C., is an interesting sequel to the discussion at the Council's meeting last week. Originally the Council had not retained counsel against the Bill in the House of Commons, but the belated appearance of Mr. Freeman is for the purpose of protesting against the purchase clause contained in the Board of Trade report, should clauses be reached. The City Corporation instructed its legal representatives to ask the Committee not only to reject the bulk supply Bill, but to make a suggestion in their report that the Board of Trade should call a conference to endeavour to arrive at a solution of the question by utilising the existing resources. The Chairman, however, intimated that the Committee would go no further than saying "Aye" or "No" on the preamble of the Bill. Thursday's proceedings closed with a clever attempt on the part of Mr. Balfour Browne, K.C., to find out the possible verdict of the Committee, which, it was stated, would in all probability be given on the following Tuesday or Wednesday. Mr. Balfour Browne asked the Chairman to name a day upon which the London Electric Supply or "eight company" Bill would be taken. The Chairman stated that in the event of the preamble of the present Bill not being found proved, it would be possible to start on Wednesday with the other Bill. If, on the other hand, the preamble was passed, the clauses would take a little time, and it might not be possible to start the second Bill until Thursday. "Shall we say we will start my Bill on Wednesday, then?" queried Mr. Browne, amid laughter. "You had better say Thursday," was the answer.

On Tuesday, Mr. Balfour Browne spoke on behalf of the North Metropolitan Electric Power Supply Co., for whom also Mr. James Devonshire, the Managing Director, and Mr. E. T. Ruthven Murray, the Chief Engineer, gave evidence. The case for this company is, of course, based upon competition, and it was urged that there was no precedent for competition between two electric power companies. It was also pointed out to the committee that Mr. Merz in 1905 had excluded any portions of the area of the North Metropolitan Co. from his Bill. The Hon. J. D. Fitzgerald, K.C., occupied a good portion of Tuesday and several hours on Wednesday with his reply. Before he commenced, however, Mr. Freeman, K.C., on behalf of the London County Council, intimated that they were quite satisfied with the Bill as it stood, and he would desire to have something to say upon the Board of Trade report. The Chairman pointed out that this report would only come under consideration when the various clauses of the Bill were being discussed, and that Mr. Freeman would then have his opportunity.

Mr. Fitzgerald, in his speech, maintained the position he took up in opening the Bill in both Houses, namely, that the opportunity of obtaining a supply in bulk from a large generating station was a valuable option to the authorised distributors, and at the same there was no obligation of any kind upon them to take it. He further argued that none of the evidence brought forward in opposition to the Bill was of a character that would influence the Committee to give such a decision as to prevent the Bill passing into law.

Mr. Fitzgerald was still continuing his speech yesterday when we went to press.

L.C.C. Report on the Bills

THE Parliamentary Committee of the London County Council has reported upon the three Electric Power Bills now being considered by Sir Luke White's Committee.

LONDON AND DISTRICT ELECTRICITY SUPPLY BILL.

The Committee point out that a new situation has now arisen in regard to this Bill by the issue of the Board of Trade report (ELECTRICAL ENGINEERING, November 5th, p. 618). The principal points arising on this report are in connection

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with the purchase clause, both in regard to the dates and terms of purchase. Where these are in conflict with the agreement arrived at between the Council and the promoters, the report states, it is obvious that the Council must adhere to the terms of the agreement which they think adequately safeguards the interests of the public. The special attention of the Council, however, is directed to one suggestion in the report with regard to the purchase clause which is considered to be most important. This suggestion is as follows:—"The Board suggest that provision should be made by the clause not only for compulsory purchase at certain dates, but also for enabling the London County Council to purchase the undertaking at any time on terms to be agreed by them with the company."

The purchase clause already contained in the Bill, it is pointed out, not only provides for purchase in 1961 on Electric Lighting Act terms, but also provides for purchase in 1931, 1941, or 1951, on payment of an additional sum for compensation in respect of loss sustained by the company by reason of such purchase taking place at a date earlier than 1961. Consequently, in 23 years from the present time, or at successive periods of 10 years, the option to purchase could be exercised, and the public would be in a position to avail itself of any benefits which might accrue from the exercise of the powers of purchase at a time when it would be possible to estimate with some certainty the financial results and possibilities of the undertaking, and after the earlier and more speculative stages of the enterprise have been passed. The Council, both in the session of 1907 and on the present Bill, has consistently adopted the attitude that any undertaking such as that under consideration should be carried on by means of private enterprise, subject to proper public control, and that money raised on the security of the rates should not be risked in the initial stage of developing the undertaking. The suggestion made by the Board of Trade, however, reopens the whole question, and if adopted, would be directly antagonistic to the Council's policy. It would make it possible for the undertaking to be taken over by the Council in its preliminary stages when but little, if any, of the estimated expenditure (£6,000,000) had been actually incurred, and before any sufficient opportunity of judging as to its prospects had been afforded. Under the circumstances, therefore, the Committee think the Council will desire to express its disapproval of the proposal and venture to hope that it may not be seriously pressed before the Select Committee. One or two further points arise on the report, including the question of some readjustment or modification of certain powers of the Council under existing Acts and Provisional Orders with respect to electrical undertakings, which will necessitate the Council being represented before the Select Committee on the Bill. Further it may be necessary in order to preserve the Council's *locus*, to seal and present a petition against alterations in the Bill. The Committee therefore recommend:—(*a*) That, as the Council has not asked for the power, as suggested in the report of the Board of Trade, on the London and District Electric Supply Bill, of purchase by agreement before the periods specified in the purchase clause now contained in the Bill, and having regard to the fact that a purchase to be authorised by the Bill of the undertaking at an early stage of its existence would be open to the same objections as have been expressed against the Council itself embarking upon such an enterprise, notably the financial risk to the ratepayers of such an extension of municipal trading over an area several times larger than the county, the Council is of opinion that such an amendment as that suggested by the Board of Trade would be undesirable. (*b*) That, if necessary, a petition be sealed and presented, against alterations in the London and District Electricity Supply Bill, 1908.

London Electric Supply and London (Westminster and Kensington) Electric Supply Companies Bills.

The Committee report that these Bills have been read a second time in the House of Commons and that instructions have been passed by that House at the instance of the Government in regard thereto (Electrical Engineering, November 5th, p. 619). The subject matter of these instructions has already been before the Council and gives rise to questions of considerable importance. Having regard to the decision of the Council on July 28th and 29th, 1908, that no opposition be offered to these Bills on second reading in the House of Commons, the Committee have not up to the present thought it necessary to take any active steps in regard to the proceedings before the Select Committee on the Bills, but in view of the above instructions they are giving the whole matter their careful consideration.

This report was agreed to, after a short discussion, at the Council's meeting on Tuesday.

LOCAL NOTES

ABERDEEN: *Underground Telephone Wires.*—The conduits for taking the telephone wires have now been laid in all the principal streets, the number of thoroughfares dealt with being about 200, and the total length of road some 21 miles. Restoration of the streets has been carried out by the borough surveyor, the cost of which, in addition to the maintenance of the disturbed streets for six months, is to be defrayed by the Postmaster-General. The remaining work will be carried out by agreement between the Corporation and the National Telephone Co.

ARGENTINE: *Electric Supply in Tucuman.*—The Tucuman Senate has, says the *Review of the River Plate*, approved a Bill authorising the creation of an official electric supply station. Concessionaires for the electric tramways in Tucuman have resumed the constructional work, which has been stopped for some considerable time.

AUCKLAND (N.Z.): *Tramways.*—The total revenue from the Auckland tramways during the past financial year amounted to £140,451, and the working expenses to £82,885. The interest on the debenture stock and loans, depreciation, &c., absorbed £48,147, leaving a balance of £9,419. From this is deducted 1 per cent. sinking fund, leaving a net profit of £3,069.

BARNES: *Street Lighting.*—The Electrical Engineer recommends that all lamps in the main roads should be changed from 50 c.p. Nernst to 100 c.p. Osram. The cost of changing over will be 12s per post for 150 posts. It was resolved, as a commencement, that twelve 100 c.p. Osram lamps be placed in the existing posts in Castelnau and twelve in Sheen Lane.

CHESTER: *Fraudulent Use of Electricity.*—A Chester hairdresser and tobacconist was fined £20 and costs last week for having his lamps connected to a power meter from which a fan was being supplied at power rates. In this way he obtained his lighting at power rates instead of the lighting rate, which is 3½d. per unit. The power rates in Chester are for the first 200 units 1½d. per unit and above that amount 1d. per unit. It was calculated that the defendant's bill, which should have been £19 10s. 6½d., was only £7 2s. 7d.

CLACTON: *Battery Inspection.*—The Electric Lighting Committee's recommendation that notice be given to terminate the contract with the D.P. Battery Co. for inspections and reports upon the Council's battery has been adopted.

CLITHEROE: *Electric Lighting Order.*—A letter has been received from the Board of Trade *re* the Council's Electric Lighting Order, asking what steps were being taken to carry it out. The Town Clerk has been instructed to reply that the matter is having consideration.

CONSTANTINOPLE: *The Tramway Co.—The Financial News* states that the Tramway Co. of Constantinople will shortly increase its capital from £T600,000 to £T940,000. Hitherto the chief voice in the affairs of the company has been held by the Continental Co. for Electrical Enterprise.

COSELEY: *Subsidences on Tramway Track.*—The Wolverhampton and District Electric Tramways Co., Ltd., having been asked to revert to the system of reduced children's fares formerly in use in the district, the company asked whether, in the event of making this concession, the Council will be willing to forego in future payment of the annual sum of £25 which is provided in the agreement of March 31st, 1899. In view of the heavy calls in respect of mining subsidences, and consequently excessive costs of repairs to the tramways in the Coseley district, the company regard this payment as an unfair burden from which they should be relieved. It may be mentioned that when the tramways company were granted concessions in the district, the Council received £1,000 down, and, as stated above, £25 per annum in perpetuity, and the matter is now under consideration by the Council.

DENNY: *Electric Lighting.*—A supply from the Fife Electric Power Co. is now available, and was switched on last week. The supply is given by means of overhead wires. Public lighting is now under consideration.

DUNDEE: *The New Power Station.*—Complaints are being made at the delay in completing the new power station. The Chairman of the Electricity Committee, however, states that nobody is really to blame. The fault lies with the Town Council itself, inasmuch as on several occasions there have been diversions from the original plans. The electrical engineer reports that Willans & Robinson, the contractors for the turbo-generators, who have been paid £10,000, now claim another instalment of £4,000, with interest, as from September 3rd, 1908.

Street Lighting.—With reference to the situation which has arisen over the lighting of the Hilltown, the Committee in charge had a meeting this week on the site, when they decided on arc lighting. Their decision has since been confirmed by the Town Council, who have instructed the gas department to have the lamps which they recently erected removed. It will be remembered that the gas department erected four lamps each within twelve yards of the four existing arc lamps, but on the meeting night it was quite apparent that only one result could be come to.

FALMOUTH: *Trackless Trolley System.*—The Corporation are considering a scheme for the provision of trolley omnibuses.

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GRIMSBY: *Supply for Wireless Telegraphy.*—The Council has now sealed agreements with the Admiralty in regard to the wireless telegraph station under construction at Humberstone. These agreements have reference to the supply of electrical energy, the laying of high-tension cable, and the maintenance of the cable and plant. The Admiralty undertakes to purchase all current required from the Corporation at agreed rates for a term of years, the Board of Trade to settle any disputes that may arise.

HERNE BAY: *Electric Lighting Provisional Order.*—An application has been made to the Board of Trade for an electric lighting Provisional Order.

HEYWOOD: *Electricity Supply.*—In a General Powers Bill which will be promoted next session, the Corporation seeks powers to the free wiring of houses for electric lighting and other purposes, and the fixing of meters, &c., upon consumers' premises. Authority is also sought for supplying local authorities and others in districts adjoining Heywood with electricity. The stand-by clause is also included.

KIRKINTILLOCH: *Proposed Tramways.*—The Council has agreed to send a deputation to wait upon the Tramways Committee of the Glasgow Corporation, urging the extension of their tramways to Kirkintilloch.

LONDON: *London County Council: The London Traffic Board.*—The General Purposes Committee of the London County Council report that the Prime Minister has agreed to receive a deputation from the Council to urge the necessity of securing the establishment of a London Traffic Board upon the lines indicated in the report of the Royal Commission on London Traffic. Thursday, November 26th, has been fixed as the date of the reception of the deputation.

Tramways.—In connection with the construction of tramways across Hammersmith Broadway, the Highways Committee recommend that authority be sought in the next session of Parliament to enable these to be laid in a different position from that authorised by the London County Council (Tramways and Improvements Act, 1903), and to amend Section 5 of that Act so that the Council may use the lines for public traffic before the widening of the northern side of the Broadway is effected.

In the King's Bench Division last week, a Mr. J. S. Yates, commercial traveller, of Palmers Green, was awarded £220 damages for injuries received in a collision between two tramcars in Brixton in November, 1907.

A deputation from the Woolwich Borough Council waited upon the Highways Committee of the London County Council on Thursday, urging the construction of the tramway to Eltham. Mr. S. Benn, who presided in the absence of the Chairman of the Highways Committee, assured the deputation that the petitions received from Eltham and Woolwich had not been lost sight of. It had been decided to adopt the overhead system, but the Astronomer Royal objected on the ground that it would interfere with the scientific instruments at the Greenwich Observatory. If, on the other hand, they were to adopt the conduit system the lines would prove a financial failure. The Highways Committee were considering a way out of the difficulty, and were seeking expert advice on the question. If, when this expert report had been received, it was found that the overhead system could be used, the construction of the line would be started at once.

The Highways Committee of the Paddington Borough Council recommend that the consent of the Council should be refused to a proposal to construct tramways from Harrow Road, via Sutherland Avenue, to Maida Vale, on the ground that such lines would depreciate the value of property in Sutherland Avenue and adjacent streets, and further, as they would not link up any of the other tramway services, they would serve no useful purpose.

Marylebone: Electricity Accounts.—The revenue statement and financial return for the June quarter of the electricity undertaking shows that the total expenditure amounted to £10,722, against £12,034 for the corresponding quarter last year. The cost per unit sold worked out as follows:—Generation expenses, 0·754d.; distribution expenses, 0·232d.; management expenses, 0·334d.; rents, rates, and sundries, 0·220d.; special distribution expenditure, 0·066d.; a total of 1·606d., compared with 1·778d., exclusive of the last item. As compared with the corresponding period in 1907, generation costs were lower by 0·051d. per unit, distribution costs 0·143d. per unit, owing to reductions in staff and other economies; management expenses, 0·2d., notwithstanding the larger amount expended this year in the work of the publicity department, and its efforts at extension of business, and rents, rates, and sundries improved by 0·024d. Under all heads the net decrease per unit was 0·172d., or nearly 10 per cent. The gross income showed a diminution of £2,501, as compared with the corresponding quarter, brought about by the more extended use of new and economical types of lamps, and a change in the dates of reading the meters, about seven days later than previously. The return adds that the sales returns for the September quarter show that the fall in units sold for the June quarter has been more than overtaken during the following three months.

MONTEVIDEO: *Underground Telephone Mains.*—In connection with the request of the Montevideo Telephone Co. to the Government of Uruguay for a concession allowing them to lay their mains underground, the question of pressing the Government for a reply has recently been under consideration. It has now been decided to send a representative to South America in order to ascertain the position of things, and it is not thought likely that any steps will be taken pending the receipt of a report from this gentleman.

MORECAMBE: *Tramways.*—The Corporation have given notice of their intention to deposit a Bill for the acquisition of the Morecambe Tramways Co., and the conversion of the lines to electric traction.

NEWCASTLE: *Electrical Exhibition.*—The Newcastle Electric Supply Co., Ltd., are holding an exhibition this week in their showroom at Hood Street of the latest appliances for electric heating and cooking. This branch of the company's business has made rapid strides in the past few years. Two years ago there were only two electric irons connected with their mains, whilst now there are 600.

OLDHAM: *New Chairman of Electricity Committee.*—Alderman Bolton was re-elected Chairman of the Electricity Committee at the first meeting of the new Council.

OSWESTRY: *Reduction in Electricity Charges.*—The directors of the Oswestry Electric Lighting & Power Co. have decided to reduce the price of current, and the following charges will come into force from January 1st, 1909:—Lighting, 5½d. instead of 6d. per unit; for heating, cooking, and power purposes the following scale will be enforced up to 250 units per quarter, 2d. per unit; from 250 to 500 units, 1½d. per unit; from 500 to 25,000 units, 1d. per unit; from 25,000 to 50,000 units, ¾d. per unit; above 50,000 units, ½d. per unit.

PERTH: *Sunday Trams.*—A motion to inaugurate a service of trams on Sunday was defeated by one vote at the monthly meeting of the Town Council last week.

PORTSMOUTH: *Tramways Extensions.*—The Corporation have given notice of their intention to deposit a Bill for the construction of additional tramways.

QUARRY BANK: *Proposed Light Railway.*—Owing to the suspension of the negotiations between the Joint Light Railways Committee, composed of representatives of Quarry Bank, Brierley Hill, and Rowley Regis, and Mr. Vesey Brown's company for the construction of a light railway between Cradley Heath and Brierley Hill, it is proposed that joint conferences should be held between the parties named to decide their course of procedure.

RAWTENSTALL: *Tramways and Lighting.*—In addressing the Town Council last week, the new Mayor stated that the cost of the tramways would be £134,000, and the electricity undertaking, £33,800. These figures indicate, to his mind, that it would be some time before the tramway scheme would be self-supporting, not to say a source of profit, and it was desirable that they should see results from their present undertakings before entering upon any new schemes which were not unavoidable.

RHYL: *Tramways.*—The Council have approved the light railway scheme between Rhyl and Prestatyn, which has been placed before them by Mr. Stephen Sellon, chairman of the Llandudno and District Electric Tramway Co.

SHEFFIELD: *Chairman of Tramways Committee.*—At the first meeting of the new City Council, Sir W. Clegg was again re-elected as Chairman of the Tramways Committee.

SHREWSBURY: *Electricity Supply.*—Notice is given by the Corporation of its intention to promote a General Powers Bill in Parliament next session. Included in the provision of the Bill are the supply and fixing of electrical fittings, wiring of houses, &c., the stand-by clause. The Corporation also seeks authority to allow of discount on rebates of electric lighting and power accounts, and to enter into agreements for the supply of electrical energy in bulk to surrounding districts.

SOUTH SHIELDS: *Lighting and Tramway Undertaking.*—In his annual abstract of accounts, the borough accountant points out that the capital expenditure upon the electric lighting undertaking amounts to £177,438. The net profit for the past year amounted to £1,368, which has been carried to the reserve fund, the latter now standing at £8,782. The capital expenditure upon the tramways undertaking amounts to £169,390. The net profit for the past year amounted to £2,884, which has been transferred to the reserve fund, bringing this to £5,454.

TASMANIA: *Launceston Tramways.*—The *Australian Mining Standard* states that the proposal to instal electric tramways at Launceston makes no headway, and to all appearances the city is as far as ever from the attainment of what all seem to be agreed upon as a desideratum. The scheme was submitted to a London tramways group, by which the Council should issue debentures and cover the cost of construction, the concessionaires then proceeding with the work and being responsible for the commercial risks. This did not quite meet with the views of the tramway group in question, but it is anticipated that further proposals will be placed before the Council.

TONBRIDGE: *Electricity Loan.*—A loan for electric lighting purposes has been taken up from the Newcastle Savings Bank at 3¾ per cent.

TYNEMOUTH: *The Electric Light Works.*—The Corporation have retained Messrs. Handcock & Dykes to report on the condition and management of the electric light station, and on the charges for lighting and power.

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WALKDEN: *Power Supply.*—Messrs. Edward Lane & Sons, cotton goods manufacturers, of Hope Mills, Walkden near Manchester have now arranged with the District Council for obtaining current for their mills, from the Lancashire Electric Power Co.

WELLINGTON (N.Z.): *Tramways.*—The total revenue from these lines for the past financial year was £122,194, and the working expenses £80,822. Interest on loans, depreciation at 2¾ per cent., absorbed £12,376, leaving £10,229. The net balance after providing for a 1 per cent. sinking fund is £5,568.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ARGENTINE.—The Parana municipality is calling for tenders for the equipment of an electric power station.

AUCKLAND (N.Z.).—Tenders will shortly be invited for consumers' services at an estimated cost of £4,800.

CLACTON.—Cable to the estimated value of £300 is to be laid in connection with a supply to the Convalescent Home.

GLASGOW.—The Electricity Committee recommend an application being made to the Secretary for Scotland for his consent to a further loan of £150,000 for electricity purposes. This recommendation is based upon the report of the electrical engineer, to the effect that £56,500 will be required for new buildings and machinery, and £75,840 for mains and meters.

HOUNSLOW.—A Local Government Board inquiry was held last week into the Council's application to borrow further loans, amounting in all to £7,088, including about £3,000 for work already done.

LONDON. *London County Council: Poplar.*—A loan for £22,180 in connection with the electric lighting undertaking has been completed.

Woolwich.—Owing to the increased load, principally due to the tramway supply, it has become necessary to construct a cooling pond at Plumstead works.

PORTUGAL.—The *Diario do Governo* of October 31st contains a copy of a decree authorising the Camara Municipal of Horta to grant an exclusive concession to Joao Raposo de Medeiros for the production and distribution of electric energy for public and private lighting purposes in the town.

RADCLIFFE.—A Local Government Board inquiry was held last week at Radcliffe (Lancs.) into the local District Council's application to borrow £14,000 for the extension of their electricity works.

ROSCREA.—The Council invite offers from electrical engineers, and others interested, for the preparation of plans, specifications, detailed estimates, and report for an electric lighting installation. Particulars from the Clerk to the Council.

SURBITON.—The Parliamentary Committee has received a letter from the Local Government Board relating to the inquiry held some time ago into the Council's application for borrowing powers to enable them to extend the electric lighting undertaking. The Board state that they have decided to sanction the borrowing of the following sums for purposes of the undertaking, viz. :—£1,377 in respect of excess expenditure; £2,000 for prospective expenditure on mains; £900 on house services; £676 on meters.

WOLVERHAMPTON.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £6,000 in connection with the electricity undertaking.

YARMOUTH.—A loan of £2,000 is to be applied for in connection with public lighting mains.

Miscellaneous

DUBLIN UNITED TRAMWAYS CO.—Tenders are invited for stores, including electrical supplies, during the year ending December 31st, 1909. Particulars from the Secretary, and tenders by November 30th.

LONDON: *London County Council.*—Tenders are invited for the road-work and platelaying required for the electrification on the conduit system of the existing tramways from Prince of Wales' Road *via* Kentish Town Road, Fortress Road, and Junction Road to the Archway Tavern. Particulars from the Engineer (fee, £5, returnable), and tenders to the Clerk by November 24th.

Hackney.—The Borough Council invite tenders for meters of the ampere-hour motor type. Particulars from the Town Clerk (fee £5, returnable), and tenders to the Chairman of the Electricity Committee, by December 17th.

MANCHESTER.—The Tramways Committee invite tenders for the supply of tramcar trucks and tramcar resistances (grid type). Particulars from the General Manager, and tenders to the Chairman of the Tramways Committee, by December 1st.

NORTH-EASTERN RAILWAY.—Tenders are invited by December 3rd, for telegraph apparatus and telegraph wire and line stores during the six or twelve months from January 1st, 1909. Particulars from the Telegraph Superintendent, York.

PERU.—*El Diario* of October 1st states that Senador Zegarra has introduced into the House of Senators a proposal for the electrification of the Central Railway of Peru for the purpose of increasing the traffic capacity and facilitating the exportation of minerals. By the terms of the proposal it is intended to continue the use of the existing rolling-stock by running electric trains and steam trains alternately.

REDDITCH.—The Electricity Supply Committee invite tenders by November 24th, for street work in connection with the laying of cables, mains, and house services.

SHEFFIELD.—The Electric Lighting Committee invite schemes and estimates for supplying and erecting complete an automatic or electric railway, telpherage, or wire rope-way for conveying and tipping boiler refuse on the tip adjoining the power station at Neepsend. Particulars from the General Manager and Engineer (fee, £1, returnable), and tenders by December 11th.

SPAIN (CANARY ISLANDS).—The *Gaceta de Madrid* of November 8th publishes a notice to the effect that D. German de Leon y Castillo has applied to the Ministerio de Fomento, Madrid, for a concession for an electric tramway from Las Palmas to the port of La Luz. The Ministerio are prepared to consider other offers on terms more advantageous to the Government if such offers are presented within one month from the date of publication of the present notice in the *Gaceta.*

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Building in Little Britain (to exceed 250,000 cubic feet). Architect, G. Vickery, 50 Gresham Street, E.C.

S.E.—New factory for Sir W. P. Hartley, Green Walk, Tower Bridge Road, Bermondsey.

Printing works, Southwark. Architect, G. F. Collinson, 81 Hallam Street, Portland Place, W.

Extension of laundry at Gordon Road Workhouse, Camberwell (estimated cost, £800). C. S. Stevens, Clerk to the Board of Guardians, Peckham Road, S.E.

Police station at Carter Street, Walworth (£13,800). J. Dixon Butler, Surveyor to Metropolitan Police, New Scotland Yard, S.W.

S.W.—Additions to Anglo-American Laundry, Tooting. Architects, S. J. Reynolds and H. Hicks, Reigate. Builders, Holliday & Greenwood, Brixton Road, S.W.

Alterations and additions to St. Leonards Girls' and Infants' Schools, Mitcham Lane, Streatham. Builders, J. H. Jenkin & Co., 36 Mitchan Lane, Streatham.

Additions to Convent of St. Andrew, Coventry Hall, Polworth Road, Streatham. Architect, E. Goldie, 31 Upper Phillimore Place, Kensington, W.

Hall, High Street, Tooting. Builders, H. Roffey & Sons, 26 and 28 Charlwood Road, Putney, S.W.

New premises in Queen Anne's Gate for Anglo-American Oil Co. Architects, Runtz & Ford, 10 Walbrook, E.C.

W.—Additions to Workhouse, Paddington. H. F. Aveling, Clerk to the Board of Guardians.

PROVINCES.

BAGTHORPE (NOTTS).—Extension to new Workhouse (£6,500) for Nottingham Board of Guardians. Clerk to the Guardians.

BARNES.—Additions, Lawn Convent Schools, Church Road. Mother Superior.

BROUGHTON-CUM-BOSSINGTON.—School (£3,008). H. Barber, Clerk to County Council, Winchester.

CHISWICK.—Additions to Royal Standard Laundry (£4,500). Architects, S. J. Reynolds and H. Hicks, Reigate and Broadstairs. Builders, Holliday & Greenwood, Brixton.

CRESWELL (NOTTINGHAMSHIRE).—School. H. H. Copnall, Clerk to County Council, Nottingham.

DERBY.—Improvements to slaughter-houses at cattle market. J. Ward, Surveyor to Corporation.

DUDLEY.—Primitive Methodist Church (£2,000). Rev. J. Shenton, Vicar Street.

DUMFRIES.—Joint Fever Hospital (£6,000) for Dumfries and Maxwelltown Town Councils. Clerk to Dumfries Town Council.

FOLKESTONE.—Enlargements at Victoria Hospital (over £2,000).

HAMPSHIRE.—Fareham Asylum Visiting Committee has decided to extend the electric lighting of the institution. Tenders are to be invited for wiring the remainder of the buildings.

HULL.—Art Gallery, Victoria Square (£10,889). Builder, G. H. Panton, 206 Anlaby Road.

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NORTHAMPTONSHIRE.—Isolation Hospital at Berrywood Asylum. H. A. Millington, Clerk, County Council.

PLYMOUTH.—Horse slaughter-house at Prince's Rock (£593). Builders, Wakeham Bros., Fairy Building Yard, Knighton Road, Plymouth.

PRESTON CIRCUS (BRIGHTON).—Proposed police station. Surveyor, Alf. Weller, Town Council, Brighton.

READING.—New Hall, St. Luke's, Redlands (£1,400–£1,500). Architect, S. Slingsby Stallwood, 27 Market Place, Reading.

SOUTHAMPTON.—Additions to Asenpart School (£12,196). J. A. Crowther, Borough Engineer and Surveyor.

Additions, Western District School (£8,250). J. A. Crowther, Borough Engineer and Surveyor.

ST. ANNE'S-ON-THE-SEA.—Extensions, Technical School (£1,200). Surveyor, H. Gregson, Urban District Council.

TYNEMOUTH.—Extension of North Shields fish quay (£21,000). J. F. Smillie, Surveyor to Town Council.

WEMBLEY.—Police station (£5,200). J. Dixon Butler, Surveyor to Metropolitan Police, New Scotland Yard, S.W.

WEST BROMWICH. Dust destructor (£11,000). A. D. Greatorex, Surveyor to Town Council.

WINCHESTER.—Proposed Asylum at Park Pewett Farm (500 places). H. Barber, Clerk to County Council, Winchester.

TENDERS RECEIVED AND ACCEPTED

BAHIA BLANCA.—In connection with the new power station at Bahia Blanca of the Buenos Aires & Pacific Railway, Messrs. Browett Lindley are supplying, as sub-contractors to the British Westinghouse Co., three triple-expansion engines for coupling to 1,000-kw. generators.

CORY BROS.' COLLIERIES.—Messrs. Crompton & Co. have received an order from Messrs. Cory Bros. & Co., Ltd., for an alternator with an output of 650 k.v.a. 2,200 volts 25 cycles, 107 revs. per min. This alternator will be a duplicate of the one now being installed by Messrs. Crompton at Messrs. Cory Bros.' Aber Colliery, and will be driven by the large Korting gas engine, manufactured and shown by Messrs. Mather and Platt, at the Franco-British Exhibition. Messrs. Crompton have also supplied two three-phase high-voltage motors for driving the main haulage. The motors have each an output of 270 b.h.p., and run at a speed of 360 r.p.m.

LEITH.—The following tenders have been accepted in connection with the Granton tramway extension:—Rails, North-Eastern Steel Co., Ltd.; joint welding, Thermit, Ltd.; cables, British Insulated & Helsby Cables, Ltd.

LONDON: *London County Council.*—The following tenders have been received for the roadwork and plate-laying, exclusive of the supply of rails and track work, in connection with the reconstruction upon the conduit system of the existing tramways in Essex Road, King's Cross, and Farringdon Street, and of the authorised tramways in Swinton Street:—Mr. W. Manders (accepted), £43,534; Dick, Kerr & Co., Ltd., £44,038; J. Mowlem and Co., Ltd., £44,856.

The following tenders have been received for the supply of overhead electrical equipment required for the tramways from Loughborough Junction to Norwood, Hammersmith to Putney, and Streatham to Norbury:—R. W. Blackwell & Co. (accepted), £7,801; British Insulated & Helsby Cables, Ltd., £8,229; Dick, Kerr & Co., Ltd., £8,266; S. G. Smith, £9,167; Reid Bros., £11,171. The Highways Committee recommend that arrangements be made with the undermentioned firms for the extension of their present contracts with the Council, to include the supply of the additional materials required for tramway work to be put in hand during 1908-9:—W. T. Henley's Telegraph Works Co., Ltd., low-tension cables; J. H. Tucker, feeder pillars; Johnson & Phillips, switchgear; the British Westinghouse Electric & Manufacturing Co., Ltd., motor generators.

The following tenders have been received for water-tube boilers for the second portion of the Greenwich generating station:—Edwin Danks & Co. (Oldbury), Ltd., £25,115; Clarke, Chapman & Co., Ltd., £25,875; Babcock & Wilcox, Ltd. (accepted), £27,526; Stirling Boiler Co., Ltd., £27,833; Richardsons, Westgarth & Co., Ltd., £39,262.

In connection with the construction of the overhead trolley tramways from Hammersmith Broadway to Putney, the County Council has come to an agreement with the Hammersmith Borough Council as to the positions of the tramway standards and the erection of electric lamps. The Borough Council will remove the arc lamps in Fulham Palace Road and substitute metal filament lamps, two of which will be affixed to each of the tramway standards. The cost of this will be borne by the County Council.

Bermondsey.—The Council has received the following tenders:—Three inkless recording voltmeters, moving-coil type, direct-current 450 to 525-volts seven-day clock, continuous roll chart (⅛in. per hour), front terminals:—Kelvin & James White, £33 15s.; Evershed & Vignoles, £32; General Electric Co., £27 4s. 6d.; Elliott Bros., £27 7s. 6d.; Everett, Edgcumbe & Co., £35 4s. 9d., alternative (accepted), £25 12s. 6d.; less 2½ per cent.

Three feeder pillars, each fitted with six 200-amp. switch fuses of standard type and bar for connecting neutrals, mounted on three separate panels, with doors back and front fitted with lock and key:—Callender's Cable Co., £46 10s.; Johnson & Phillips, Ltd. (accepted), £43 10s.; Crompton & Co., £46 5s.

One hundred feet 0·7 square inch single cable, insulated with pure and vulcanised rubber, Association 300 megohm grade, taped, braided, and compounded over all:—Siemens Bros. & Co., Ltd., £31 7s. 5d.; Johnson & Phillips, Ltd., £31 17s. 5d.; Callender's Cable & Construction Co., Ltd. (accepted), £31 17s. 6d.; British Insulated & Helsby Cables, Ltd., £31 17s. 6d.; W. T. Henley's Telegraph Works Co., Ltd., £33 13s. 2d.; 2½ per cent. less in each case.

Marylebone.—The tender of Messrs. W. J. Fryer & Co., at £4,426, has been provisionally accepted by the Electric Supply Committee for alterations at the Aybrook Street sub-station. Messrs. Sykes and Sugden's tender has been accepted for cut-outs, concentric 0·03 and 0·06, 7s. each, and triple concentric 0·1 and 0·15, 15s. each; and that of Lucy & Co., Ltd., for triple concentric cut-outs 0·03, 14s. 3d., 0·06, 14s. 6d., 0·25, 27s., and 0·4, 80s. each. Joint boxes concentric 0·4-5, 1 square inch, £1 12s. 9d. each; triple concentric 0·4, £1 3s. 8d.; disconnection boxes, Council's pattern or stock (four-way), £6 5s.; extra for 0·4 triple concentric, 6s. 9d.

Stepney.—An order has been placed with the Tudor Accumulator Co., Ltd., to substitute a battery with 250 cells for the old station electrical battery at a cost, including allowances for scrap, of £342.

Woolwich.—The Council have accepted the tender of Siemens Bros. & Co., Ltd., at £36 15s. for 220 yards of service cable, consisting of 0·035 and 0·022 square-inch section conductors.

WADEBRIDGE.—Tenders have been received from the Wadebridge & District Electric Supply Co., and from the Wadebridge Gas Co., for the replacement of the oil lamps which are now used for street lighting. The tender of the Electric Supply Co. has been accepted.

COMPANIES' MEETINGS AND REPORTS

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—At the annual meeting on Thursday, the report and accounts given in our last issue were adopted. The chairman, Mr. R. M. Horne-Payne, in moving the adoption of the report, stated that the directors did not know of a single cloud in the outlook, and that every indication pointed to increasing trade and prosperity for British Columbia and for the company. There was only one item in the balance sheet, he said, that required explanation, and that was under the heading "supplies." The large increase in the value of supplies on hand was due entirely to the fact that the company availed themselves in the spring of the panic prices of copper, steel, and other supplies to make purchases in advance for some 18 months or two years. A very pleasant and important feature in the report, he said, was the paragraph which refers to the concession granted to the company to carry on their business for a longer period of years in almost all the municipalities adjacent to Vancouver and New Westminster. The Hon. R. G. Tatlow, Minister of Finance and Agriculture for British Columbia, explained the conditions now prevailing there, and the possibilities of the future. After the resolution adopting the report and accounts had been carried, a further resolution was passed, authorising an increase of the capital of the company by an issue of 300,000 new shares of £1 each.

CAPE ELECTRIC TRAMWAYS CO.—At the annual meeting last week, the report and accounts given in our issue for November 5th were adopted. The chairman, Sir Charles Euan-Smith, who presided, again made reference to the competition of the Sea Point municipality with the company's service. With regard to the general commercial and financial depressions, he was convinced that this was only temporary, for the gold industry was more prosperous than ever, and this must react favourably on the general conditions of trade throughout the country.

EASTERN TELEGRAPH CO.—At the half-yearly meeting last week, Sir John Wolfe Barry, K.C.B., presiding, the report and accounts given in our issue for November 5th were adopted. Dealing with Mr. Henniker Heaton's suggestion of penny-a-word cables all over the world, the chairman referred to the statement of a very powerful committee who reported in 1902

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upon the whole subject of submarine cables. This committee consisted of the Secretary of State for Scotland, the Postmaster-General, the President of the Board of Agriculture, the Under Secretary of State for the Colonies, the Director of Military Intelligence, and the Director of Naval Intelligence. This committee were directed "to examine existing rates; to report how far they are fair and reasonable; and, if not, how any reduction should be effected." Upon this reference, Sir J. Wolfe Barry pointed out, the committee replied that all proposals for a very large reduction in existing rates, such as Mr. Henniker Heaton suggested of 1d. rate to America and Australia, were regarded as quite impracticable. There was, he said, little analogy between submarine cables and the 1d. post. In reply to a question as to the future of wireless telegraphy, Sir John stated that he had always refused to pledge himself to any opinion on this matter. From his knowledge, however, he did not see that wireless telegraphy was going to be a material competitor with cable telegraphy. It was a very beautiful, ingenious, and captivating mode of telegraphy, but he did not think it possessed, and never would possess, the advantages of cable telegraphy. As a matter of fact, the Eastern Co. were putting up a wireless installation in conjunction with one of the foreign Governments to act as a feeder to their general system, and if the time came for wireless telegraphy to be used by the cable companies on a larger scale, none of them would be backward in keeping abreast of scientific improvements.

LANCASHIRE & DISTRICT TRAMWAYS.—At the annual meeting in Lancashire on Saturday, the report and accounts given in our issue for November 12th were adopted.

LANCASHIRE POWER CONSTRUCTION CO.—At an extraordinary general meeting, held in London last week, the resolution sanctioning the creation of income debenture stock to the extent of £150,000 was carried. An amendment was moved to the resolution, urging that the business should be sold as a going concern in order that the "A" shareholders might get a little of their money back. This was defeated, however, and the resolution passed as mentioned above.

MEXICAN LIGHT & POWER CO.—The revenue statement for October shows that the working expenses have been reduced to 24½ per cent., as against 38 per cent. twelve months ago, and the net earnings are now equivalent to 7 per cent. on the common stock, the present dividend being at the rate of 4 per cent. per annum. The earnings for October amount to $519,651, an increase of $68,555 for the corresponding period of last year, whilst the expenses amount to $126,966, a decrease of $47,389. The fixed charges amount to $20,800, an increase of $48,000, leaving a surplus of $184,685, an increase of $67,944 over the corresponding period of last year.

MONTREAL STREET RAILWAY CO.—The report for the year ended September 30th shows that the gross earnings have increased by $173,789, or 4·96 per cent., and the operating expenses by $53,741, or 2·55 per cent. The net earnings have increased by $120,048, or 8·58 per cent. This result the directors considered very satisfactory in view of the general depression in business, and further satisfaction is expressed at the reduction in the percentage of expenses to gross earnings from 60·07 per cent. to 58·69 per cent. To some extent these results are attributed to the fact that the principal lines of the system are now equipped with "pay as you enter" cars. The directors issued to the shareholders in July last $1,000,000 new stock at 125.

WESTERN TELEGRAPH CO.—Sir John Wolfe Barry, K.C.B., presided at the half-yearly meeting last week, when the report and accounts given in our issue for November 5th were adopted.

WEST INDIA & PANAMA TELEGRAPH CO.—The report for the half-year ended June 30th shows a revenue of £39,733, compared with £43,832 for the corresponding period of last year, whilst the expenditure amounts to £27,560, against £30,028. To the balance is added £1,578 interest on investments, and £557 brought forward from last account, making a total of £14,302. It is proposed to pay a dividend of 6s. per share for six months to June 30th on the first preference shares, and 12s. per share on account of dividends accrued to June 30th upon the second preference shares, carrying forward a balance of £11,032. Owing to the difficulty of maintaining uninterrupted cable communications between Demerara and Trinidad, owing to the unfavourable nature of the seabed, the directors have decided to establish wireless telegraphy as an additional means of communication. A contract has accordingly been entered into with the Lodge-Muirhead Wireless & General Telegraphy Syndicate, Ltd., for the installation of the necessary apparatus in Demerara and Trinidad.

Telegraph Traffic.—The El Arich route was interrupted between Antiodre and Lattaqine on the 15th inst., and on the 11th inst. the submarine cable between Zanzibar and Mombassa, which was interrupted on September 11th, was restored to working order. There may be, of course, many interruptions which are not known of, as if there are duplicate lines working such incidents are not reported.

RECONSTRUCTION OF THE STREET RAILWAYS OF SAN FRANCISCO

AN article in the *Electric Railway Journal* on the street railway system of San Francisco contains some interesting information regarding the reconstruction of the lines after the earthquake and fire of 1905. Just prior to the earthquake there were in all some 153 miles of tramway route, comprising 288 miles of track, of which 260 were owned by the United Railroads Co. of San Francisco, and the remainder by the smaller companies. Of the total track mileage 205 were equipped for electric traction and 77 for cable, while horse traction was used on about five miles, and on rather over one mile steam was employed.

The electrical equipment of a large proportion of the cable lines had been decided upon before the earthquake, but the change was accelerated by the disaster, as all except the smallest of the cable power stations were practically destroyed. The damage done to the tracks is well known; it was due partly to the earthquake, for in some places the surface of the street dropped about 6 ft., and partly to warping of the rails by the fire which followed. Some of the car-sheds were burned down, but the United Railroads Co. only lost seven of their 455 electric cars, although 75 of the 423 cable cars belonging to this company were destroyed. All the electric power stations were outside the fire area, but they were to some extent damaged by earthquake.

Immediately after the fire the only feasible method for quickly restoring service was by the introduction of the overhead trolley system, and powers were granted for the substitution of electric power on all the cable lines.

During the year following the earthquake, the United Railroads reconstructed approximately 35 miles of single track and laid in the neighbourhood of 100 sets of special work, the greater portion of the latter being built up in the company's own shops. This work was accomplished under exceedingly adverse conditions, among which may be mentioned the bad conditions of the streets, high wages and the inefficiency of labourers, strikes and the high price and scarcity of building materials of all kinds. The greater portion of the reconstruction consisted of cable lines converted to electric, and had been planned by the company prior to the earthquake. This work proved much more difficult and expensive than the construction of entirely new electric lines.

Various methods of reconstruction were adopted on the different lines, differing mainly in the manner of disposing of the yokes on which the cable tracks were supported. Some of these were adopted temporarily owing to the exigencies of the situation. Thus, on McAllister Street, an attempt was made to run the electric cars over the old cable tracks, but it was found that the flanges of the wheels on the electric cars would bear on the inner portion of the rail head, before the tread would bear on the outside portion of the head. Therefore, the inside portion of the head was sheared off by hand. Under these conditions the track gave moderate satisfaction until the spring of 1907, when standard reconstruction was begun.

The method of reconstruction adopted in some cases, such as in Sutter Street, was to leave the yokes and structures of the original cable construction in place, merely cutting away enough so that the ties, rails, and pavement could be put in position. This was found necessary on account of the weakness of the yoke, which would tear in pieces instead of pulling out intact.

The yokes on some other streets, such as Hayes Street, were made up of bent rails, and were so strong that they had to be pulled out from the concrete bed intact. This was done by means of a crane car. First a length of rail was attached to the yoke in such a manner that, combined with the yoke, it acted as a lever. The crane pulling on this lever broke up the concrete substructure to such an extent that the yoke could readily be pulled out and thrown aside. A method of drawing the yokes by means of hydraulic jacks was also tried, but was abandoned in favour of the crane system.

The same general type of roadbed was adopted for the entire city and was used on all reconstruction, modified only by the existing yokes and substructures. The sections in the figure on page 684 show the standard construction, and also methods of treating the yokes which were used.

The substructure is a combination of ties and concrete stringers, resting on 6 in. or 8 in. of broken stone or broken concrete ballast. In most cases this broken concrete consisted of the original substructures broken on the ground by means of a portable electric crusher mounted on an old flat car. This ballast is brought up flush with the bottom of the ties. The ties are spaced 2 ft. 6 in. apart, and between the ties and under each rail is a mass of concrete 6 in. thick, which forms

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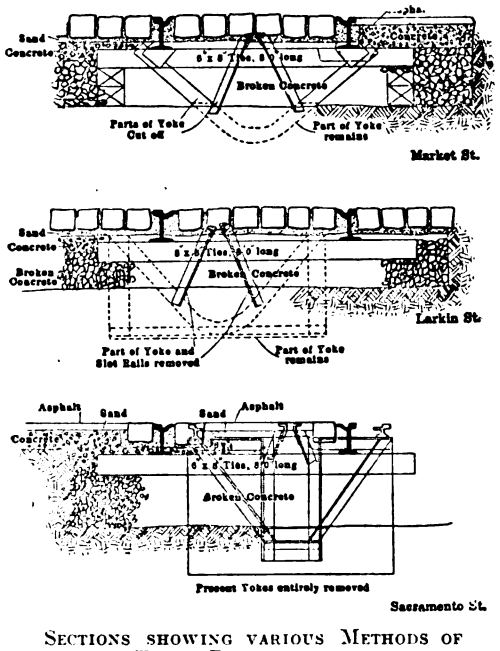
a monolith with the floor of concrete which covers the ties and supports the pavement. There are two types of paving between rails, one consisting of Belgian blocks and the other being an asphalt surface with a toothing of alternate 5-in. and 8-in. blocks inside each rail.

The rails used vary in weight on the different parts of the lines from 141 lb. per yard to 109 lb. per yard.

One of the smaller companies has been able to repair its cable line, but another decided to reconstruct as an electric line, taking power from the United Railroads Co. One of the lines of the United Co. which contains very steep gradients has been rebuilt as a cable tramway.

The largest of the steam-driven power stations of the company is of interest on account of the boilers being fired by California crude oil, obtained through an 8-in. pipe, 8,000 ft.



SECTIONS SHOWING VARIOUS METHODS OF TRACK RECONSTRUCTION.

long, from the storage tanks of the Associated Oil Co. An auxiliary 5-in. oil main runs from the docks, so that oil can be pumped into the station tanks direct from barges if necessary.

One pound of the oil used contains about 18,500 B.Th.U., and will evaporate 14·8 lb. of water from and at 212° Fahr. The oil consumption is at the rate of 0·28 gal., or 2·24 lb. per kw.-hour, which equals 1·68 lb. per h.p.-hour. The corresponding coal consumption would be 3·52 lb. per kw.-hour, with a boiler efficiency of 78 per cent. and a grade of coal giving an evaporation of 9 lb. of water, from and at 212° Fahr., per pound of coal. Provision was made in the boiler foundations for ash pits, &c., for burning coal, but up to date the price of oil has been such that it proved more economical than coal.

The greater part of the power is, however, derived from the hydraulic stations of the California Gas and Electric Corporation.

MISCELLANEOUS CITY NOTES

ANCHOR CABLE CO.—Applications are being invited for an issue of £50,000 4½ per cent. debenture stock at par.

DORMAN, LONG & CO.—A final dividend of 4 per cent., free of income tax, making, with the interim dividend already paid, 6½ per cent. for the year, is recommended.

GENERAL ELECTRIC SUPPLY CO.—The 4 per cent. guaranteed debenture stock transfer books will be closed from November 17th to 30th inclusive, preparatory to the payment of interest due on December 1st.

METROPOLITAN AMALGAMATED RAILWAY CARRIAGE & WAGON CO.—A dividend on the ordinary shares at the rate of 7½ per cent. per annum, free of income tax, has been declared for the half-year to September 30th.

RICHARDSON, WESTGARTH & CO.—It is announced that no dividend will be paid to the shareholders for the current year, owing to the prolonged strike in the engineering trade. Twelve months ago a dividend of 4 per cent. was paid upon the ordinary shares, and for several years previously the dividend of 6 per cent. was paid.

CORRESPONDENCE

25-VOLT TRANSFORMERS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Referring to Mr. A. H. Dykes' article in your issue of October 29th, I would say that his remarks comparing balancers, autos, and double-winding transformers for use with metal filament lamps need some modification from the transformer point of view, especially as the balancing transformer should be considerably smaller and have smaller losses than given in his article. In the following table I therefore give a comparison between the figures given by Mr. Dykes for a 1,000 watt total output at a primary voltage of 200 and a secondary of 25 (all assumed to be 50 periods), and the figures obtained, for instance, by the British Westinghouse Electric & Manufacturing Co.'s transformers on standard frames, with the rating so adjusted as to give exactly 1,000 watts for all three cases.

	Balancer, 200/8×25 v.			Auto, 200/25 v.				Double wdg., 200-25 v.			
	List price.	Iron loss.	Total loss.	List price.	Iron loss.	Total loss.	Regulation.	List price.	Iron loss.	Total loss.	Regulation
Dykes ...	65s.	19	29	73s.	21	47	3·75	81s.	24	54	4·25
Westinghouse..	41·6s.	7	17	88s.	13	39	2·6	92s.	14	50	3·70

The balancer is so arranged that each circuit can take 125 watts at 25 volts, and can be switched on or off quite independent of any of the other circuits. It will thus be seen that the figures given by Mr. Dykes considerably under-state the gain obtained if it is possible to arrange the wiring so that balancer transformers can be used.

I would further point out that where a double-winding transformer is used, no improvement can be obtained either in cost or in efficiency of the transformer by using a three-wire system for 2×25 volts instead of a 25-volt system, the three-wire transformer, as a rule, being slightly more expensive, due to the extra lead required. On the other hand, I heartily agree with Mr. Dykes that a saving in the wiring may be obtained by the use of a transformer for 2×25 volts, and that where such simplified wiring, as proposed by him, can be arranged, it is usually justified to use a double-winding transformer instead of an auto-transformer. Wherever such simplified wiring cannot be adopted, however, a great saving may be made by using balancer transformers.

Yours faithfully,

K. FAYE-HANSEN.

British Westinghouse Works, Trafford Park, Manchester.
November 17th, 1908.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, quoted on Tuesday night, net c.i.f. port of arrival, was £66 10s. to £67 per ton (last week £66 10s. to £67 5s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Sevenoaks Motor & Electric Co., Ltd., is to be wound up voluntarily. Mr. A. P. Guerrier, of 126 Gresham House, London, E.C., has been appointed liquidator. A meeting of creditors will be held at the above address on November 25th, at 3 p.m.

A meeting in the bankruptcy of Percy F. Letts, electrician, The Arcade, Northampton, was held last week, when a statement of affairs was submitted showing liabilities to unsecured creditors amounting to £117 18s. 11d. After allowing £4 for preference claims, the assets were expected to produce £86 1s. 2d., or a deficiency of £31 17s. 9d. The following are creditors:—General Electric Co., £11; Berry, Skinner & Co., £11; A. Berkeley, £12; Baxendale & Co., £53.

The trustee in the bankruptcy of C. H. Vere, electrical engineer, 5 Park Parade, North Finchley, has been released.

The trustee in the bankruptcy of F. B. Egginton, electrical engineer and contractor, 11 Tempest Street, Wolverhampton, has been released.

CORDOBA LIGHT POWER & TRACTION CO.—The *Stock Exchange Gazette* states that a debenture issue of some importance will shortly be available.

SIMPLEX CONDUITS.—The Newcastle offices and showrooms of the Simplex Conduits, Ltd., were officially opened on Thursday, when a large party of electrical users and others were received by Mr. L. M. Waterhouse, managing director. In the evening a dinner and concert was held at Tillies' Restaurant to celebrate the opening of this new branch.

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THE LONDON ELECTROBUS COMPANY

THE directors have decided to close the company's financial year on October 15th. The balance-sheet and profit and loss account is being prepared, and will be submitted to the shareholders at the annual general meeting to be held in December. In the meantime a statement has been issued showing the working of the company's omnibuses from July 15th, 1907 (when the service was commenced), until October 15th of this year. Over the whole period, as certified by the company's auditors, the average takings of the 'buses have been 14d. per 'bus mile, a result which the directors believe to be without precedent in London 'bus traffic experience. The total number of passengers carried up to date on the company's 'buses is nearly 3,000,000. and the statement referred to above includes some figures comparing the results of the company with those of the London General Omnibus Co. and the London tramways. This shows that the London Electrobus Co.'s vehicles have an average seating capacity of 34; and that during the 15 months from July 15th, 1907, to October 15th, 1908, the number of passengers carried per vehicle mile have been 10·75, and the average takings per vehicle mile 14d. The respective figures for the London General Omnibus Co. for the year ending June 30th, 1908, taken from the company's 49th report, were 30, 6, and 8, and for the London trams, 60, 10·35, and 1d·13. These latter figures, were taken from *The Tramway and Light Railway Journal*. With regard to battery maintenance, with the exception of a few experimental batteries, all the battery maintenance has been done under contract at 2d. per 'bus mile, and the directors have offers to maintain 100 electrobuses at the same rate for three years. From the certificate of the auditors, it appears that the earnings of the 'buses during the first twelve months only exceeded the operating expenses by £743, which was not sufficient to pay the establishment and overhead expenses of the company. For the last three months, however, the earnings have exceeded the operating expenses by £1,526, which has just about been sufficient to meet the establishment and overhead expenses. These expenses are about £6,000 per annum, and it is pointed out that they would not be materially increased if the company's fleet of 'buses were doubled. An estimate is given, based upon the present rate of profit, namely, £448 per 'bus per annum, showing that with a fleet of 80 'buses there would be available for dividend on ordinary and deferred shares a sum of £12,851 after meeting establishment and overhead charges, debenture interest, and provision for depreciation and amortisation of debentures. Having considered the whole position and consulted some of the largest shareholders, the directors have decided to raise the capital necessary to increase the fleet, by way of debentures (exchangeable for ordinary shares), and to offer these debentures in the first instance to the shareholders. For this purpose £50,000 of first mortgage 6 per cent. debenture stock have been created, exchangeable during three years for ordinary shares, and if not exchanged is repayable on December 31st, 1919, at £110 per cent.

AN AMERICAN THREE-PHASE LOCOMOTIVE

SOME time ago the interesting announcement was made that three-phase traction was to be adopted by the Great Northern Railroad of America through the Cataract Tunnel. According to the *Electrical World* (New York) the first of the four locomotives which the American General Electric Company will supply has been completed, and is now being subjected to exhaustive tests under service conditions. Although a liberal air-gap of ¼ in. has been allowed, the power factor remains above 80 per cent. throughout the whole operating range and reaches a maximum of 86 per cent. The maximum torque is at least three times the guaranteed full-load running torque. It is noteworthy, moreover, that the motors, being of the three-phase induction type with secondary rheostatic control, are capable of exerting this torque at any speed from standstill to within a few per cent. of synchronism.

The locomotive is of the double-truck type, and there are two motors per truck. The total weight is 230,000 lb., all of which is on the drivers. The over-all length is 45 ft., and the rigid wheel-base is 11 ft. The wheels are 60 in. in diameter.

The rotor of each motor is mounted on a shaft geared at both ends to one axle of the locomotive. The gear ratio is 1-to-4·28. The motors are wound for eight poles, and when operated at 25 cycles have a synchronous speed of 375 r.p.m. The rotors are equipped with slip rings. In order to obtain the maximum of simplicity no effort has been made to operate the motors in cascade or to use any pole-changing device. It was held that the saving in energy by the introduction of speed-changing schemes was of no importance, because the energy is obtained from a hydro-electric station where there is no storage available, and any saving at the motors will represent merely a saving in water, which would then be allowed to flow over the dam.

In arranging the apparatus and controlling devices within the locomotive the keynote has been simplicity. Step-down transformers, contactors, blowers, air compressors, &c., are placed within a fireproof compartment in the centre of the body of the locomotive, and a wide alley-way is arranged on all four sides of this compartment. The transformers for changing the line pressure of 6,600 volts to 500 volts for use at the motors are of the air-cooled, two-coil type. A negligible saving in constructive material could have been obtained by using auto-transformers for this purpose, but the improved insulation and the reduction in the risk to life by the use of two-coil transformers were considered of predominating importance. The air which is forced through the transformers passes upward through ventilating openings in the top of the locomotive after having passed through the speed-controlling rheostats. The motors also are cooled by the air, which is obtained from a centrifugal blower driven by a three-phase induction motor.

The locomotive is equipped with four wheeled trolleys, two of which will be used for operation in each direction, while the rail will be employed as the third conductor. The normal trolley potential will be 6,000 volts, but it will reach a value of 6,600 volts during starting conditions on account of the fact that Tirrill regulators will be employed at the station for increasing the e.m.f. with increase in load. It is expected that the speed regulation of the driving turbines will not be close, but this condition is looked upon as advantageous rather than disadvantageous. For example, under starting conditions when the load is heaviest the speed will be lowest. The reduction in speed does not involve a decrease in e.m.f., but merely a lowering of the frequency. This change in the frequency will assist the locomotive in starting a train and will cause a shift of the load from other locomotives which may be running at full speed to the locomotive which is accelerating.

One of the advantages of a three-phase locomotive which was considered of much importance in the Great Northern equipment is the tendency to operate at constant speed. The gearing is such as to give to the locomotive a speed of about 15 miles per hour, which will be maintained on the up-grade and will be only slightly exceeded on the down-grade. When the train is going down-grade a certain amount of energy will be returned to the supply system. No importance was placed upon the return of this energy, but the limiting of the maximum speed was considered as of great importance. The tendency to limit the speed will not be affected by the removal of one trolley wheel from contact with the overhead wire.

According to the present plans, the locomotives will be used only through the Cataract Tunnel, which is somewhat less than three miles in length and has a uniform grade in one direction of about 1·7 per cent. However, in event of the satisfactory operation of the locomotive, it is probable that at least the two grades in the immediate neighbourhood of the Cascade Tunnel will be operated electrically in the near future. The consulting engineer for the Great Northern Railroad Company is Dr. Cary T. Hutchinson, under whose supervision the entire installation is being made.

Explosion of a Stop Valve at the Works of the National Electric Supply Co. at Preston.—The Board of Trade Report on the explosion of a stop valve at the works of the National Electric Supply Co., Crown Street, Preston, on Friday, August 21st, has now been issued. From the investigations of the inspector, it appears that the valve which burst, which was of the equilibrium type, 7 in. in diameter, is the main stop valve of an engine which had been out of use for about a week, and that the main stop valve on the main range leaked somewhat, so that a considerable amount of water must have collected in the pipe. These pipes normally drain into an automatic steam trap. In starting any of the engines, however, it is not the custom to depend alone upon the efficient and automatic working of the traps for clearing the steam pipes of water, the invariable rule being to ease the relief valve at the bottom of the trap, by hand, before starting the engine. This work is usually performed by one of the drivers, but in this case was omitted. The cause of the explosion is given in the report as follows :—"The explosion was due to water hammer action, owing to the driver having neglected to drain the water from the pipes previous to starting the engines." No fault is found in the report with the construction of the valve, and the following remarks are made with reference to the draining arrangements :—"The draining arrangements of the pipes may be said to be as complete as is usually found in any well equipped and modern power station, and although the automatic steam trap is fitted, it is merely an adjunct, the standing order being—to clear the steam pipes and receiver of water by hand before starting an engine."

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BOARD OF TRADE REPORT ON LONDON TRAFFIC

A REPORT has been issued by Sir Herbert Jekyll, who has charge of the special London traffic branch of the Board of Trade which was constituted last year. The objects of this branch of the Board of Trade are to consider all new schemes of locomotion for which Parliamentary powers are sought, so far as they come within the scope of the Board; the collection of information; and the preparation of annual reports on London traffic to be presented to Parliament. The report now issued is the first of this annual series, and is intended to supplement the report of the Royal Commission on London traffic. A special section relates to means of locomotion, including tramways and railways. It is pointed out that the number of tramcars during the year in the area covered by the report increased from 1,719 to 2,112, those propelled by mechanical power having increased from 576 in 1903 to 1,768 in 1907. The report considers there is an insufficiency of tramways in London, and that the lack of harmony between the working of different systems and the absence of through running, or even of through booking, has been a drawback to making the fullest use of existing means of locomotion. Special reference is then made to the controlling power secured by the Underground Electric Railways Co. of London over certain of the tube railways, and over the District Railway and the London United Tramways, Ltd. It can hardly be doubted, the report states, that an extension of a similar principle of amalgamation to the whole of the electric railways and tramways of London would be attended with still greater benefit. In fact, it is even suggested that the omnibus services might be included in such a scheme so that all the public means of locomotion in London, with the exception of the trunk railways might be brought into one comprehensive system under a single management. The mischievous lengths to which competition has been carried between electric railways, tramways, and omnibuses, have resulted in most of the undertakings being worked at a loss, or at a profit which does not yield a fair return upon the capital outlay. Therefore, it is thought that a scheme of amalgamation and co-ordination would prevent not only the present unprofitable results, but also that overlapping and duplication of services which is a most uneconomical feature of the present system.

Since the report of the Royal Commission on London traffic was presented, it is pointed out that 26½ miles of new tube railways have been opened; 28½ miles of new tramways have been constructed; electric traction has been substituted for steam traction on 68 miles of railway; 80 miles of new electric tramways have been constructed in the outer area; and the northern and southern tramway systems of the London County Council have been linked up, in addition a number of other improvements, such as tunnels under the Thames and street widenings have been completed.

At the end of the report Sir Herbert Jekyll speaks strongly in favour of the formation of a traffic board, which was unanimously recommended by the Royal Commission on London traffic. This question, he says, involves social and economic considerations of great magnitude and intricacy, and a close study of the whole subject tends to support the conclusion that it can only be dealt with effectively by a permanent body giving continuous attention to it.

A large mass of statistical information is contained in Sir Herbert Jekyll's report in the form of appendices, together with a number of plans and maps relating to electric railway and tramway services, as well as to the other aspects of the question.

Interruption of Supply at Leeds.—We have received from Mr. H. Dickinson, the engineer and manager of the Leeds Corporation electric lighting department, the following account of the mishap which caused a slight interruption to the supply on Saturday night. The trouble arose when synchronising a new machine on to the bus-bars. The new machine broke down the moment it was synchronised. This caused the automatic trips on the main switches of the other machines running at the time to operate, and the whole of the supply was shut down. Fresh machines were run up, and within about ten minutes the greater portion of the supply was restored. In about twenty minutes the last circuit was reconnected. The trouble occurred about a quarter past eight, and although considerable inconvenience was caused no serious trouble has been reported.

Finsbury Technical College Old Students' Association.—The third annual dinner of this Association will be held at the Criterion, Piccadilly Circus, London, on December 15th, at 7 for 7.30 p.m. The chair will be taken by Mr. P. V. McMahon, President of the Association. Tickets (5s. each, exclusive of wine) may be obtained from Mr. E. W. Moss, Secretary to the Electrical Section, 20 Huddleston Road, Tufnell Park, London.

CATALOGUES AND PAMPHLETS RECEIVED

ACCUMULATORS.—A pamphlet dealing with the "Exide" accumulator for ignition purposes has been issued by the Chloride Electrical Power Storage Co., Ltd., of Clifton Junction, Manchester. In this pamphlet the ignition capacity has been taken as double that at a continuous discharge at the 10-hour rate, whereas the recommendation of the Society of Motor Manufacturers and Traders is that the capacity be taken at the 20-hour rate of discharge, with an interval of rest after 10 hours. To give a capacity at the 10-hour rate is considerably more severe than at the 20-hour rate with a rest, but for the sake of simplicity it is stated that the capacities given in the list are in accordance with the S.M.M.T. rating, although as a matter of fact they are better. Prices and particulars of 4-volt accumulators of from 20 to 120 ampere-hour capacity are given, and a few 6-volt sets are also listed.

CREOSOTED POLES.—A leaflet from Richard Wade, Sons & Co., Ltd., of Hull, gives a list of the particulars which customers should forward to the company when ordering poles for telegraph or other overhead line work.

ELECTRICAL PLANT & ACCESSORIES.—We have received from the A.E.G. Electrical Co. of South Africa, Ltd., copies of a number of pamphlets published by the foreign department of the Allgemeine Elecktricitäts Gesellschaft. One of these contains a fully illustrated article on "Electric Locomotives for Mines and Iron Works," which contains descriptions of installations carried out by the A.E.G. Other pamphlets deal with joint boxes for use with lead-covered cables and other accessories, open type high-speed continuous-current shunt motors, and enclosed motors. A special pamphlet contains particulars and prices of the W.E. single-phase commutator motors manufactured by the firm for outputs of from 0.5 to 6 h.p. A new pattern of section insulator for tramway systems, and an adjustable cord roller for lamp pendants are also described on separate leaflets.

ELECTRICAL SUPPLIES.—A comprehensive catalogue of electrical fittings, cables, insulators, switchgear, and other accessories has been recently issued by the British Electrical & Manufacturing Co., of St. Nicholas Buildings, Newcastle. The first few pages are devoted to abstracts of the various Home Office and Board of Trade regulations, and a large number of conversion tables, tables showing current capacity of wires, bare and covered, and other useful information is also included. The catalogue proper commences with full particulars of wires and cables; these are followed by a section on insulating materials and insulators. Steel conduits and fittings are listed, and a large variety of water-tight telephone instruments, switches, and other apparatus for use in mines, shipyards, &c., is included. Lamp fittings for use in factories, mines, and for similar industrial purposes are fully listed, and switchgear, including the well-known "Ajax" patterns, is described in the list. The catalogue is profusely illustrated and well arranged.

RESONANCE INSTRUMENTS.—A new pamphlet from Messrs. Isenthal & Co., of 85 Mortimer Street, W., contains particulars of a considerable variety of instruments based on the resonance principle, including frequency meters and tachometers of both the visible vibrating reed pattern and also of a special design with ordinary scale and pointer, worked by a relay system by means of a set of vibrating reeds contained in a separate box. Special instruments for synchronising with several sets of reeds are also included. When used as frequency meters they are actuated by the alternating-current of the system, but they can be used as speed indicators for any kind of machinery by means of a small alternating magneto generator. A special form is made for locomotives. In addition to the ordinary indicating patterns a recording form is made in which the particular reed thrown into vibration is caused to make a mark on a revolving paper drum. The same list contains particulars of a form of revolution counter with cyclometer dial, which can be actuated electrically from a distance.

SPIRAL RIVETED PIPES.—A pamphlet from the American Spiral Pipe Works calls attention to the many different uses to which Taylor's spiral riveted pipes are adapted, and contains a number of views of pipe-lines for various purposes where this form of construction is used. Several methods of jointing pipes of this description are illustrated.

SWITCHGEAR.—A cover is to hand from the Switchgear Co., Ltd. (late J. G. Statter & Co.), of Newhall Street, Birmingham, in which are filed various leaflets relating to the switchgear manufactured by this firm. Reverse current and overload circuit breakers, fitted with the Statter patent time lag attachment, and others with magnetic blow-out arrangements, are described. Other leaflets refer to the Statter time lag relay for alternating-current circuits, oil-break switches, and motor-starting switches.

TELEPHONES & BELLS.—Two lists have been issued during the past week by Messrs. Johnson & Phillips, Ltd. One of these deals with telephones for domestic use, with either battery or magneto call, as well as portable and testing telephones, and the other is devoted to bells, indicators, &c.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

MR. A. H. DYKES replies to Mr. FAYE-HANSEN'S letter in our last issue with regard to losses in 25-volt transformers. Correspondents ask for the names of makers of alloy-steel for transformers and of a remote-control switch for small currents. (Page 690.)

THE address delivered on Thursday last by Mr. W. M. MORDEY, as President of the Institution of Electrical Engineers, consisted of a comparison between the condition of the electrical industry of this country, as indicated by the statistics and returns relating to electricity supply, with the electrical industry abroad, perticularly in Germany. He showed some tables which gave the average consumption in units per inhabitant and the average price per unit paid, and other interesting figures for representative towns in both this country and in Germany. From these figures the conclusion was arrived at that in the large towns in Germany electrical energy costs twice as much per unit, and the consumption per inhabitant is half as much as in our large towns; further, in the medium-sized and small towns in Germany, although the consumption per inhabitant appears to be about the same, the price per unit is over 30 per cent. higher than in the corresponding British towns. Further, the capacity of the generating plant in all the public supply stations in this country is about two and a quarter times as much per inhabitant as in Germany, and in the relative statistics with regard to tramway work we do not compare unfavourably. With respect to several towns in Europe, which obtain their supply from large water-power stations, Mr. Mordey quoted figures which showed that the lowest of the average charges made in these towns was higher than the average price obtained in Bolton, which is 1·18d. per unit; Lyons comes second with an average price of 1·27d. per unit. In conclusion, Mr. Mordey insisted that our alleged backwardness did not exist, and that there was no justification for the statements about our scientific and technical education being behind other countries. (Page 691.)

MR. W. W. LACKIE, in his inaugural address as Chairman of the Glasgow Local Section of the Institu-

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tion of Electrical Engineers, dealt with load factors and diversity factors, offering a number of alternative definitions. We make use of the opportunity to explain clearly the accepted definitions of these two "factors." The address also included a useful table giving the load factors and other useful information with regard to various classes of power consumers, and an explanation of the method of calculating the charges to consumers at Glasgow. (Page 693.)

In his written reply to the discussion on the Paper on turbo-alternators, read before the Manchester Local Section of the Institution of Electrical Engineers, Dr. M. Kloss answers the questions put by several speakers, and makes some further remarks with regard to the limitation of the output of turbo-alternators by the heat limit of the rotor. (Page 694.)

Tenders from fifteen firms have been received by the London County Council for the supply of turbo-generators for the second portion of the Greenwich generating station. The lowest tender was sent by Messrs. Belliss & Morcom, Ltd., but the Committee have rejected this on the ground that the firm have not manufactured machines of a size similar to those now required. They recommend the acceptance of a tender by the British Westinghouse Electric & Manufacturing Co. at £40,800, the turbines being of the Rateau type. (Page 695.)

That section of the report of the Special Committee on Brakes appointed by the Tramways and Light Railways Association, which relates to the training of tram-car drivers, contains a proposed course of instruction for intending drivers, and other recommendations. Annual re-examination in the working of the electrical and mechanical equipment and in the general regulations is proposed, and a medical examination every five years is strongly recommended. The importance of strict discipline is also emphasised. (Page 695.)

At the first general meeting of the new Institute of Metals, the President, Sir William White, described the origin and objects of the Institution, and several Papers were read. Among the latter was one by J. T. Echevarri on the properites and uses of aluminium, and another by W. H. Robertson on the manufacture of tubes contained brief references to the different electrolytic processes. (Page 696.)

In a Paper read before the North-East Coast Institution of Engineers and Shipbuilders, Mr. J. B. Duckitt dealt with the electrical equipment of cranes, particularly with reference to the rating of crane motors and methods of braking and regenerative control. The author recommended a system of control in which the motor acts purely as a series motor when hoisting, and regenerates as a shunt motor when lowering. A special method of stating the rating of motors for intermittent work, which is based on the ratio of the time during which the motor is on load to the time during which it is switched off, is also described. (Page 697.)

In an article on depreciation and obsolescence in small engineering works, Mr. W. O. Horsnaill puts in a plea for more accurate account being taken of the actual residual value of the plant. He points out that one of the reasons for turning out good plant in favour of more economical machinery is that the value of the former is much higher before the new methods have made headway. (Page 699.)

At a special meeting of the Elektrotechnischer Verein, which is to be held in Berlin this evening, a discussion will take place on the proposal of the German Government to impose a tax on electricity, gas, and illuminating apparatus. As an example, illustrating the heavy nature of the proposed tax, we reproduce some figures published in a German contemporary which have been estimated on the basis of the actual consumption of energy, lamps, &c., of a large ironworks on the Rhine. The tax in this particular instance totals up to £2,670, or over one per cent. of the share capital of the company. (Page 700.)

Mr. W. N. Y. King read a Paper at an informal meeting of the Leeds Section of the Institution of Electrical Engineers yesterday, comparing natural and induced draught for steam raising. The Paper contained figures giving the cost of a particular plant and sketches showing its arrangement, a set of curves connecting height of chimney, draught pressure, and chimney temperature in the case of natural draught, and also a number of general considerations with regard to induced draught plant. (Page 701.)

The latest pattern of mercury vapour quartz lamp has a tube length of only from 3 in. to 6 in. As the tube is of quartz, a very high working temperature is permissible, but an outer globe of special glass is necessary to absorb the injurious ultra-violet rays. The tube is tilted automatically to strike the arc, and special arrangements are provided to render the arc steady and free from the effects of fluctuations in the supply pressure. (Page 704.)

Sir Luke White's Committee of the House of Commons has rejected the London and District Electricity Supply Bill. The preamble of the London Electric Supply Bill, which gave the existing companies power to link up their undertakings, &c., has been passed. A clause has been inserted constituting the London County Council the purchasing authority in substitution for the Borough Councils, the County Council to give three years' notice of their intention to purchase all the companies' undertakings in 1931 and during the three years period of notice to lend the necessary sums for the development of the undertakings at an agreed rate of interest. The repayment of these sums will simply be made by a reduction in the purchase price. During the proceedings the promoters of the Bill threatened to withdraw it if the terms of purchase were not satisfactory to them, and on Tuesday they again reserved their right to withdraw the Bill should necessity arise. (Page 706.)

We give particulars of a number of Bills which will be deposited for the Parliamentary session of 1909. (Page 708.)

Damages have been awarded in the Appeal Court to the Barnes Urban District Council against the London General Omnibus Co. for damage to eighteen lamp posts by the Company's 'buses.—With reference to the new power station of the Bury Corporation the Local Government Board have approved of the plans, but ask for further details on certain points before sanctioning a loan of £72,000.—In a report upon a fire at the Dublin City Hall, which was attributed to electricity, Mr. Mark Ruddle states that at the time the fire took place the supply to the building was switched off.—A statement has been issued by the Kalgoorlie Electric Tramway Co. stating that the recent fall in the price of the Company's stock has been brought about by decreased receipts consequent upon a reduction in the number of men employed at the mines, upon which the Company chiefly depend for its revenue.—An action is being taken by the Limerick Corporation against Messrs. Crompton & Co. for damages for delay in the execution of an electrical contract.—A proposal has been made that the Preston Corporation should purchase the National Electric Supply Co.—The Birmingham Corporation Tramways Committee recommend a large expenditure upon new tramways. (Pages 709 and 710.)

Plans have been prepared for a combined pumping, electric light, and power station for the Belfast Harbour Commissioners. Local Government Board inquiries have been held as follows:—Birkenhead, £20,000; Neath, £18,000; Radcliffe, £14,350; Wrexham, £4,165; and Hastings, £1,683. The Local Government Board has sanctioned a loan of £12,400 for new tramways at

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Liverpool, and £1,000 for free wiring. The Manchester Corporation Tramways Committee require tramway rails and tramcar axles, and the Electricity Committee, exhaust steam circulating water- and air-pump discharge pipes. A Diesel oil-engine and dynamo is required by the Felixstowe Urban District Council. (Page 711.)

THE accounts of the Electromobile Co. for the year show a deficiency of £1,444. A profit of £5,516 is shown by the accounts of the Isle of Thanet Tramways and Lighting Co. for the year ended September 30th, and, after adding £2,500 to the reserve fund, a dividend of 1¼ per cent. is recommended upon the preference shares. Although the revenue of the Singapore Electric Tramways Co. for 1907 showed a substantial increase, there is a loss upon the year's working owing to the large amount required for debenture interest, depreciation, and royalties. Applications have been invited during the week by the Brush Electrical Engineering Co. for an issue of £100,000 prior lien 5 per cent. debenture stock. A scheme of reorganisation of the Anglo-Argentine Tramways Co. is being placed before the shareholders. (Page 712.)

AMONG the specifications published by the Patent Office on Thursday last is one by the BRITISH THOMSON-HOUSTON Co. covering a process for the manufacture of a nickel-iron resistance alloy. A specification by E. C. and M. EKSTROMER relates to the production of a particularly porous active material for storage battery plates, and another by S. EISENSTEIN proposes the use of a Wehnelt cathode-ray tube in the Duddell oscillating circuit for wireless telegraphic purposes. An armature winding for ensuring better commutation in high-speed continuous-current and alternating-current commutator motors is protected by E. F. W. ALEXANDERSON, and the WOLFRAM-LAMPEN AKT.-GES. have a specification relating to the manufacture of compound metal filaments. A new method of constructing commutators is patented by BROWN, BOVERIE & CIE. AKT.-GES, and in a specification by the SOCIÉTÉ ANONYME WESTINGHOUSE and R. BRUN a flywheel motor set for taking an intermittent load with constant current consumption is described. Short abstracts of the above are given in our Patent Record. (Page 715.)

THE throwing out of the London & District Electricity Supply Bill has had a beneficial effect upon the prices quoted for the shares of the London electric supply companies on the Stock Exchange. (Page 716.)

MR. MORDEY is always outspoken, and we welcome the defence of the British electrical industry and his attack on its detractors, which he has given us in his Presidential Address before the Institution of Electrical Engineers. He has taken the electricity supply industry as the criterion of the activity of the electrical industry, and he has shown that we are well in advance of other countries, not only in the employment of electricity as measured in units per head of population in our large towns, but also in economical generation, as evidenced by the works costs and in the cheaper price at which electrical energy is retailed to the consumer. These conclusions apply to electric power as well as electric lighting. Nor are we retrograde with regard to electric tramways, especially when the Britisher's love of fresh air and exercise is taken into consideration. That there is a smaller margin between cost of production and selling price in this country is rather favourable to increased activity in the electrical industry than adverse to it, for, as the bulk of the supply is by municipal authorities, it simply means that the prices are not kept up to enable the electricity supply department to contribute to the general rates. Mr. Mordey has, however, only covered part of the question. If we are buying too large a proportion of our generating machines, lamps, motors, and cables abroad, or if over-production in manufacture in this country counterbalances the increased production of electrical energy, no amount of economy in electric supply can put our industry on a sound footing. We believe, however, that the tide has now turned, and that the depression in our industry is rapidly lifting. Mr. Mordey's address should help to dissipate the gloom with which electrical engineers have surrounded themselves during the past two years, and should do something to instil a little more enthusiasm into their work. Great Britain holds the record for economical electrical supply, and it should now regain its position as the leading country for electrical manufacture.

AFTER the action of the Government in affording facilities for the second reading of the London and District Electricity Supply Bill, and the pronouncement of the President of the Board of Trade on that occasion that such a bulk supply scheme was not only necessary but essential to the industrial well-being of London and the surrounding districts, the summary rejection of the scheme on preamble by a unanimous vote of the Select Committee can only be regarded in the light of a political decision. As Select Committees of Parliament are not called upon to justify decisions, we are not likely to know the real reasons which weighed with Sir Luke White's Committee in rejecting the Bill, and the action of a committee with the same chairman in 1906, which issued a special report upon the London County Council Electric Supply Bill, is in sharp contrast with the present course of action. In seeking, by deduction, to arrive at the possible reasons, one is forced to put on one side the scheme of the Bill and the finance of it. The Bill was admittedly framed upon that of Mr. Merz in 1905, and Sir Luke White himself had characterised this as a scientific scheme, and one which, in the absence of a Bill by the London County Council, should be passed. The financial proposals of the Bill, whilst, on the surface, of a somewhat nebulous character, were deemed satisfactory to Lord Cromer's Committee after a very much more detailed hearing than took place in the House of Commons. Moreover, in addition to Lord Cromer, who has had such an extensive experience of economic problems in Egypt and South Africa, the House of Lords Committee also included Lord Welby, a great financier, and for several years Chairman of the Finance Committee of the London County Council. It says much for the versatility of counsel, by the way, that Mr. Balfour Browne, K.C., who has frequently argued successfully that it is unfair to expect promoters to guarantee capital before a Bill is passed, should, on this occasion, have waxed eloquent over the enormities of the present promoters in this respect. The rejection of the London and District Bill, in conjunction with the subsequent important proceedings before Sir Luke White's Committee on the London Electric Supply Bill (which are fully reported on another page) may be regarded as the closing of the London electric power controversy for many years to

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come. Now that the London County Council have been substituted for the Borough Councils as the purchasing authority over the existing companies, and that a more or less unified electrical undertaking will be at their disposal in 1931, there would seem little need for them to set up a rival undertaking. The policy of altering the general law in a private Bill, however, as has been done, can hardly be said to have been successful. Obviously, Sir Luke White and his Committee are far from familiar with all the intricacies of the various Provisional Orders and their terms, which apply to different portions of London, and the task put upon them was clearly one for the Government Department concerned, and would have been carried out much better in a Government measure. As it is, legislation of a kind has been enacted, but it will afford ample work for the lawyers to interpret it when the time comes, unless the Government now "fathers" the Bill on third reading, and subjects the clauses to a thorough revision, with the assistance of the permanent officials of the Board of Trade. As the Bill now stands, however, the position of the existing companies has been considerably strengthened, and, even with the extinction of their claim for compensation for "severance" as between one district and another, they will obtain as the purchase price something over and above the bare terms of the Electric Lighting Act of 1888. In addition to this, the wide "linking up" powers should afford means of effecting considerable economies in distribution and generation in many cases, and the extension of their sphere of action with regard to electric power supply cannot fail to be beneficial to the electrical industry generally.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 26TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster. Papers to be read:—(1) "Domestic Electric Supply (including Heating and Cooking) as Affected by Tariffs," by W. R. Cooper. (2) "Commercial Electric Heating," by J. Roberts (Durban).

FRIDAY, NOVEMBER 27TH.

Electro-Harmonic Society.

8 p.m. Concert (Ladies' Night) at King's Hall, Holborn Restaurant.

SATURDAY, NOVEMBER 28TH.

Rugby Engineering Society.

12 noon. Party leaves Rugby by 12.42 p.m. London express to pay visits to Fisher Street sub-station of the Metropolitan Electric Supply Co.; Taylor's Lane (Willesden) generating station of the North Metropolitan Electric Power Supply Co.; Central London Railway power station at Shepherd's Bush.

TUESDAY, DECEMBER 1ST.

Institution of Electrical Engineers: Manchester Local Section.

7.30 p.m. Meeting at the University. Paper to be read:—"Transformers: Some Theoretical and Practical Considerations," by A. T. M. Fleming and K. M. Faye-Hansen.

WEDNESDAY, DECEMBER 2ND.

Institution of Electrical Engineers: Birmingham Local Section.

7 for 7.15 p.m. Annual dinner at the Grand Hotel, Colmore Row.

Institution of Electrical Engineers: Students' Section.

7.30 p.m. Meeting at 92 Victoria Street, Westminster, London. Paper to be read:—"Electric Road Vehicles" (other than tramcars), by S. H. Hills.

THURSDAY, DECEMBER 3RD.

Civil and Mechanical Engineers' Society.

8 p.m. Meeting at Caxton Hall, Westminster. Paper to be read:—"The Influence of Track upon Railway and Tramway Carriages," by J. Sutherland Warner.

Röntgen Society.

8.15 p.m. Ordinary general meeting at 20 Hanover Square, London. Paper to be read:—"Phenomena Observed in Electrical Currents of Continuous Oscillation," by Dr. Horace Manders

CORRESPONDENCE

25-VOLT TRANSFORMERS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Mr. K. Faye-Hansen, in his letter on the above subject, makes me say that the full load loss on the balancing transformer will be 29 watts as against his figure of 17 watts I fear that the wording in my article was not quite clear, or that he has misread it, as what I meant to say was that the full load losses were approximately 18 to 20 watts, the higher figure of 28 to 30 watts being the loss when the loads on the various circuits of the transformer are out of balance. As others may have made the same mistake in reading the Paper, perhaps you will kindly insert this correction.

I am glad to note that otherwise Mr. Faye-Hanson and myself are in agreement, and that the figures I have given, which obviously must vary with different makes and types of transformers, agree on the whole so closely with those of the Westinghouse Co.

Referring again to the balancing transformers, it should not be forgotten that it is only when the circuits are equally balanced that the losses are as low as 20 watts, a condition of affairs which does not frequently happen in practice.

Yours faithfully,

A. H. DYKES.

1 Victoria Street, London, S.W.,
November 23rd, 1908.

ENQUIRIES.

(*In replying to enquiries, firms are requested to mention* ELECTRICAL ENGINEERING.)

Alloy Steel for Transformers.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—We wish to secure information in regard to alloy steels which are manufactured in England or in Germany. At present we are using in our transformers an alloy steel which is manufactured in this country, but we wish to investigate some of the foreign steels. Can you give us the name of any manufacturers in England or in Germany who are manufacturing this material? Thanking you for your favour, we beg to remain,

Very truly yours,

PITTSBURGH TRANSFORMER CO.

Pittsburgh, Pa., November 13th, 1908.

Small Remote-Control Switch.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Can any of your readers inform me where I can obtain a simple half-ampere quick-break lamp switch, to be operated at a distance by an eight- or ten-volt battery of Leclanché cells, either with or without a relay? I wish to make use of the above in a system of fire-alarm signals.

WM. P. M.

November 21st, 1908.

[We shall be pleased to send on replies to our correspondent.—ED. E. E.]

P. & O. Batti Wallahs Society.—The second smoking concert of the season is to take place on December 7th, at the Abercorn Rooms, Great Eastern Hotel, Liverpool Street, in the Middlesex Room, at 7.45 p.m.

Leeds Local Section.—The Paper on "Natural and Induced Draught," by Mr. W. N. Y. King (published on p. 701 of this issue) has not yet been formally approved by the Council of the Institution of Electrical Engineers, but it was read at an informal meeting of the Leeds Local Section yesterday. The word "informal" should have been added in the introduction to our article on p. 701, but we only receive this information as we go to press.

Wireless Telegraphy and Telephony.—According to a British Consular Report, wireless telegraph stations are to be established permanently at Algiers and Oran, the latter being erected by the French Admiralty, the former by the Postmaster-General. The Oran station may accept private messages in time of peace, but it is established primarily as a means of communication in time of mobilisation. The Algiers station will be situated at Fort de l'Eau, some ten miles east of the town, on the bay, the station at Mustapha being done away with. It will be open to all private telegrams, and will communicate direct with Port Vendres and the Eiffel Tower.

The *Daily Chronicle* states that successful experiments with wireless telephony have been carried out between the Eiffel Tower and Melun, over a distance of 30 miles, and that Prof. Majorana has made equally successful experiments between Maddalena Island, on the Sardinian coast, and the fortifications of Montemario, at Rome. The Italian Government has placed a warship at Prof. Majorana's disposal for long-distance experiments in the Mediterranean and the Atlantic.

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SOME COMPARISONS OF THE ELECTRICAL INDUSTRY IN THIS COUNTRY AND ABROAD

MR. W. M. MORDEY, President of the Institution of Electrical Engineers, delivered his Presidential Address last Thursday. He made a comparison between the condition of the electrical industry in this country, as indicated by the statistics of returns relating to electricity supply, with the electrical industry abroad, particularly in Germany. His attention had been specially directed to some resolutions which were passed five years ago by a committee of engineers and business men prominently connected with electrical engineering, and he was asked to consider what steps, if any, it would seem to be advisable to take in view of those resolutions.

The first resolution was as follows:—

Notwithstanding that our countrymen have been among the first in inventive genius in electrical science, its development in the United Kingdom is in a backward condition as compared with other countries in respect of practical application to the industrial and social requirements of the nation."

To answer the question whether it is true that this country is in a backward condition as compared with other countries in respect of practical application to the industrial and social requirements of the nation, Mr. Mordey said, it is only necessary, so far as the service of the public is concerned, to find the extent to which the systems of supply of electrical energy in different countries provide for the requirements of the public; or, in other words, to find the average consumption in units per inhabitant, and the average price per unit actually paid. He has prepared some tables giving this information for a large number of towns here and abroad, particularly Germany. The figures for Great Britain are based on the returns rendered to the Board of Trade by the supply authorities, and those for Germany on a very useful annual volume of statistics, edited by Herr Döpke, and published at Dortmund by the Vereinigung der Elektrizitätswerke, which are based on official or specially collected and authoritative returns. In some cases he has supplemented this information by further particulars furnished in response to his own applications.

Mr. Mordey sums up his conclusions as follows:—

1. In the large towns in Germany electrical energy costs twice as much per unit, and the consumption per inhabitant is half as much as in our large towns. The difference in the cost of coal is insignificant, and does not account for the higher price. The labour there costs more than it does here.

2. In the medium-sized towns the price in Germany is 33 per cent. higher than here, and the consumption is about the same as here in our medium-sized towns.

3. In the small towns in Germany the price is 40 per cent. higher and the consumption is about the same as here.

4. Our public generating stations contain two and a quarter times as much power per inhabitant of the whole country as those of Germany.

5. In electric tramway work we do not compare unfavourably.

As regards important towns in other countries, while the advantage of cheap and ample water power in a few places has enabled an extensive supply to be given at low prices—notably in Lyons, Geneva, and Grenoble—the lowest price in any town here tabulated is in a British town; Bolton, with its average of 1·18d. per unit, heads the list, and Lyons is second with 1·27d. per unit.

There is nothing in our electrical work to justify in any way the charges that have been so freely made against us. There is one thing I think I ought to say—these depressing charges have not originated abroad; they are entirely of home production. Our alleged backwardness does not exist; we are ahead, and well ahead. I do not wish it to be thought, however, that there are no hindrances—legislative or otherwise—to our getting still further ahead. But I do wish to say that, in my opinion, there is no more justification for the statements about our scientific and technical education being behind other countries, than for the statements about the backwardness of our electrical engineering. I resent very strongly the disparagement of the results achieved in this country by the band of teachers, eminent over the whole world, who have been responsible for the scientific and technical education of the engineers concerned in the development of our industry. Technical education should be judged, not by the wealth of the equipment of laboratories, but by the engineering results achieved in the country.

The comparison in the tables is made as follows:—First London and Berlin are compared. London has a total consumption of 131·1 million units for light, 43·6 million units for power, or a total of 176·7 million units. In Berlin, the corresponding figures are 41·0, 53·7, and 94·7. These are worked out into the number of units per inhabitant, which are as follows:—London: Lighting, 28·0; power, 9·3; total 37·3. Berlin: Lighting, 15·8; power 20·7; total, 36·6.

Next, three groups of towns are taken, six towns in each group, arranged according to population, to show the conditions respectively in large, medium, and small towns. The figures necessary for this comparison are given for each town, and are averaged for each group. The towns were selected in the following way. A list of the towns was arranged in order of their populations, ranging from 10,000 to 20,000 for the small towns, and from 100,000 to 200,000 for the medium-sized towns. Then six towns were selected from each group, distributed uniformly according to population. For the group of large British towns—of more than 350,000 inhabitants—Glasgow and Bristol, the first and the last of the list, were excluded in order to restrict the group to six towns. The order of selection was in no way influenced by the electrical results—in fact, those results were not known at the time. In the case of Germany, the list was made only of those towns for which the information was available.

In the case of all these towns, more detailed comparisons have been made than in the case of the two capitals, as for Berlin all the figures were not available. Table I., on p. 692, gives a summary of the results. The figures are for light and power combined, but as the two totals were ascertainable separately a further comparison was made in the detailed tables in the address. Thus, the average for the six largest towns shows 12·7 and 12·2 units per inhabitant for light and power respectively in British towns, and 7·68 and 5·27 in German towns. The average price paid by the consumer per unit is 3·22d. for light and 1·00d. for power in Great Britain and Ireland (Belfast is included in these six towns), and 5·67d. and 2·12d. respectively in Germany. Bolton has the lowest figure for the average price per unit, viz., 1·18d. It is lower than any of the German towns; Mulhausen is the lowest German town at 1·61d. At Bolton the average price charged for power is 0·56d. per unit, as against 0·93d. in Mulhausen (the lowest German average power price).

An important column in the detailed tables is that showing the gross profit as a percentage of the total capital expended. This shows a larger gross profit in Germany, and in view of the fact that in both countries nearly all the systems examined are under municipal control, Mr. Mordey pointed out that it indicates that the municipalities are taxing the consumers of electricity for the benefit of the rates. The wages and salaries costs were inserted to test the usual opinion that in Germany labour is cheap. The column headed "Wages and Salaries" for the British towns includes also management, office, legal, and insurance charges, whereas in the case of the German towns it includes only wages and salaries, the information regarding management, office, legal, and insurance charges not being obtainable from the German records.

In all three classes of towns labour is higher in Germany than here, which shows that low wages and long hours do not necessarily mean cheap labour. Another possible explanation, Mr. Mordey added, is that more labour is required with German

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machinery. If the wages and salaries column had included the same in the two cases the comparison would have been still more in our favour.

Table II. compares the total power provided in Germany and Great Britain respectively for the public supply of electrical energy for lighting, power or traction, providing a further proof that there is no foundation whatever for the common belief in British backwardness in electrical supply. Our generating stations contain two and a quarter times as much power per inhabitant as those of Germany.

Table I.—*Electric Light and Power.*

Towns.	Per inhabitant. Units.	Revenue. s. d.	Per unit. Price. d.	Difference. d.	Per cent.	Coal. d.	Wages & Salaries. d.	Coal plus Wages, &c. d.	Difference. d.	Total costs. d.	Difference d.
Six large British ...	24·9	4 5½	2·13	2·09	98	0·28	0·19	0·47	0·10	0·69	0·46
,, ,, German ...	12·9	4 7	4·22			0·32	0·25	0·57		1·15	
Six medium British .	24·2	3 8½	1·83	0·60	33	0·36	0·21	0·57	0·03	0·86	- 0·03
,, ,, German	23·7	4 9	2·43			0·38	0·22	0·60		0·83	
Six small British ...	21·9	5 3	2·86	1·15	40	0·49	0·58	1·07	0·31	1·53	0·39
,, ,, German ...	19·7	6 7	4·01			0·82	0·56	1·38		1·92	

Table II.—*Total Kilowatts of Generating Plant in Power Stations for Public Supply or for Tramways.*

	Kilowatts.	Population.	Watts per inhabitant.
Great Britain	983,181	45,000,000	21·8
Germany	612,652	63,000,000	9·7

The power in the stations in Great Britain is made up as follows:—

	Kilowatts.
282 public supply stations	688,117
14 power companies' stations	107,480
48 separate tramway stations	94,144
16 electric railways stations	93,440
	983,181

Information which Mr. Mordey had collected with regard to a number of important towns in different parts of the world outside of Germany showed that, with the exception of a very few places which have ample and cheap water power, the supply of electrical energy, and its cost to the public, does not compare favourably with ours. In Zurich and St. Gallen in Switzerland, in both of which the supply is partly from water power, the average price is 75 per cent. higher than in the medium-sized British towns. Lyons has water power and a very large industrial motor load. Its price for lighting is, however, high, and the consumption only about half as much as the average of our large towns. The power load is, however, the largest in the list, and yet the average price per unit is 1·27d., as against 1·18d. in Bolton. The average price for power in Chicago is 2·08d., against 1·73d. in London and 1·0d. in the large British towns. The price for light is 3·52d., as compared with 3·27d. in London and 3·22d. in the large British towns.

Table III. contains information enabling a comparison to be made between two groups of British towns and two corresponding groups of German towns in respect of tramway statistics. The differences between the two countries are much less than in the supply statistics. In capital expended per inhabitant the large British towns show rather less than the corresponding German towns, while in the medium towns the positions are reversed. In journeys per inhabitant there is very little difference in the large towns, but in the medium towns there is a difference of 18 per cent. in favour of this country. In revenue per inhabitant the German average is slightly higher than ours. The length of single track per inhabitant is greater in the large German towns, and nearly equal in the medium towns to the British figures. The most striking difference between the two countries is in the car miles per inhabitant - the German figures being nearly double the British for both groups of towns. This difference is, of course, due to the use of small cars in Germany. An examination of the German statistics shows that in all the towns mentioned in the table the average normal or licensed carrying capacity of the cars (including standing space, which is allowed in German practice) is 33 passengers—probably the average capacity of our cars would be about 50 passengers. In Germany the average revenue per passenger is slightly higher than here—we do not know the average distance travelled.

The cost per passenger—a very important quantity—is distinctly higher in Germany in both groups of towns, being 9 per cent. higher in the large towns and 14½ per cent. higher in the small ones.

The total cost per car mile is lower than here. Low wages help in this. As only two attendants can be employed on each car, low wages and low cost of labour are synonymous. The comparison of the ratios of costs to revenue is in favour of the British towns.

Table III.—*Electric Tramways.*

Towns.	Per inhabitant. Capital. £	Journeys.	Revenue. s. d.	Yards of track.	Car-miles.	Per passenger. Revenue. d.	Cost. d.	Per car-mile. Revenue. d.	Costs. d.
Six large British	2·40	160	14 7	0·29	16·5	1·09	0·68	10·6	6·6
,, ,, German	2·83	157	15 1	0·36	27·8	1·15	0·74	6·5	4·2
Six medium British	2·05	92	8 2	0·31	8·9	1·06	0·69	11·0	7·1
,, ,, German	1·79	78	7 7	0·30	15·2	1·15	0·79	5 9	4·1

On the conclusion of Mr. Mordey's address, Colonel CROMPTON proposed a vote of thanks to the President for his interesting, instructive, and patriotic address. Prof. KAPP, in seconding the proposal, congratulated Mr. Mordey on the exact and scientific nature of his address; and, as one who had been in close touch with the electrical industry and electrical undertakings in Germany, he supported the figures given by Mr. Mordey. He thought the address highly opportune, and hoped that it would discourage the old habit of disparaging our own work. Mr. MORDEY replied briefly, thanking the meeting for the reception given to his address, and expressing his indebtedness to his two assistants, Mr. Green and Mr. Haslam, in collecting and preparing the numerous statistics.

Electrical State of the Upper Atmosphere.—There exists under normal conditions a potential gradient in the atmosphere surrounding the earth. The earth being negatively charged with respect to the air, a continuous electric current flows from the upper atmosphere to the earth. It follows, therefore, that a kite attached to an earth-connected wire will tend to assume the potential of the air surrounding it, and an electric current will flow continuously down the wire to earth. Experiments, undertaken with a view to determining the magnitude of this current when the kite was at different heights above the ground, were described in a Paper by W. Makower, M. White, and E. Marsden, read recently before the Royal Meteorological Society. The authors found that in general a high wind produced at a given altitude an abnormally high value of the current flowing down the wire. Whether the action of the wind is to be accounted for by the greater volume of air which passes in a given time over the sails of the kite, so giving a greater volume of air from which electricity is collected, or whether the action of the wind is to be attributed to electrification by friction, the authors could not say.

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LOAD FACTORS AND DIVERSITY FACTORS

LOAD factors and diversity factors formed the subject of Mr. W. W. LACKIE's Address as Chairman to the Glasgow Local Section of the Institution of Electrical Engineers on November 10th. Mr. Lackie, who is Engineer-in-Chief of the Glasgow Electricity Department, dealt with this subject partly in order to put forward a number of alternative definitions that have been suggested from time to time for load factor and diversity factor, and partly to explain the principle underlying the system of charging at Glasgow.

We will not reproduce the numerous definitions of load factor and diversity factor given, as the multiplicity of these merely tends to confusion. The definitions of these two "factors" introduced by Mr. Robert Hammond and Mr. Arthur Wright, and generally accepted throughout the electrical industry, are as follows:—

Load factor is the ratio of the average load, represented by the actual sales to consumers, to the maximum load supplied to the feeders at the station, expressed as a percentage. That is to say, it is $\frac{\text{Number of Units sold during the year} \times 100}{365 \times 24 \times \text{Maximum Load}}$. One point that is sometimes overlooked is that, even if all the consumers had a steady 24-hour load, the load factor as thus defined could not be 100 per cent., for the average load represented by the number of units sold divided by 365 × 24 includes the losses in distribution—*i.e.*, the "units unaccounted for" in the Board of Trade form of accounts—and these may be a considerable percentage, especially in the case of A.C. transformer systems. The definition above is the accepted one, however, and should not be varied. An ambiguity that sometimes occurs is that, in calculating load factors, some engineers take the maximum load as the total maximum load on the 'bus-bars, including the power used on the works; and others take only the maximum load supplied to the feeders, which is the more correct way. If the power used on the works is included, the load factor will often come out at a much lower figure.

The diversity factor is the ratio of the sum of the consumers' maximum demands to the maximum demand on the feeders at the station 'bus-bars. It is thus always greater than unity, although there can be a hypothetical case in which the consumers' maximum demands might occur simultaneously, in which case the demand on the feeders would be greater, as it would include the distribution losses, so that in this instance the diversity factor in accordance with the accepted definition would actually be somewhat below unity. In calculating diversity factor, the station auxiliaries and lighting may be regarded as a consumer, if desired, in which case the ratio would be taken of the sum of the consumer's maximum demand and the maximum demand by the station auxiliaries and lighting to the maximum power delivered from the 'bus-bars, including the power used on the works. This is usually not done, however; as a rule, its tendency would be to reduce the diversity factor.

Last May there were 3,583 motors connected to the Glasgow Corporation mains used for 113 different trades or purposes. The load factor from these (that is presumably excluding the units sold for lighting and the maximum power for lighting) Mr. Lackie estimates at 38 per cent. The following list of trades with the load factor of each, the ratio of maximum demand to the power installed (wrongly called "diversity factor" by Mr. Lackie), and other information is of considerable interest. In this case, the load factor of each set of consumers is, of course, the ratio between the average and maximum load of each particular set of consumers. The numbers in the first column represent the number of consumers for which the figures are calculated in each case:—

No. of consumers.	Occupation.	Total H.P. for trade.	Load factor for trade.	H.P. of M.D. H.P. installed per cent.	Revenue per H.P. of M.D. £ s. d.	Revenue per H.P. installed. £ s. d.
36	Bakers	578	11%	62	3 13 4	2 7 0
10	Bookbinders ...	30	12·2%	72	5 2 0	3 13 0
60	Butchers ...	222	9%	58	3 8 3	2 15 0
100	Clothing manufrs.	604	18%	66	6 7 5	4 3 0
78	Engineers ...	2563	23%	66	6 9 0	4 6 0
77	Hoists	834	4·6%	100	2 0 3	2 0 3
12	Ironworks ...	808	26%	55	6 11 5	3 13 0
68	Printer and Publisher ...	1328	11·5%	58	4 8 0	2 12 0
Total on station:—						
3583	113 trades ...	23,748	38%	37	£10 0 0	£2 16 0

Dealing with the system of calculating the charges to consumers at Glasgow, Mr. Lackie said:—

A fair method of charging would be some such figure as £6 per kw. of maximum demand for lighting and £4 per kw. of M.D. for power, plus the cost of coal and other stores per unit. To meet the lighting consumers' convenience in Glasgow the £6

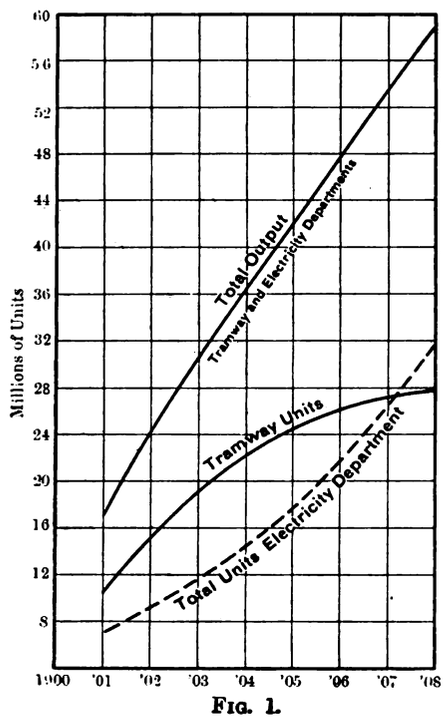

FIG. 1.

is divided up into 730 equal payments, and in the case of the power consumer the £4 into 1,000 equal payments, but if a set of consumers do not use their maximum demand for 730 and 1,000 hours respectively, they do not pay all their standing charges and are therefore a loss to the undertaking notwithstanding the fact that throughout they have to pay the higher or initial rate under the maximum demand system. In other words, a consumer paying the maximum charge per unit allowed by the B.O.T. (say 6d. or even 8d.) may be an unprofitable consumer, while an industrial user paying ¾d. per unit throughout for a long hour power supply will make a solid contribution to the profits of the supply undertaking. All the figures I have used are based on a capital cost per kw. of £80. If the capital cost is greater than £80 per kw., the figures will be increased proportionately and *vice versâ*. This is the principle underlying the maximum demand system of charging as used in Glasgow.

In the supply of energy for lighting and power we have to meet two entirely different sets of conditions. The *power* load is practically uniform without a peak for nine hours a day and 300 days in the year; while the lighting load has a very pronounced peak for about two hours in the winter afternoons. The lighting load is, of course, at its maximum in winter and at its minimum in summer. Until some means has been devised of overcoming these varying conditions it will continue to be

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necessary to differentiate between the charges for lighting and those for power supplies. At present many companies and supply authorities in supplying energy for power purposes allow their consumers to use 5 or 10 per cent., and in some cases 20 per cent. of their consumpt for lighting, the whole being charged at power rates. If this is right, we may look forward to the time when the total demand for lighting will be, say, only 10 per cent. of the total output, the other 90 per cent. being used for power and heating purposes; and electrical energy used for lighting purposes will then be thrown in at a price corresponding to our charge for power to-day. The effect of the metallic filament lamp helps on this idea by reducing the present demand and corresponding consumpt of energy for lighting purposes, whereas we know that no such vital change in the efficiency of motors can take place to reduce in a similar manner the demand made by them. The passing of the Daylight Bill, which was recently before Parliament, would also make for the same end, although I do not wish nor think it will pass.

Figs. 1 and 2 show the demands for lighting and power in Glasgow since 1901, from which you will see that the lighting demand, while it is still on the increase, is growing in a decreasing ratio as compared with the power demand, and next year it is anticipated that the power demand will exceed that for lighting. If we take the units used for tramway purposes and add them to the units used for power purposes delivered from the electricity department for last year we find that 42,000,000 units were used for power purposes, and 15,000,000 for lighting,

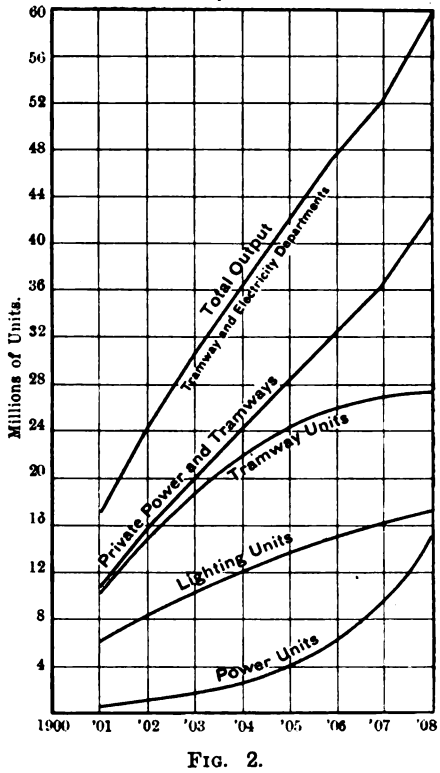

FIG. 2.

or 26 per cent. of the total units generated were used for lighting.

Much has yet to be done in the way of supplying electricity for heating purposes. It is commonly said that the absence of a good storage system is the only obstacle that stands in the way of a flat rate being adopted all round; but until the effective storage battery comes we must bend our efforts to find ways and means to create a demand which will keep the plant running during those hours of the day and night when it is not fully taxed to supply the power and lighting demands. In a city such as Glasgow, however, subject to fogs, the nature of the demand between 6 a.m. and 6 p.m. must be very carefully watched, but after 6 p.m. the supply station engineer should welcome any demand almost irrespective of its nature. Beyond encouraging the sale of energy for power purposes so as to improve the load factor or ordinary day load, the present position of affairs might be bettered by seeking to develop the demand for electrical energy after 6 p.m. for illuminated signs and other forms of decorative lighting. I understand the American Supply Companies do a large business in this way after 6 p.m. by offering electrical energy for this class of lighting at a low rate.

The use of larger units in the generating station would also mean a saving in capital and in the consumption of coal; and further instalments of plant will enable the supply undertaking to make fuller use of plant and buildings which are at present earning practically no revenue.

THE RATING OF TURBO-ALTERNATORS

THE written reply of Dr. M. Kloss to the discussion on his Paper on the rating of turbo-alternators has now come to hand. An abstract of the Paper and the ensuing discussion, which took place at Manchester on November 3rd, was given on page 637 of our issue of November 12th. It will be remembered that Dr. Kloss emphasised some of the leading differences between slow-speed and high-speed alternators in regard to the necessity for artificial ventilation, the fact that such close inherent voltage regulation was not attainable with turbo-alternators as with slow-speed machines, and the influence of the amount of margin allowed in the specification of the rated load factor on the price of the machine.

With reference to Mr. A. H. Law's remarks on the ventilating arrangement of the 6,000-kw. Siemens turbo-alternator at Stuart Street, Manchester, the author points out that his assumption that the air after cooling the stator core and stator coils had to go through the rotor, and thus would be already warm when it had to cool the rotor, is not correct. The ventilation of this machine is so arranged that the cool air, entering the machine from the bottom, is divided into two streams—one going through the stator core from both ends to the middle, whilst the other stream of air enters the rotor and leaves it without interfering with the stator stream, which it only joins near to the outlet of the machine. A special feature of this machine is the axial cooling of the stator through holes punched in the core plates, by which means it is possible to take the heat produced in the core to the cooling medium in the direction of the laminæ, where, of course, the heat conductivity is much greater than in the direction across the laminæ, where it has to travel through the paper insulation. The author agrees with Mr. Law that the V-shaped space between the poles is not simply wasted, but has the result that the number of ampere-turns per cm. circumference need not be reduced to such a large extent as would otherwise be the case, simply on account of the reduced winding space; further, that for small machines, a forced ventilation scheme with an outside fan would not be advisable.

As regards the voltage drop, the author remarks that the saturation factor has really only a very small influence, the governing factor being the ratio $\frac{I_n}{I_k}$. This is one reason why it is inadvisable to go too far in reducing the short-circuit current of turbo-alternators, even in view of the fact that the various methods of compounding or of automatically regulating give us the possibility of working machines safely with reduced short-circuit current. A ratio of short-circuit current of 1·6 times normal current would seem to be a fair figure for turbo-alternators. The author agrees with Dr. Rosenberg that a cylindrical rotor has less leakage than a salient pole type rotor, and that from this reason the voltage regulation of a machine of the former type will be better. With regard to enclosed self-ventilating machines, the author points out that if a fan is fixed to the rotor, the diameter and the speed are fixed, and therefore there is no great possibility of variation in the design, and it is only natural that such a fan cannot be expected to be very economical. However, in the case of the separate external fan, we are quite at liberty to choose the diameter and the speed, so as to obtain the most economical design with the highest possible efficiency. It is thus quite possible that an external outside fan will provide the necessary amount of cooling air with about half the power which would be absorbed by internal fans. In answer to Mr. Watson's question about the separate losses of the 6,000-kw. alternator mentioned in the Paper, Dr. Kloss gives the following values:—Iron loss, 135 kw.; copper losses in stator and rotor, 50 kw.; bearing friction and windage, 65 kw. The fan requires about 16 kw. for supplying the necessary cooling air to the machine.

The author concludes with the following remarks with regard to the heat limit of the rotor:—Some of the speakers disagreed with my statement that the output of turbo-alternators was not so much limited by the stator but by the rotor. Of course, I did not mean to say that it was impossible to provide a good ventilation for the rotor. But I think when, with certain dimensions, the stator of a turbo comes up against the heat limit whilst the rotor is still below this limit, it will certainly be possible to increase the *outside* diameter of the stator to allow for a bigger flux to pass through, and by such means increase the output until the increased excitation loss brings us up to the heat limit of the rotor. When, however, this is reached, no further increase is possible, because all the available space in the rotor has already been taken up. I must therefore still maintain that the output of a turbo-alternator is at the end limited by the rotor and not by the stator.

Royal Society of Arts.—The following Cantor Lectures have been arranged:—"Electric Power Supply," by G. L. Addenbrooke, January 18th, 25th, and February 1st; "Methods of Artificial Illumination," by Mr. Leon Gaster, February 15th and 22nd, and March 1st and 8th; "Steam Turbines," by Mr. G. G. Stoney, March 22nd and 29th, and April 5th.

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NEW TURBO-GENERATORS FOR THE L.C.C. TRAMWAYS

THE Highways Committee of the London County Council has reported upon the tenders for the supply, delivery, and erection of two 5,000-kilowatt steam turbo-generators for the second portion of the Greenwich generating station. The list of tenders received is given below:—

Belliss & Morcom, Ltd., Birmingham (Westinghouse generator)	£37,350 0 0
Bellis & Morcom, Ltd., Birmingham (Electric Construction Co.'s generator) (*Alternative tender*)	37,644 0 0
Electric Construction Co., Ltd., Wolverhampton (Belliss turbine)	37,858 0 0
British Westinghouse Electric and Manufacturing Co., Ltd., Manchester (Rateau turbine)	40,800 0 0
Belliss & Morcom, Ltd., Birmingham (General Electric Co.'s generator) (*Second alternative tender*)	41,821 0 0
General Electric Co., Ltd., Birmingham (Belliss turbine)	42,249 6 0
Willans & Robinson, Ltd., Rugby (Dick, Kerr generator)	43,174 0 0
Electric Construction Co., Ltd., Wolverhampton (Parsons turbine) (*Alternative tender*)	43,736 0 0
C. A. Parsons & Co., Newcastle-on-Tyne (Parsons generator)	44,055 0 0
British Thomson-Houston Co., Ltd., Rugby (British Thomson-Houston generator) ...	44,620 0 0
C. A. Parsons & Co., Newcastle-on-Tyne (Westinghouse generator) (*Alternative tender*)	44,688 0 0
James Howden & Co., Ltd., Glasgow (Westinghouse generator)	48,495 0 0
General Electric Co., Ltd., Birmingham (Parsons turbine) (*Alternative tender*)	49,137 3 6
Electric Construction Co., Ltd., Wolverhampton (Musgrave turbine) (*Second alternative tender*)	50,328 0 0
John Musgrave & Sons, Ltd., Bolton (Westinghouse generator)	50,890 0 0
John Musgrave & Sons, Ltd., Bolton ((Electric Construction Co.'s generator) (*Alternative tender*)	51,237 0 0
The Electrical Co., Ltd., Charing Cross Road, W.C. (A. E. G. generator)	57,700 0 0

The estimate of the chief officer of tramways comparable with the above tenders is £50,000.

In reporting upon these, the Highways Committee state that the Chief Officer of Tramways, with the Tramways Electrical Engineer, has personally inspected the works of several of the firms submitting tenders, and he has also inspected turbines made by the firms in question. As regards the two lowest tenders of Belliss & Morcom, Ltd., the turbo-generators manufactured by this firm and in operation are not of a size commensurate with those required at the generating station, and although it is recognised that the firm has a high reputation for reciprocating engines, the Committee feel it essential that the contractors for the work should have had experience in the manufacture of turbines comparable with those to be installed at the generating station. The first three tenders include Belliss & Morcom turbines, while the fourth, namely, that of the British Westinghouse Electric & Manufacturing Company, Ltd., includes turbines of the "Rateau" type. There are no examples of a large type of these last-mentioned machines in operation in this country, and accordingly the Chief Officer of Tramways and the Tramways Electrical Engineer visited works in Milan, where "Rateau" turbines are in use. Having considered a report by the Chief Officer of Tramways, the Committee have decided that it would be in the best interests of the Council that it should accept the tender of the British Westinghouse Electric & Manufacturing Co., Ltd., above referred to, amounting to £40,800. This tender, it will be seen, is £3,450 higher than the lowest tender, that of Belliss & Morcom, Ltd., but the Committee feel justified in recommending the adoption of this course as the result of the very full investigations which have been conducted in the matter. It is also pointed out that the British Westinghouse Electric & Manufacturing Co., Ltd., has had very considerable experience in the construction and operation of large turbines, and if they will supply turbines of the "Rateau" principle, containing the main features and latest developments which the Council's officers have inspected, and in other respects conforming with the details of the specification and subject to the approval of the fully-detailed drawings when prepared, their tender should be accepted.

THE TRAINING OF TRAMCAR DRIVERS

THE report of the Special Committee appointed by the Tramways and Light Railways Association to consider the question of tramway brakes was published at the beginning of the present month, and an abstract of the report, together with the general conclusions of the Committee, was given on page 647 of our issue of November 12th. Among the causes of accidents were mentioned the insufficient training and the physical unfitness of motormen. The following is an abstract of the portion of the report relating to these:—

Of the 15 serious accidents reported upon by the Board of Trade, blame is directly imputed in nine cases to the driver of the car, and in the remaining six accidents a better knowledge on the part of the driver might have averted the accident. No amount of training will prevent accidents which are caused by carelessness, but many of the accidents which have occurred have been due to want of training in the motormen. While some undertakings give very considerable attention to the training of their motormen, with others the training provided is quite inadequate. On careful consideration of this matter, the Committee feels that it is not possible now to lay down the exact training necessary for motormen under all conditions, but gives the following as being the minimum course through which a man should go before driving a service car.

(1) After a man has been accepted as suitable in build, general appearance, and character, he should be certified by a doctor as being of sound physique generally, more especially as regards his limbs, heart, sight, and hearing.

(2) The man should be put in the shop or shed to get a general insight into the parts of the equipment.

(3) The learner must be provided with a book of regulations and instructions, and before he goes on a car he should be examined generally on the working of the car and its equipment, and on the book of regulations and instructions.

(4) When the learner is ready to practise driving, he should be taken on a special car, or placed with an experienced driver on a service car. It is most desirable, however, that the learner should practise with a dummy controller before going on a car.

(5) For the first day or so on the platform, the learner should only watch, and afterwards he should drive on the easy roads.

(6) When the learner is capable of driving, he should be re-examined as in (3).

(7) Lastly, the learner should be taken out on a practice car by the manager, instructor, or inspector, and tried on the worst parts of the route, difficulties being intentionally made to try the man's capabilities.

(8) When a learner starts as driver, he should be piloted for a few journeys by an inspector or skilled driver.

The above course should occupy not less than three weeks. A driver should not be placed on hilly routes until he has shown himself a reliable driver for at least twelve months.

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Facilities should be given for conductors to qualify as drivers. In all cases, drivers should be re-examined annually as regards training, and medically every five years. The school of the London County Council is, perhaps, the most up-to-date of those already established. The following is the course of instruction carried out :—

Motormen are recruited from all classes of labour, though men are preferred who have had some experience as drivers of other vehicles. Before a man is placed in charge of an electric tramcar, he is trained not only in the starting and stopping of the car, but also in a knowledge of the working of the full electrical equipment. This is done by a series of lectures and demonstrations on a dummy car, in which all working parts are fully exposed. Between the lectures, the men go out on the practice car for driving without passengers, and are shown any special points in the track, insulated sections, and Board of Trade stops. After showing proficiency, the learners go out with an experienced driver to gain confidence in running the car to time, and learn the different routes. Before being passed out as an efficient driver, the learner is examined in driving and knowledge of the car, and what to do in case of emergency and breakdowns. A re-examination takes place again when an increase of pay is due, and the increase is only given to those who pass.

Finally the Committee state that they are desirous of emphasising the fact that, even if the best brakes are fitted, and the best training given to the drivers, the greatest security is not obtained unless good discipline is maintained, and care taken to see that the rules laid down for working the line are carefully adhered to. Driving at excessive speeds, inattention to stop notices, and the like, should be severely dealt with.

THE INSTITUTE OF METALS

THE first general meeting of this new institution was held in Birmingham on November 11th and 12th, when Sir William White delivered his Presidential Address, and several Papers were read and discussed.

The subject of the Presidential Address was the origin and objects of the institution. For some time past, said the President, there has been a widespread feeling that there was a need for a specialised society which should deal with the metallurgy and manufacture of non-ferrous metals and their alloys, on lines parallel to those which have yielded remarkable results in regard to iron and its alloys since the Iron and Steel Institute was founded in 1869. The researches carried out at the National Physical Laboratory with the financial assistance of the Institution of Mechanical Engineers strengthened this feeling, and at a meeting of representatives from London, Birmingham, Sheffield, and Manchester, held in London last June, it was decided to found the present Institute. The objects of the Institute are to afford a means of communication between members of the non-ferrous metal trades and to advance generally the knowledge of metals and alloys.

The following are brief abstracts of some of the Papers which were read at the meeting.

Copper and Copper Alloys.—The author of this Paper, Mr. J. T. Milton, dealt with copper and its alloys from the point of view of the marine engineer. The minimum amount of working either by hot or cold rolling and drawing which was necessary to convert unreliable copper castings into reliable plates, sheets, or tubes, was, he said, not yet known; and this, together with the differences in practice with regard to annealing, often led to unexpected results. He also considered the relative strengths and the tendency to corrode of various copper alloys, including brass and gun-metal.

Aluminium.—In a Paper entitled "Aluminium and some of its Uses," Mr. J. T. W. Echevarri, after referring to the physical, mechanical, and chemical properties of the metal, described the methods of casting, rolling, and drawing most suitable for aluminium, and then dealt with a few of its applications. Its uses in iron and steel works for reducing the iron oxides and for preventing porosity, as well as the various applications of the heat liberated by the reaction between iron oxide and aluminium, were described, and the various alloys of aluminium and copper, zinc, or nickel were mentioned. With regard to the use of aluminium in the electrical industry, the author stated that, at the present prices of aluminium and copper, the saving in cost of the bare conductor is so large that there is an extensive field for the former metal for insulated underground cables, even taking into account the increased amount of insulation necessary. The usual method of jointing bare stranded cables is to weld the two ends together by pouring molten aluminium into a cigar-shaped mould, but for insulated cables the simplest method is to slip a tube over the two ends of the cable, with a slot through which the solder can be run.

Manufacture of Tubes.—Various processes, and some of the machines used in the manufacture of solid drawn tubes, were described in a Paper by W. H. A. Robertson. Among the electrolytic processes referred to was the Elmore process, in which a revolving mandril is surrounded by unrefined Chili bars in a depositing tank of copper sulphate; the copper is deposited in the form of a tube of pure copper on the mandril. In this process it is necessary to burnish the deposited surface continuously. The centrifugal process due to Mr. Cowper Coles, and fully described on page 255 of ELECTRICAL ENGINEERING for August 13th, 1908, was also mentioned.

A Paper by Mr. C. H. Desch dealt with the formation of intermetallic compounds and their formulæ, and Mr. W. Rosenhain, of the National Physical Laboratory, read a Paper on the metallographic investigation of alloys. A Paper by Mr. C. D. Bengough and Dr. G. F. Hudson related to the mechanism of annealing in the case of certain copper alloys, and some notes on phosphor bronze were contributed by Mr. A. Philip. The last-mentioned Paper included the results of a large number of mechanical and chemical tests on phosphor bronze of different compositions.

The Electrobus in London.—We understand that the London, Brighton & South Coast Railway, in combination with the South-Eastern and Chatham Railway, have sanctioned the introduction of the electrobuses into the forecourt of Victoria Station, a privilege denied to all other motor omnibuses

New Cables for Special Purposes.—Among the exhibits of the Liverpool Electric Cable Co. at the Manchester Electrical Exhibition was a special "hard cord" braided cable. Specimens were shown of a twin vulcanised rubber cable, covered with a thin braided whip-cord, which is impregnated with ozokerit. The surface presents a rough appearance, but looks exceedingly strong, and the cable is particularly recommended by the firm for use as a trailing cable in shipyards, mines, and other places where rough usage is anticipated. Another use for this "hard cord" cable is as stage cable in theatres, and we understand that a considerable quantity of it has been supplied to Drury Lane Theatre. Another strong trailing cable shown was a concentric cable with an outer conductor consisting of a braid of copper wire covered with a similar braid of thin steel wire. A useful "hospital" cable was exhibited, in which the conductors are covered with a close outer tube of soft vulcanised rubber, so that the wire may be thoroughly cleaned, and, if necessary, washed down with dilute carbolic. Specimens of flexibles for motor-car ignition were also exhibited; these have a heavy insulation in black vulcanised rubber, and are supplied in two thicknesses, one for high-tension and one for low-tension igniters.

Workmen's Compensation.—The case of Lewery v. The British Westinghouse Electric & Manufacturing Co. came before Judge Scully in the Brighton County Court on Friday. The plaintiff, a labourer in the employ of the Westinghouse Co., was helping to move a dynamo, weighing 20 tons, into the Corporation's electricity works at Brighton on October 18th, 1907, when a balk of timber 5 ft. long fell upon his head from a distance of 20 ft. Since then he had been an out-patient at the Sussex County Hospital. It had been agreed to estimate his wages at 26s. per week in order to arrive at the amount, namely, 13s. per week, which should be paid him by the company. These payments have been continued until September 11th this year, when they ceased. The point to be decided was whether the plaintiff was still incapacitated. It was stated that he had tried to get various jobs but failed owing to his incapacity to do the work offered him. Medical evidence was called as to the fitness of the plaintiff, but the Judge came to the conclusion that he was still partially disabled and made an order for the payment by the company of 11s. per week.

Glass Which Conducts Electricity.—A Paper by Chas. S. Phillips, read before the Royal Society of Edinburgh and published in the Proceedings, describes the preparation of a conducting glass. Fused sodium silicate conducts fairly well, but becomes moist by exposure to the air and is soluble in boiling water. Attempts, therefore, were made to prepare a glass which would conduct the current and yet would not absorb water, and finally a glass containing 32 parts sodium silicate, 5 parts borax, 0·8 part lead oxide, and 0·2 part of sodium antimoniate was found to have these properties. After boiling this glass with water, it was found that it was practically unacted upon by acids, but conducted a current of electricity fairly well. The specific resistance was found to be 5×10^8 ohms at 20° C., and although this value is high, it is about 1,000 times less than that of ordinary glass at 100° C. Plates of this glass are already in use for the windows of electrometers and electroscopes (a conducting transparent varnish, first introduced by the late Prof. Ayrton and Mr. Mather, has been in use for some years for the same purpose), and fibres have been found sufficiently conducting over their surface to justify their replacing the gold leaves in the latter instrument. A length of glass fibre fixed in position with a small hinge of gold leaf thus affords an extremely sensitive index, the position of which may be accurately read by means of a telescope; instruments of this kind are of especial use in the study of radio-activity.

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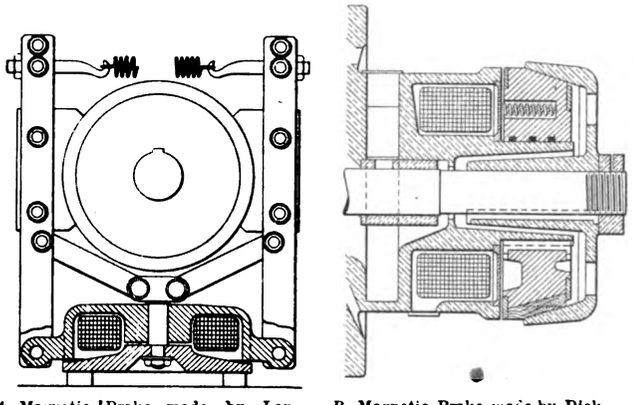
ELECTRICAL EQUIPMENT OF CRANES

A Paper on the electrical equipment of cranes was read by Mr. J. B. Duckitt on Friday last before the North-East Coast Institution of Engineers and Shipbuilders, at Sunderland. In introducing his subject, the author mentioned the principal advantages claimed for electrically-driven cranes, which are as follows:—(1) high over-all efficiency; (2) crane only absorbs power when actually doing work; (3) increased safety; (4) greater flexibility; and (5) higher speed of the various motions. Against these claims must be placed the extra cost and upkeep of the electrical equipment.

Speed of Cranes.—There has been, said the author, a tendency during the last few years to increase the speeds of the various motions, but this has not always proved wise. In the first place, higher speeds necessitate the fitting of larger motors, and this means an increase in the starting current. Again, larger motors take longer to attain maximum speed, and where the range is small, the motor may never reach its maximum speed or only attain it for a very short time, resulting in a reduction of the efficiency.

Motors.—As all crane motors are subjected to variable loads, it is essential that the fixed losses should be small and the variable losses large, as motors designed in this way have a high efficiency over a large range of load. Though shunt motors are occasionally fitted, the series motor has been almost universally employed on account of its wide range of speed and torque, and also the loss due to field excitation is a component of the variable losses which increases the efficiency at light loads. The totally enclosed type of motor has proved the most suitable, as dirt and damp are excluded and the electrical portions are effectively protected from mechanical injury. A disadvantage of this type is that slight faults developing in the electrical portions of the motor cannot be observed and often serious damage ensues before attention is drawn to them.

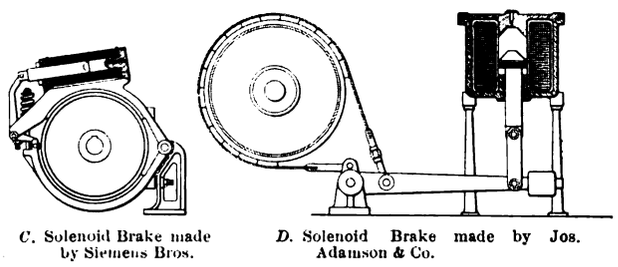


A. Magnetic Brake made by Lancashire Dynamo and Motor Co. *B.* Magnetic Brake made by Dick, Kerr & Co.

FIG. 1.—TYPES OF MAGNETIC BRAKES.

Constructional Details.—Armature shafts should be designed on liberal lines owing to the heavy torsional strains to which they are subjected by being constantly reversed, and the heavy overloads and excessive vibration to which they are liable. The bearings should be of gun-metal or phosphor bronze and provided with self-lubrication. Where the diameter is increased they can be made much shorter than is the usual practice; this, as the over-all length of the motor is reduced, results in a more compact design of crab. Armature core-plates should be stamped out of one sheet, with the air vents stamped in them and the core-plates carried down to the spindle so as to decrease the number of mechanical joints; where spiders are necessary care should be taken that they are perfectly rigid upon the shaft and keys, and also between the discs and arms. Two-circuit or series winding should be adopted for the armatures, because inequality in the lengths of the air-gaps does not affect the satisfactory running of the motor, as equal voltage is induced in both circuits of the armature; whereas with multiple-circuit or parallel winding, unless the armature is central, the various sections of the winding will have unequal voltages, and heating and sparking will result. The commutator lugs should be carried up solid, and the commutator should have a large number of sections in order to keep down the reactance voltage and allow of fixed brushes for all loads. In the design of the brush-holders, the number of screws, nuts, springs, and parts liable to work loose, should be reduced to a minimum. Brush-quadrants when fitted should be very firmly secured; a good method is to fix the brush-holders direct to the end cover, connection being made to them from the outside.

Rating of Motors.—Most makers of crane motors specify the b.h.p. of the motor on a continuous run of one-quarter, one-half, or one hour for a specified rise of temperature. This method has not always proved satisfactory in the case of one-quarter hour rated motors, as the rise of temperature due to overloading increases very rapidly in the armature and field-coils, and they burn out before it has had time to spread to the other portions of the motor. It is therefore inadvisable to adopt motors of less than one-half hour rating. Another system of rating motors for intermittent work, called the "load-factor" method, has been adopted by Messrs. Siemens Bros. The factor of most importance in selecting a motor for intermittent work is the ratio between the working period and the time occupied for a complete cycle of operations; this latter ratio is termed the "load-factor." Messrs. Siemens find that basing the output of the motors on a twelve minutes' cycle gives satisfactory results. "Load-factors" are expressed as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and so on, and mean that the motor is running under full load for $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$ of the total time occupied for a complete cycle of operations; with a twelve minutes' cycle the load periods are 6, 4, 3, 2, and $1\frac{1}{2}$ minutes respectively. The motors are designed to give the specified temperature rise when run intermittently under full load for six hours at the various "load-factors," that is, at $\frac{1}{4}$ "load-factor" the motor would be run under full load for three minutes out of every twelve minutes, the test extending over a period of six hours.



C. Solenoid Brake made by Siemens Bros. *D.* Solenoid Brake made by Jos. Adamson & Co.

FIG. 2.—TYPES OF SOLENOID BRAKES.

Speed of Crane Motors.—In deciding the most suitable speeds for the motors the speed at full load has not only to be considered, but also the acceleration of the armatures at light loads on the various motions. The ratios of the speed increase from full load to light on overhead travelling cranes are for the hoisting motion about 3 to 1, for the traversing motion 2 to 1, and 1·5 to 1 for the travelling motion. It is essential that the "no-load" speeds should come well within the safety limit, particularly in the case of the hoisting motor, as the speed when lowering with load may be much higher than when hoisting light. The permissible maximum speeds at normal load for a 9 in. armature are about 450, 600, and 720 r.p.m. for hoisting, traversing, and travelling respectively, and about 340, 450, and 540 r.p.m. respectively for a 16 in. diameter armature.

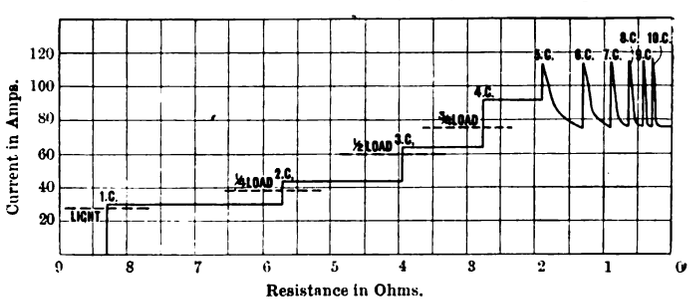


FIG. 3.—DIAGRAM OF DEVELOPMENT OF HOISTING RESISTANCE AND STARTING CURRENT.

Brakes.—Electrically released brakes are usually fitted on the motor spindle and may be divided into two classes, magnetic and solenoid. In the magnetic type the brake is released by an electro-magnet, the pull of the magnet opposing the pressure exerted by springs. Examples of this type are shown in Fig. 1. It is very compact and powerful, but it needs careful adjusting, for should the gap become too great owing to wear, the brake will not be released on light loads. In the solenoid type the plunger is usually connected to a lever to the other end of which

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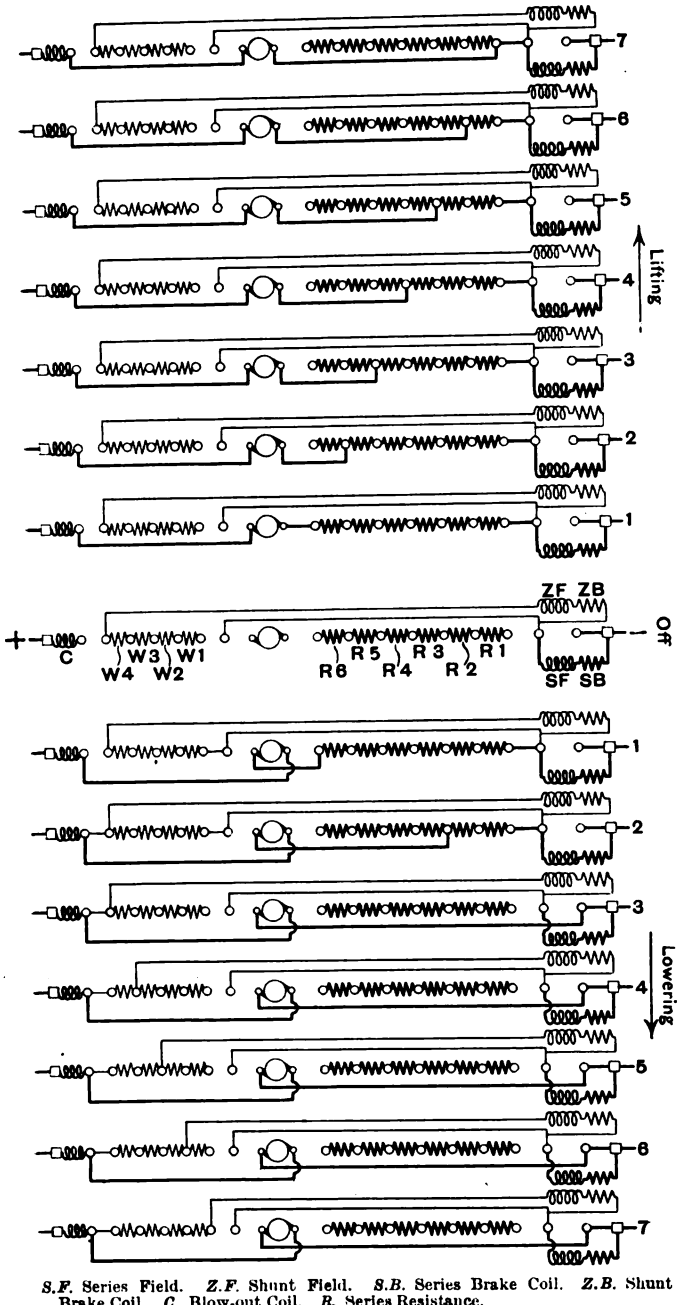
is coupled the brake arms or strap. It is essential that this type should have a dashpot connected with the plunger to prevent hammering and shocks to the motor and gear when it is released. Fig. 2 shows examples of this type of brake. The brake coils are either shunt or series wound. When shunt wound they involve extra contacts in the controllers and extra wiring on the crane, and are not so safe as when series wound. The brake magnets should be designed to release when starting with light loads, but at the same time care has to be taken that they do not release too soon or the load may start lowering. It is best to design the brake so that it will release when the



S.F. Series Field. *Z.F.* Shunt Field. *S.B.* Series Brake Coil. *Z.B.* Shunt Brake Coil. *C.* Blow-out Coil. *R.* Series Resistance. *W.* Shunt Resistance used in Series as Shunt Regulator or as Discharge Resistance in Parallel. Shunt Circuit Connections shown in Thin Lines.

FIG. 4.—DEVELOPMENT OF DRUM CONTROLLER FOR COMPOUND MOTOR WITH REGENERATIVE CONTROL WHEN LOWERING.

pull on the armature of the motor is sufficiently strong to hold the load.

Controllers.—Liquid controllers are cheap and simple to design, and there is no sparking and burning of contacts. The disadvantages are polarisation of the plates, the necessity of short-circuiting the tank to cut out the resistance entirely, the difficulty of effectively insulating the tank, and corrosion due to the solution. The percentage of chemical in the liquid should be carefully regulated for different voltages or sudden rushes of current will occur when starting or short-circuiting. Another objection is that where large power motors are used the tank becomes very heavy. In face-plate controllers the large number of contacts permit of a greater subdivision of the resistance and tend to smooth starting and better regulation of the motor. The leading objections to this type are the difficulty of fitting an effective blow-out, also the contacts and contact arms are not usually enclosed. The drum or tramway controller is totally enclosed, a powerful magnetic blow-out can be easily and effectively fitted, and the various connections for different systems of control can be easily carried out. The leading disadvantages are that few regulating steps in the resistance can be fitted, and that the resistances are not self-contained. The various sections of the resistance must be in the form of a geometrical progression, the extremes of which are the total resistance necessary and the resistance of the motor, which are known quantities. Generally the maximum starting current ranges from 1·5 to twice the normal full-load current, and the hoisting motor resistance is designed to give a reduction of from 0·3 to 0·6 times the normal full-load current, according to requirements, on the first step; for traversing these figures are usually 0·5 to 0·6, and for travelling and slewing 0·5 to 0·75. Fig. 3 shows the development of the resistance for a 20 b.h.p. hoisting motor at 250 volts.

Rating of Controllers and Resistances.—Controllers, like motors, are designed for intermittent working. It is found that doubling the capacity of the controllers for continuous rating, and making the period of work to period of rest as 1 : 1, and the time limit from two to five minutes for resistances, will generally meet the requirements for crane work satisfactorily.

Electrical Control of Lowering.—The use of mechanical brakes can be obviated by so designing the controller that the energy

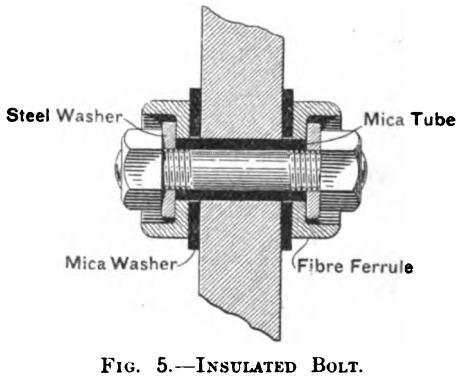


FIG. 5.—INSULATED BOLT.

exerted by the load falling is used to convert the motor into a generator; the electric power so developed being absorbed by short-circuiting it through the resistance. This method of lowering gives complete control over the speed with light or heavy loads, does not throw excessive strains on the gearing, and is much cheaper than fitting mechanical brakes.

Methods of Increasing Efficiency.—The rheostatic method of control is always adopted for crane motors; though simple, effective, and reliable, it is very wasteful. Series-parallel control cannot be adopted for the hoisting motion on cranes, as when hoisting with load the motor would have no inertia to assist it over the transition points when changing from series to parallel. In the case of travelling motions for large cranes the ordinary series-parallel control could be adopted, and the objection to fitting two motors surmounted by fitting one motor with a double armature, and, if requisite, double-field windings.

Regenerative Control.—In the author's opinion the adoption of motors with compound field windings for hoisting motions, controlled in such a manner that when hoisting they act purely as series motors, with the shunt winding entirely cut out, and when lowering as shunt motors, with the series windings cut out, and the regenerative effect utilised, would give an ideal system of control for this motion, as it would result in economy in current consumption, and would give absolute control over the speed of lowering. The disadvantages are that the size and cost of the motor would be somewhat greater on account of the extra field windings and higher rating, it would be necessary to drive down the hook and very light loads by passing the main current through the armature, and the solenoid brake would have to be either shunt or compound wound. Fig. 4 shows the development of this system.

Wiring Details.—The size of cables or wires for the various motions can safely be based on 1,500 amperes per square inch for normal full load. Cables should be protected against oil and dirt by running them in steel conduit or iron piping. A main double-pole enclosed switch should be fitted in the cage. Enclosed fuses, rated to blow at not more than twice the normal full-load current of the motor, should be provided. Sliding contacts give more satisfaction on overhead travelling cranes, as the grit in most works causes trouble with trolleys. The

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contact shoes should be of soft gun-metal and easily and quickly replaceable. Switches for the prevention of over-winding should be fitted on all cranes to break the circuit when the block reaches a minimum safe distance from the barrel. Limit-switches are also sometimes used to prevent the travelling and traversing motions from running against the stop-blocks, but they are objectionable when it is desired to work the crane as near as possible to the extreme limit of these motions. Nothing but porcelain or mica is permissible for insulating purposes; fibre should never be used except as a further protection to the insulating medium, in which case it will often prove useful and effective when insulating bolts or studs which are connected to current-carrying apparatus. Fig. 5 gives an example: the mica is used as the insulating medium, and the fibre ferrules prevent oil and dirt from bridging it and causing a burn-out.

Polyphase Motors.—Although they lack the chief characteristics which make the continuous-current motor suitable for crane work, polyphase motors are sometimes used; but they should be avoided when possible.

DEPRECIATION AND OBSOLESCENCE IN SMALL ENGINEERING WORKS

By W. O. Horsnaill

IN addition to the stock of material and finished parts which should not be subject to depreciation, the assets of an engineering works consist of machine tools, power plant, distributing gear, lifting appliances, patterns, drawings, buildings, &c., upon all of which items depreciation must be allowed before the true net profits from the undertaking can be arrived at.

In a large concern, which can afford to employ a first-class engineer, the proper allowances for depreciation, and the problems in connection with the scrapping of obsolete machinery, can be settled in the most effective manner with the assistance of a good independent accountant. The engineer for such an undertaking is able not only to estimate closely the useful life of each appliance and to keep himself posted in the very latest practice, but he will introduce original designs and methods to meet competition from similar developments in the works of trade rivals.

These qualifications involve a salary which cannot be paid by a small firm; consequently the latter must either call in outside assistance from time to time or content themselves with inaccurate accounts and out-of-date equipment.

As regards depreciation, very loose methods of estimating this charge are used in many small undertakings; not unfrequently the value of the whole plant is totalled up and written down in one account, the results being more or less accurate according to the knowledge and experience of the accountant. Such a plan cannot be considered satisfactory, neither is it in keeping with the care which is now taken to ascertain the costs of production.

The plant must be considered in detail, and no one but an engineer, well versed in the most modern practice, can estimate the proper allowances for depreciation. The usual method of effecting the latter operation involves a ledger account for each section of the equipment, which is credited with the value of the machinery or appliances referred to. Thus, if a new lathe were installed, a works order would be issued in the ordinary course, to which the cost of purchasing and fixing should be charged, the total being abstracted to the plant ledger account. This account is also credited with any new accessories which may be bought from time to time, and at the end of each year depreciation is charged, and the balance brought down as representing the present value of the lathe.

The system is extended to include all valuable loose tools, such as stocks and dies, reamers, &c., which are kept in the tool-room and lent to the workmen in response to signed receipts or brass tool checks, an account being kept for each different class of tool.

The allowances for depreciation are made at the end of each year, the revised values being carried forward. In estimating these charges the useful life must be considered, together with the residual value and the probability of early replacement becoming advisable owing to the introduction of more efficient appliances.

This question of turning out good plant in favour of more economical machinery is of very great importance, and the firm who takes immediate advantage of new developments in this way is likely to benefit by them to a much greater extent than competitors who wait until the new appliances are in general use before making the change. There are two reasons for this state of things:—Firstly, the residual value of the old machinery is much higher when sold before the new methods have made headway; secondly, the price of the product will not be reduced in proportion to the lower cost of manufacture until the more efficient means have been largely adopted.

In this connection it may be remarked that the concern in which new machines or devices for cheapening production are continually being invented has a great advantage over its rivals who only adopt new methods when placed upon the market by others. Such a concern can obtain good prices for its old machines as the latter *appear* to be up-to-date to less enlightened competitors.

In the manufacture of machinery, perhaps more than in other industries, development is continually going on, and there is no reason to suppose that finality will ever be reached. Such being the case, it would seem imperative that some allowance for this feature of obsolescence be made in the charge for depreciation, a short life, and a high residual value being substituted for the assumption that a machine will be worn out and finally scrapped.

In view of the rapid changes being made in engineering methods, a life of ten years for machine tools is long enough, but, provided immediate advantage be taken of new contrivances, the residual value (excluding erection) should be, say, a third of the first cost, where the plant has been carefully maintained. Many tools will retain their efficiency for a much longer period than that specified above; on the other hand, new machines may be brought out for replacing existing plant which has only been in use for two or three years.

The same principles apply to drawings and patterns, both of which depreciate very rapidly. The value of drawings depends very much upon the class of business being done. Drawings of standard products cannot be expected to possess any value after machines or appliances have been made to them for two or three years, as by that time new designs must be got out if the undertaking is to keep going forward, the days being passed when the same article or machine could be manufactured year after year without modification. If improvements are not demanded by the users, competition compels a reduction in price, involving more economical designs to enable profits to be made.

Patterns are similarly affected, and their value, as regards those constructed of wood, is still further reduced by wear and tear. It is an open question whether drawings and patterns can, under modern conditions, be deemed to possess any appreciable value, but if they are to be treated as an asset, depreciation must be based on a very short life and a scrap residual value; further, it is imperative that the stock must be looked over every twelve months by an engineer who is competent to write off patterns and drawings which have become obsolete.

It may be contended that customers will sometimes insist upon being supplied with an old design to which they have become accustomed, but this feature is being gradually eliminated under modern conditions. At one time articles or machines were made up singly or in small numbers to suit customer's requirements, and the prices were very much higher than is the case at present for similar products manufactured by special tools and in large quantities. Consequently when a customer asks for old designs he has to pay the old prices, which can seldom be afforded.

Drawings and patterns for very large machines or appliances which are constructed in response to special orders will have been allowed for at their full value in the cost of production, and although they may be kept for years, the chances of their being used over again are too remote to justify their inclusion amongst assets.

The power plant and distributing gear are open to the similar influences to those we have described in connection with machine tools. It is not impossible that shafting may be almost entirely superseded by electric motors before another decade has passed away. These possibilities can be allowed for in the charge for depreciation, which should not be less than 7½ per cent. for power plant and transmission gear.

It might be supposed that brick buildings, if carefully maintained, would not be subject to depreciation, but here, again, the

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question of improvements comes in, and experience tells us that modification to the equipment entails alteration to buildings, hence a yearly allowance of, say, 5 per cent. should be deducted from the value of the latter to cover expenditure in this direction. Buildings into the construction of which steel largely enters must be specially considered, a larger allowance being set aside to cover the deterioration of this material.

Some authorities advocate the setting aside of a reserve fund to cover the replacement of machinery which has become obsolete before being worn out, the allowance for depreciation being based upon the useful life of the plant when carefully maintained. Such a fund is often contributed to liberally during successful periods, and there is a temptation (not always resisted) to draw upon it when trade is bad, for the purpose of paying dividends which have not justly been earned. In the writer's opinion, the inclusion of obsolescence in the allowance made for depreciation is a simpler and more correct method, the provision for replacing out-of-date plant being just as essential as the renewal of machinery which is actually worn out.

Moreover, it is clearly understood that arrears of depreciation must be paid off before profits are made, whereas the setting aside of a sum out of revenue in favour of the reserve fund does not appear to be so imperative. Hence when this system is adopted, although what may be called ordinary depreciation is properly allowed for, the equally essential feature of obsolescence may not receive the attention it deserves.

The percentages for depreciation given above cannot be looked upon as rules to be adhered to when determining such charges, the figures being only specified to illustrate the principles put forward.

It is impossible to lay down definite rules for depreciation as the conditions are continually changing, and the first cost may have been much too high in view of subsequent developments. The most accurate method of obtaining correct results is to have the plant valued by an independent engineer every few years, supplemented by an annual inspection, the rates for the next few years being fixed at each valuation. This duty may be carried out by the manager or principal in a small undertaking, but the results are not so satisfactory, there being generally a lack of knowledge regarding the most modern practice, together with a natural tendency to cut down the rates for the purpose of showing a better profit.

THE PROPOSED TAX ON ELECTRICITY IN GERMANY

IN last week's issue we published an abstract of the Bill which has been introduced by the German Government, in which a tax on electrical energy, gas, and illuminating apparatus is proposed. There is considerable opposition to the Bill, and in engineering circles the proposals are being eagerly discussed. There is little doubt some formal protest will be presented to the Government from the representatives of the industries concerned. A special meeting of the Elektrotechnischer Verein will be held in Berlin this evening, when Herr G. Dettmar (General Secretary of the Verband Deutscher Elektrotechniker) will open a discussion on the subject. Owing to the importance of the matter an unusually large attendance of the representatives of the electrical industry is expected.

With regard to the influence of the tax on the electrical industry, the following figures, which are taken from a letter written by the director of a large iron works in the Lower Rhine district and published in the *Elektrotechnischer Anzeiger*, afford a striking example of the heavy nature of the proposed tax. The works in question has a generating plant in connection with its blast furnaces, which supplies the whole of the works with power and light. The yearly output of the station at present amounts to 28 million units, and when the proposed extension of electric driving to all the rolling-mills will have been completed, the output will be about 35 million units.

Now according to the provisions of the tax (see ELECTRICAL ENGINEERING, November 19th, page 677), energy for the use of the producer is to be taxed uniformly to the amount of 5 per cent. of the total generating costs. With the total costs in the works at 2·5 pfennig (0·3d. per unit), this amounts to a total sum of 43,750 marks per annum (approximately £2,150). To this also must be added the tax on lamps. From the works' records 5,500 lamps, on which a tax of 30 pfennigs is to be imposed, and 1,500 lamps with a proposed tax of 50 pfennigs, were used in the past year. This amounts to a total tax on lamps of 2,400 marks (approximately £120). Some 8,000 kg. of arc lamp carbons were consumed during the year, and with a tax of 1 mk. per kg., this means 8,000 marks (approximately £400). Thus the annual sum which will have to be paid out if the proposed tax becomes law will amount to 54,150 marks (approximately £2,670), or over 1 per cent. of the share capital of the company. The writer concludes that it the tax becomes law, the company will regret that they did not continue to use steam as the driving agent in the works.

It is interesting to compare the relative values of the revenues expected from the new sources. These are as follows:—Spirits, £5,000,000; tobacco, £3,850,000; beer, £5,000,000; wine, £1,000,000; death duties, £4,600,000; electricity and gas, £2,500,000 (the relative amounts expected from the different items were given on page 678 of our last week's issue); and from the tax on advertisements, £1,650,000. These total up to some £23,600,000, of which it is seen that over 10 per cent. is to be contributed by electricity and gas.

The taxes on electricity and on illuminating apparatus are not the only proposals which will affect the electrical industry. The proposed company tax, which is to apply to Prussia only, will have a far-reaching influence if passed. In cases of affiliated companies, it is said that the tax will be imposed more than once, and this will have the effect of bringing up its amount from 6 to 7 per cent. of the net profits to as much as 20 per cent. under certain conditions. With respect to the above, it is interesting to note that the Deutsche-Ueberseeischen Elektricitäts-Ges., of Berlin, and the Elektrische Licht- und Kraftanlagen Akt.-Ges. have both decided at meetings held recently that, in the case of the proposal becoming law, the official offices of the respective companies should be established outside Prussian territory, and the latter company also decided to abolish its subsidiary companies who have official offices in Prussia.

Troubles with Overhead Equipment.—According to the *Railway Gazette*, the New York, New Haven & Hartford Railway's overhead contact line construction, which was designed particularly for rigidity, has given considerable trouble because it was too successful in this respect. It is on the double catenary suspension system, two upper steel messenger wires being connected to the lower copper wire, with which the sliding-bow comes in contact, by triangular trolley-hangers spaced 10 ft. apart. The sliding-bow strikes these points of support a heavy blow, and the triangles are so stiff that breakages result, as well as excessive vibration throughout the structure and a great deal of sparking. To remedy this, another wire has been strung an inch or two below the old contact wire, being hung from it at points half-way between the triangles. The sliding-bow touches this wire only, and the blows at its points of support are cushioned in transmission to the rest of the structure, instead of striking directly the stiff triangles. This has proved so successful that the overhead construction has now been modified in this way over a considerable length of track.

Audible Signalling on the Great Western Railway.—On page 431 of ELECTRICAL ENGINEERING, Vol. I., we gave a full illustrated description of the Great Western Railway Co.'s system of audible distant signals, in which a third rail a few yards long is provided at each signalling point, with which contact is made by a shoe on the locomotive. When the signal "clear" is to be given, the current picked up causes a bell to ring in the locomotive cabin, but if the contact rail is not connected to the battery in the signal-box, the plunger carrying the contact shoe is caused to interrupt a local circuit and release a whistle valve, which is normally held closed. According to the *Railway Times*, this system has given so much satisfaction on the Witney and Fairford line, that a further extension has been decided upon, and the four main lines of the Great Western Railway between Reading and Slough are being equipped for working on this system. There will be sixty-six signalling ramps on this section of the line. An improvement in the cab apparatus has been effected, in that only one electromagnet is used, a polarised relay serving, when energised by the current picked up from the ramp, to keep the local circuit on the engine closed. The Lambourn Valley branch of the Great Western is also to be equipped on this system.

The Junior Institution of Engineers.—The inaugural address delivered by Mr. J. Swinburne to the Junior Institution of Engineers on Tuesday, November 17th, consisted of a lucid exposition of the theory of the ideal heat engine and of the notion of entropy. Mr. Swinburne employed metric units, the "barad," or one megadyne per square centimetre, which is almost exactly equal to one atmosphere, being the unit of pressure, and the joule the unit of energy. The ordinary thermal unit, involving the specific heat of water, was, said Mr. Swinburne, of no use; it belonged to the days when people had not fully realised that heat was energy. After carefully explaining the notion of entropy and the true meaning of the $\Theta\Phi$ diagram, Mr. Swinburne concluded by stating that a study of the kinetic theory of gases afforded a means of obtaining a physical conception of the notion of entropy, and enabled a student to get a good mental hold of the principles of thermodynamics. The kinetic theory of gases was, in fact, one of those main roads of knowledge from which it was always easy to branch out into any particular study.

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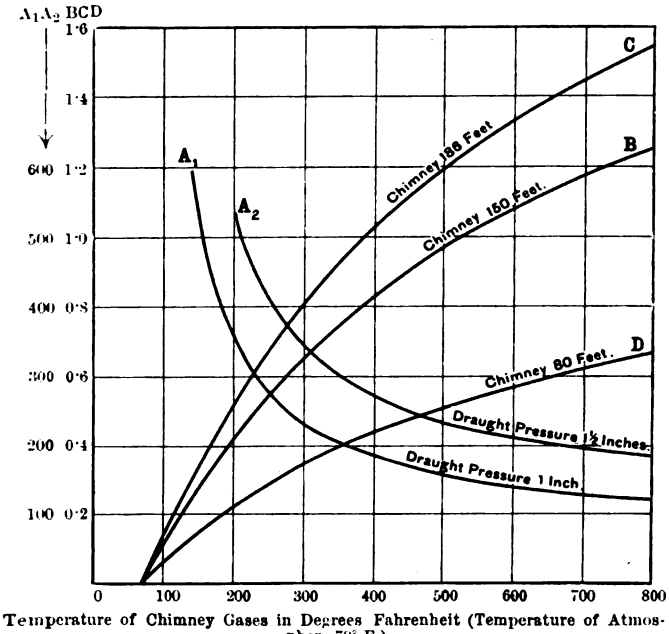
A COMPARISON OF NATURAL AND INDUCED DRAUGHT SYSTEMS

AT a meeting of the Leeds Local Section of the Institution of Electrical Engineers yesterday, Mr. W. N. Y. King read a Paper comparing the merits of natural and induced draught for steam-raising plant. In his introductory remarks he stated that in steam-raising plants, as commonly installed and operated with natural draught, the discharge to waste in the atmosphere of a large volume of gas at high temperature represented in many cases a loss of as much as 20 to 25 per cent. of the total available energy of the fuel. Of the two systems of mechanically-produced draught, the "Induced Draught," in which the boiler furnace outlet is connected to the fan suction chamber, is the only one dealt with in this Paper, on account of its many advantages, for land purposes, over the other, namely, the "Forced Draught," in which the fan discharges air into the furnace inlet, a system which has been more adapted to marine purposes, though latterly it has been combined with underfeed stokers on land in some instances.

The curves, A_1, and A_2, (Fig. 1) show the height of chimney required to produce one inch, and one-and-a-half-inch draught pressure respectively, with different values of chimney gas temperatures. Curves *B*, *C*, *D* show how the draught pressure varies with the chimney temperature for heights of 150, 186, and 80 ft. respectively. The atmospheric temperature is assumed to be 70° F., and barometer normal, in all cases. Under



Temperature of Chimney Gases in Degrees Fahrenheit (Temperature of Atmosphere 70° F.).
Curves A_1 A_2. Height of Chimney in Feet.
Curves B C D. Draught Pressure in Inches of Water.

FIG. 1.—NATURAL DRAUGHT CURVES.

ordinary working conditions the draught indicated by gauge at the base of a chimney is about 5 per cent. less than the theoretical value on account of this proportion of the pressure being counteracted by the friction of the gases in the chimney, and a corresponding allowance must be made when referring to the curves if gauge pressure at the chimney base is being considered. The draught pressure, the author explained, determines the available rate of air supply to the furnace, and through this the rate of fuel consumption, so it is obvious that the height of a chimney is its most important dimension, and when this has been decided upon in any case, the area remains to be calculated sufficiently large to deal with the maximum volume of gases it will be required to discharge in a given time, without excessive loss due to friction or to the velocity of the gases leaving the chimney. It is usual practice in this respect, he added, not to exceed a maximum velocity of about 16 ft. per sec., in any part, for above this value the friction losses become excessive, and, as a rule, 10ft. per sec. is a good working velocity.

The author next proceeded to make a comparison in efficiency between natural and induced draught. To represent the latter, the particular case was taken of two Stirling water-tube boilers of the five-drum type, built together in one casing, and one motor-driven fan with a short chimney, to serve both boilers working simultaneously at their maximum output. Table A gives some of the more important particulars of the boilers, and table B those of the fan and motor. Table C gives results which were obtained with one boiler working under normal conditions during a period of six hours. As the two boilers are identical in construction and working, the output of the combined plant was taken as double that in the table. Table D shows the relations existing between the draught shown by gauge at fan intake and the power, speed, &c., of the motor when working on both boilers.

Table A.

Type of boiler	Stirling water tube	(5 drums; Babcock and Wilcox Chain Grate Stoker; style 5.)
Heating surface, each	3,450 sq. ft.	
Superheating ditto ...	188 ,,	
Grate area	59·5 ,,	
Working pressure ...	165 lbs. per sq. in.	
Evaporative capacity	12,500 lbs. per hour from and at 212° F.	

Table B.

FAN:	*Type*	Davidson's Sirocco	
	Capacity ...	45,000 sq. ft. per min.	Against 2½ ins. water pressure
MOTOR:	*Type*	Crompton 4-pole	
	Speed ...	300-600 r.p.m.	
	Power ...	35 B.H.P.	

Table C.

Coal consumption ...	1,232 lbs. per hour	(Washed nuts.)
Water evaporated ...	11,700 lbs. ,,	(Equivalent to 14,860 from and at 212° F.)
,, ,, ...	9·5 lbs. per lb. coal	(Equivalent to 12·06 from and at 212° F.)
Superheat, average ...	100° F.	
Feed water, temperature	42° F.	
Flue gas, temperature...	439° F.	(At fan intake.)
Draught press., by gauge	1·04 ins. of water	,, ,,
CO_2	13 to 14 per cent.	(Leaving the furnace.)
Thickness of coal feed...	4 ins.	
Speed of grate (approx.)	4 ins. per min.	

Table D.

Regulator Notch No.	Current, amps.	P.D., volts.	Power, kw.	Speed, r.p.m.	Draught, ins. of water.
1	14	540	7·56	262	0·88
3	15	540	8·1	292	1·1
5	17	540	9·2	330	1·25
10	20	540	10·8	396	1·6
20	40	540	21·6	528	2·8

The maximum temperature of the furnace gases is assumed to be 2,800° F. (regarding this Messrs. Booth and Kershaw, in a Paper read before the Institution of Electrical Engineers in January 12th, 1905, said that: "The theoretical temperature attainable in the furnace by the combustion of coal lies between 3,500° F. and 3,700° F.; the maximum attained under practical conditions is about 2,800° F.") and the atmospheric temperature is taken to be 70° F.

With this assumption, the author made the following calculations:—The percentage loss of total available furnace heat, with gases leaving the boiler and entering the fan at 439° F. (Table C) is:—

$$\frac{(439-70)\times 100}{2{,}800-70}=13{\cdot}5 \text{ per cent.}$$

A further loss has to be debited to the fan on account of the energy taken by the motor, and from Table D it is found that the power taken to produce the draught of 1·04 in. is just under 8·1 kw. for the two boilers, or for one hour, 8·1 kw.-hours is the energy used. Assuming the coal equivalent as 4 lb. per kw.-hour, the fan takes 32·4 lbs. of coal for the combustion of 2,464 lbs., or 1·31 per cent. of the total. However, this loss is taken into account later in the running charges, and need not be further considered here.

Now, taking the case of a natural draught chimney with the same temperature of gases at the inlet as in the fan intake just mentioned, and allowing 5 per cent. for loss of pressure in friction, the theoretical draught pressure to be produced is 1·1 inches of water, hence the height of chimney required is:—

$$H=\frac{P}{7{\cdot}6\left(\frac{1}{T_2}-\frac{1}{T_1}\right)}=186 \text{ feet,}$$

where T_1 is the mean temperature of the internal gases, and T_2 the temperature of the atmosphere, both expressed in absolute

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degrees Fahrenheit, and this will give the same heat loss in chimney gases as the fan plant.

The volume of gas discharged is :—

$$\frac{2,464 \times 18 \times 12{\cdot}5 \times 899}{60 \times 60 \times 492} \text{ cu. ft. per sec.} = 282 \text{ cu. ft. per sec.}$$

allowing 18 lbs. of air per lb. of coal.

The area of chimney to deal with this volume at 10 ft. per sec. is 28·2 sq. ft., or for a circular section, the internal diameter must be 6 ft.

The author continued :—.

In connection with the temperature of the gases leaving the boiler, it is to be noted that no air-heater or economiser was in use with the fan system, though the reduction of temperature in that way would have been an entire gain. With natural draught, on the other hand, the temperature could not be reduced on account of the necessity of maintaining the draught pressure. The advantages of an economiser by way of reduced flue gas temperature are principally obtained when the plant is worked below the normal full-load capacity of the chimney; at such a time the economiser takes up heat in a useful way, so that the boiler and furnace may be worked at a relatively high and efficient temperature, while the chimney has a relatively lower temperature corresponding to the smaller draught pressure required. As a source of hot feed water in preference to cold for the benefit of the boilers, an economiser is, of course, equally advantageous to both natural and induced draught plant. The limit to the reduction of gas temperature in fan plant is set by the cost of installation and maintenance of heaters for air and water supply to the boilers, and up to the present time it seems questionable economy to carry the reduction lower than about 350° F. This leaves a considerable margin for improvement down to the ideal limit of the atmosphere. For example, if a temperature of 300° F. is obtained, the heat losses become, in the instance considered, 8·5 per cent., which, with the addition of 1·3 per cent. for fan power, makes the total loss in question 9·8 per cent. only

In the design of a power station, the space occupied by different types of plant is an important consideration, and more particularly so in the boiler-room, because, in consequence of the use of high-speed electric generating machinery concentrating large power units in a small space in the engine-room, there has grown a corresponding difficulty in so laying out the steam-raising units as to keep the steam ranges reasonably short, simple, and safe. Hence the advantages to be obtained by making the most of available space in connection with flues and draught plant are worthy of consideration for reasons other than and in addition to those associated with the ordinary economy of space in general. The fan plant, whose working has been referred to above, is illustrated in the sketches given in Figs. 2 and 3. On account of the lightness of structure, consisting

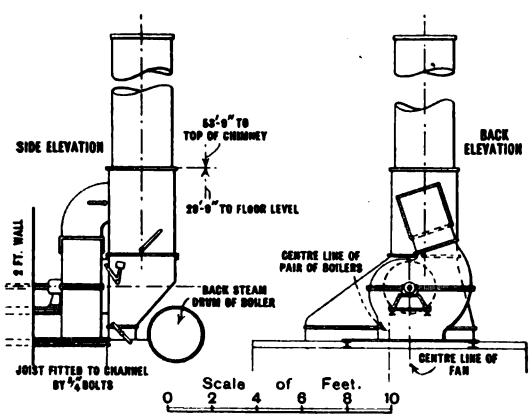

FIG. 2.—ARRANGEMENT OF FAN AND CHIMNEY. (CAPACITY : 45,000 CU. FT. PER MIN. AGAINST 2½ MINS. WATER PRESSURE.)

largely as it does of thin steel plates rivetted or bolted together, the plant is very conveniently placed so as to occupy no floor space at all, and this has proved to be an entirely suitable and thoroughly practical arrangement.

The passage from the final pass of the boiler rises vertically into the base of the chimney, so that when working on natural draught for light load, the full benefit of the chimney draught is obtained without any baffling at sharp bends and angles. Four dampers of the "butterfly" or "swing" type control the passage of the gases, so that either "fan" or "natural" draught can be put into service in a minute or two, for either or both boilers. The fan housing is carried on a half-inch steel plate bolted to two joists, which in turn are supported by the wall at one end and a steel channel, a member of the boiler framing, at the other end. The weight of the fan and motor is about 3 tons, and of the chimney, 4 ft. 6 in. diameter internally, of $\frac{3}{8}$ in. steel plate, is a little over 2½ tons; say 6 tons in all. The chimney top, 80 ft. above grate level, has a steel ring rivetted round, and to this four steel guy ropes are attached to stay the stack. The motor is carried on two steel joists embedded in the engine-room wall, in such a way that the weight of the fan is partially balanced against that of the motor on the remote side of the wall. The motor has the advantage of being in the cleaner atmosphere of the engine-room, and one of an open type

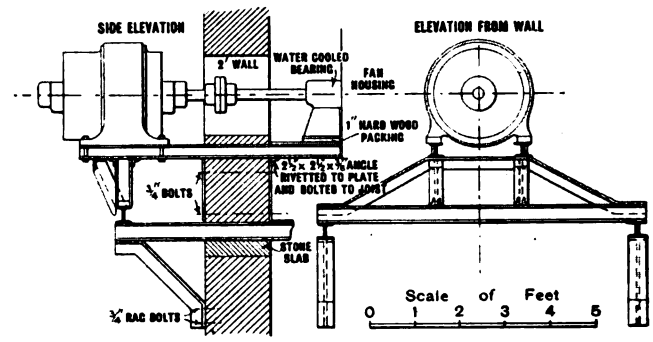

FIG. 3.—METHOD OF SUPPORT ADOPTED FOR THE FAN AND MOTOR AND FAN BEARING. (FAN MOTOR 35 B.H.P., 300/600 R.P.M.)

is used with its attendant advantages over the more or less enclosed type, which would be advisable in the presence of the more dusty atmosphere of the boiler-room. The tendency to vibration, liable to be set up when the fan runs at its higher speeds, is overcome satisfactorily by bracing the joists together, as shown in Fig. 3. Access for inspection is obtained by means of a light vertical wrought-iron ladder, attached to the wall, and a wood platform erected at a suitable height round the motor. The motor starter and speed regulator are placed at a convenient position for working from the engine-room floor.

The ground space occupied by a brick chimney of circular section is the area of a circle whose diameter is from one-twelfth to one-tenth of its height, as a rule, so that in the case of the example under present consideration, for a height of 186 ft. the external diameter at the base will not be less than 16 ft., and the area 201 sq. ft. The floor space occupied by the two boilers and stokers is 20·5 x 25 = 512·5 sq. ft., so that the chimney space is 39 per cent. of the boiler space. This ratio is reduced somewhat when a larger number of boilers is served by one chimney, but it is always a considerable proportion.

The weight of a brick chimney 186 ft. high, 6 ft. internal diameter, and 16 ft. external diameter at the base, is over 800 tons, exclusive of foundations, which would require to be very large and on good solid ground.

If the site were near a river, such as is frequently selected in order to obtain ample water supply, the ground would be liable to be of a marshy and unstable nature, necessitating an extensive system of piles to support the foundation.

A lighter structure is obtained if the chimney be built of steel, but the ground space occupied will be practically the same as with brick, for the lower portion must be well splayed out to give the necessary stability; and a firebrick lining is required for this as well as for the brick chimney. Reinforced concrete without any lining is in use in America for this purpose, but in this country there does not seem to be any example of this type of structure for chimneys, because, apparently, it is not definitely settled that the material will be reliable permanently, when subjected to temperatures of 800° F. and 900° F., for there is no doubt that cheap and light construction can be obtained by its use.

Unless the scheme is a very large one, it is the usual practice to erect only one natural draught chimney, in order to minimise capital expenditure, and one main flue, with by-pass if economisers are installed, consequently, the dimensions of the draught plant must be of sufficient magnitude to cope with such boiler extensions as are expected for some time to come.

For induced draught it is generally more suitable to install two, three, or more fans, each serving a boiler or group of boilers, and connected together through cross-flues so that any fan may do duty for any group of boilers. Fig. 4 shows the elevation and plan of a portion of the induced-draught plant at the generating station of the Sheffield Corporation tramways. Here the boilers and flues are divided into three sections, by two section dampers, which in the ordinary way are kept shut, so that each pair of boilers is served by its own fan or fans. This arrangement allows for the capital cost of the draught plant being incurred in proportion to the evaporative capacity of the boilers installed, contrary to the conditions which obtain with the natural draught chimney, and demand a considerable capital expenditure, whose full value is not made use of for perhaps some years.

The extreme reliability of a brick chimney is a very grea'

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point in its favour, "there is nothing to go wrong. However, there are cases where cracks have developed in the brickwork and necessitated strengthening by clipping steel rings round the structure to prevent the fissures spreading and causing collapse. Further, with the important exception of loss of heat in the gases, the running costs are entirely contained in the charges for flue cleaning and pointing the brickwork at long intervals dependent on individual and local conditions. The reliability of a chimney is only to be equalled by installing two or more fans. As the fan is more reliable than the motor or engine which drives it, a considerable degree of reliability is obtained at less expense than by a complete duplicate plant, by arranging one fan so that it can be driven from either one of two sources of power, as, for example, in the generating station of the South Metropolitan Electric Light & Power Co., East Greenwich, where a large fan is direct-driven by a motor, which can be uncoupled if required, and the drive be taken by a steam engine, through chain gearing. In Fig. 4, No. 5 fan is driven directly by a high-speed steam engine, so that draught is obtainable when the main generating plant is not running. The other three fans are driven directly by variable-speed electric motors supplied by different mains from the station bus-bars.

Under working conditions when the demand for steam is variable, the natural draught chimney must be kept hotter than is necessary for the average demand, and the excess draught pressure is throttled by the main damper when the demand is slack. When the load comes on, the damper is opened wide to use the full temperature of the chimney to rouse the fires and obtain the more rapid fuel combustion now required. If a considerable "peak" load is anticipated, this must be done a few minutes in advance to obviate a temporary drop in steam pressure, which would otherwise follow. In fact, it is only on a fairly uniform steam demand that a natural draught chimney can be worked at the efficiency for which it is designed, and the more "peaks" the average demand has, the more will the chimney digress from its best efficiency on this account. Rapid variations of load taking place within two or three minutes, as a tramway traction load, will not have this effect so long as the mean load keeps fairly uniform. The boilers will have sufficient capacity to deal with the changes for so short a time, and the effect on the fuel consumption will be an average one, unaltered until the change is so great as to be beyond the water space capacity of the boilers between the limits of high and low water level.

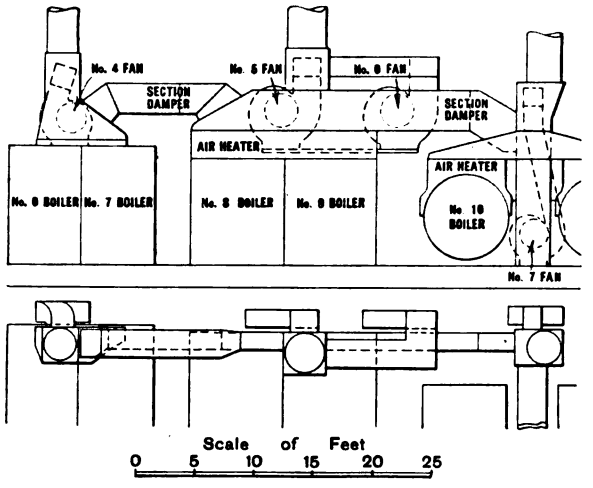

FIG. 4.—FANS AND FLUES.

With fan draught, coal combustion, and steam production in consequence, are under more instant control, the increased draught required to meet a sudden demand being obtainable at a moment's notice, by increasing the speed of the fan; and when the demand is unexpected, it is much more readily met than by the more gradual process of raising the temperature of the chimney gases. Similarly when the load declines rapidly, the fan can be more quickly and efficiently adjusted to the changed conditions, for the heat of the natural draught chimney must be allowed to waste in the process of cooling off.

The costs of the two systems can only be compared very roughly in general, but as they differ very materially in this respect, even an approximation will serve to indicate the contrasts between them, and show under what conditions each is likely to be at its best. Taking the case of fan plant and chimney (brick) of the dimensions previously used in this comparison, the approximate values of the different charges will be somewhat as follows in Table E:—

Table E.

Charges.	Natural draught chimney.		Induced draught plant.	
(*a*) Capital	say £1,000		say £300.	
(*b*) Interest and Sinking Fund	at 6%	£60	at 6%	£18
(*c*) Depreciation	at 2½%	£25	at 5%	£15
(*d*) Maintenance	at ½%	£5	at 1%	£3
(*e*) Power charges: ¼d. per kw. hr., 8·1 kw. for 365 days)	Nil		(i) 20 hrs. per day	£123
			(ii) 10 ,, ,,	£61·5
			(iii) 5 ,, ,,	£30·8
			(iv) 2½ ,, ,,	£15·4
Total annual cost...		£90	(i) 20 hrs. per day	£159
			(ii) 10 ,, ,,	£97·5
			(iii) 5 ,, ,,	£66·8
			(iv) 2½ ,, ,,	£51·4

In this particular example the total annual costs of the two systems are equal for an average daily service of about 9 hours; for longer service than this the chimney would be cheaper, for shorter service the fan would be so.

It is assumed so far that the chimney is worked with the same flue gas temperature as the fan is, *i.e.*, 439° F., but if the temperature were allowed to exceed this in the chimney by 35° F., making the temperature 474° F., then the extra loss in the gases, namely, 1·3 per cent. of the total furnace energy available, would cancel the power required to drive the fan, and the comparison of the costs would be made between the standing charges (*b*) and (*c*), resulting considerably in favour of the fan plant.

From the foregoing considerations it is to be concluded in general that if a natural draught chimney is to be as economical as an induced draught plant, it is essential that the temperature of the gases entering the former should be kept as low as in the latter, and then the load factor of the plant must be taken into consideration; a high value for this being favourable to the chimney and a low one to the fan. Table D shows that with a fan a very considerable increase above the normal draught pressure is obtainable when desired, up to 2·8 in. of water in the present instance. With the natural draught chimney of the given height, about 1·5 in. is the practical limit, and that with great loss of efficiency; as shown by curve C, the chimney temperature required would be about 750° F.

It is not economical to run a fan for long periods at a greater speed than that for which it is designed, because the power taken is increased in proportion to the cube of the speed when dealing with gas at a constant temperature, whereas the volume of gas discharged is only increased in proportion to the speed. With this limitation, the great draught capacity attainable by a fan is of use at times when shortness of boiler power has to be met, and by its help coal consumption may be increased to 30 or 40 per cent. above the normal rate, and evaporation in nearly the same proportion. If coal consumption is forced beyond 35 or 40 lbs. per sq. ft. of grate area with mechanical stokers, there is considerable risk of parts of the mechanism being damaged by over heating, the back ends of moving bars and the surfaces of chain gates, and air seals of the latter, if metallic, being the principal parts to suffer. However, the draught required to produce this rate of combustion with any but the best coal is usually 2 in. or over, and the most efficient evaporative results are obtained below this limit, so that it is very exceptional that risk need be incurred in this direction.

Further, this property of the fan makes its application very suitable for burning cheap small fuels which generally require strong draught, over one inch water pressure for combustion, to take place rapidly enough to make good use of the grate area. The question of advantages connected with the burning of cheap fuels was thoroughly gone into in two Papers read before this Institution on November 23rd, 1899, namely, "The Cost of Steam Raising," by John Holliday, and "Influence of Cheap Fuels on the Cost of Electrical Energy," by R. E. Crompton. Curves A_1, A_2, show that for burning this class of fuel, chimneys of less than 180 ft. high must be very inefficient compared to a suitable induced draught plant.

It is frequently quoted that with mechanical draught a smaller excess supply of air than that demanded by theory, is required, than with natural draught. In all probability this arises from the fact that natural draught pressures are as a rule considerably lower than those mechanically produced, and fires are worked with less thickness with the former, so that such a thorough and uniform mixing of the coal and air does not take place, as with the greater pressure and thicker fires of the latter. But if the conditions are equal in respect of draught pressure

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and thickness of fires there is no reason that a larger air supply is required with one system than with the other

It is of more importance that attention be given to the regulation of a fan when load is going off than to a natural draught system in the same case, because the latter is to a considerable degree automatic, the former is not. At such a time, in any case, the coal feed is slackened off, and even if the damper regulation with natural draught is neglected the resultant flue gases are cooler and reduce the draught pressure so that the proper value is attained eventually, though less rapidly and efficiently than if the damper were regulated to assist. In the same circumstances a fan left running at too high a speed for the lighter load, with the coal feed reduced, causes the back portion of the grate to burn bare, with the exception of the thin covering of clinker and ash, through which excess cold air is admitted and the steam generation is reduced by loss of furnace efficiency. Meanwhile the power taken by the fan remains the same as when more evaporation was taking place, so that a double loss is being incurred. Hence it is essential for the economical working of a fan plant on a varying load that both the draught and coal feed be adjusted to suit the demand, and the limiting conditions are, on the one side, that the coal shall not be completely burnt before it reaches within a few inches of the back of the grate, and on the other side that no unconsumed fuel shall fall into the ashpit. The corresponding adjustments for a rising load with either system of draught, if not promptly attended to, draw attention to themselves in an immediate and insistent manner by a falling off in steam pressure.

For reducing the temperature of gases leaving the boiler the Ellis and Eaves air-heating system for supplying the furnaces with hot air is one which is frequently used in conjunction with induced draught plant. The air supply is heated either inside long horizontal tubes round which the flue gases pass, or outside shorter vertical tubes with the flue gases conducted inside. In the latter arrangement the close contact required between the tubes and the air to be heated is obtained by fixing over the tubes near the air inlet a diaphragm plate with holes about ½ in. larger than the outside diameter of the tubes, which are centrally disposed in the holes so that the air enters the annular openings adjacent to the tube surfaces and is effectively heated. Suitable vertical baffle plates are also fitted to obtain a good distribution of air over the heating surface. As an example of the kind of result obtainable with short vertical type air-heaters the three following sets of figures are extracted from tests on a 10 ft. by 10 ft. double furnace marine boiler thus equipped, and with no other heater or economiser in the flues, so the value of the air-heater may be estimated when it is understood that the temperature of the flue gases in the smoke-boxes, upon the top of which the air-heaters were fitted, is usually over 600° F.

Method of firing.	Draught pressure.	Coal consumed per sq. ft. grate area.	Temperature of flue gases leaving air-heater.
Hand	2 ins. (approx.)	30·5	404° F.
Hand	,, ,,	33·1	335° F.
Mechanical ...	,, ,,	40·5	499° F.

Briefly, the advantages of induced draught are :—

(1) Greater efficiency obtainable, by lower temperature of flue gases.

(2) More suitable for burning cheap fuel on account of greater draught pressure obtainable.

(3) Coal combustion can be largely increased at times of emergency, allowing less spare plant to be installed.

(4) Greater facility and efficiency in suiting draught to variations of load.

THE QUARTZ MERCURY VAPOUR LAMP

SOME particulars of the quartz mercury-vapour lamp were published in ELECTRICAL ENGINEERING, Vol. II., p. 549. We are now able to give some further details as to the actual construction. The quartz lamp is a mercury-vapour lamp in which the arc is surrounded by a transparent quartz tube from 3 to 6 in. in length. At the ends of the tube quartz receptacles are placed which contain the mercury electrodes. These receptacles are surrounded by fan-shaped coolers of copper, by means of which the heat radiation and the value of the current are regulated. The burner is attached to a metal plate, *A*, which carries a reflector placed above the light tube. By means of the pivots placed at the end of the metal plate the burner is attached to the supports provided in the lower part of the lamp casing, so that it can turn. An operating rod, *U*, which is suspended from the upper part of the lamp, is allowed to hang down through the loop *Y* attached to the metal plate. A shunt-wound magnet, *Q*, is placed in the centre part of the lamp casing, and the previously-mentioned operating rod, *U*, is attached to the armature arm of this magnet. On the plate above the electro-magnet, *Q*, a cylindrical choking coil, *L*, is placed, surrounded by a rheotan resistance, *M*. Around this latter six iron resistances, *H*, enclosed in air-tight glass cylinders, are fixed, these resistances being connected in parallel with one another, but in series with the rheotan resistance, the choking coil and the burner, whereas the shunt-wound magnet, *Q*, is connected in parallel with the burner. The choking coil *L* serves to prevent the lamp from being extinguished should the voltage fall suddenly. At its lower end it carries an iron piece, *N*, projecting sideways, which is placed opposite to a small movable iron piece, *O*. This iron piece lies in the circuit of the shunt-wound magnet, *Q*, and breaks the same at *P* as soon as it is drawn up from the iron piece, *N*, by the choking coil. When the lamp is switched in, no current passes through the burner itself, owing to the fact that there is no connection between the mercury electrodes, the current passing instead through the electro-magnet, *Q*, connected in parallel with it. This latter draws up the armature, *R*, and, by means of the operating rod, *U*, tilts the burner on its axis, so that the mercury can flow from the positive to the negative electrode receptacle. The current now set up magnetises the choking coil, *L*, which immediately attracts the iron piece, *O*, and consequently interrupts the circuit of the shunt-wound magnet, *Q*. The latter, therefore, releases its armature, *R*, the burner returns again to its former position of rest, and an arc is now formed in the light tube as the mercury flows back from the negative to the positive receptacle. Shortly after ignition, the burner only absorbs approximately 30 volts, and, therefore, gives very little light. Its full voltage (85/90 volts for 110-volt lamps, 165/185 volts for 220-volt lamps) is first attained when the electrode receptacles are thoroughly warmed, and the full brilliancy is reached at the same time. The warming of the electrode receptacles and the increase in brilliancy will take place more rapidly the higher the current is, as the latter will flow through the burner from the beginning. On this account iron resistances are connected in series with the burner, and are enclosed in air-tight glass covers in order to allow a high current to flow through them as long as the burner voltage remains low. During this period these resistance glass covers will become noticeably hot, should any resistance fail to exhibit this feature or remain cold after the lamp has been switched in, this is a sign that it is burnt out, and must be replaced; if this is not done the starting current will be too low, and a considerable time will elapse before the burner is sufficiently warm; it will also take a very long time for the latter to reach its full brilliancy, or it may entirely fail to do so. Only the lamps for 3·5 amps. 220 volts and 4 amps. 120 volts are provided with iron resistances; for the 2·5 amps. 220-volt lamp they are not necessary.

The rheotan resistance, *M*, is provided with a sliding contact, *K*; if this is moved upwards, the resistance is increased and the burner voltage will be reduced. The lamps may, therefore, be used without further alteration for high pressures (up to 220 volts for 120-volt lamps), if the sliding contact of the rheotan resistance is moved to its highest point. In installations in which large voltage variations take place, all resistances must be placed in series, that is to say, the sliding contact must be moved to its highest point, otherwise the lamps may be extinguished if the voltage falls suddenly. The current in the lamp is dependent solely upon the cooling of the electrode receptacles: it rises if the lamp is allowed to burn without a globe, or if globes or burners which are intended for indoor use are used in the open air, on account of the fact that the metal cooler will be surrounded by colder air. Higher currents, however, bring with them the danger of the softening of the quartz tube; for this reason the lamps should never be allowed to burn without globes or with broken globes. Burners required for use without globes for special purposes must be specially constructed.

When connecting up the lamps care must be taken that the correct polarity is observed. A strong flickering of the light which does not entirely disappear a few minutes after the lamp has been switched in, is usually a sign that the latter is burning with the current reversed, or that the burner has not entirely returned to its original position of rest, and, therefore,

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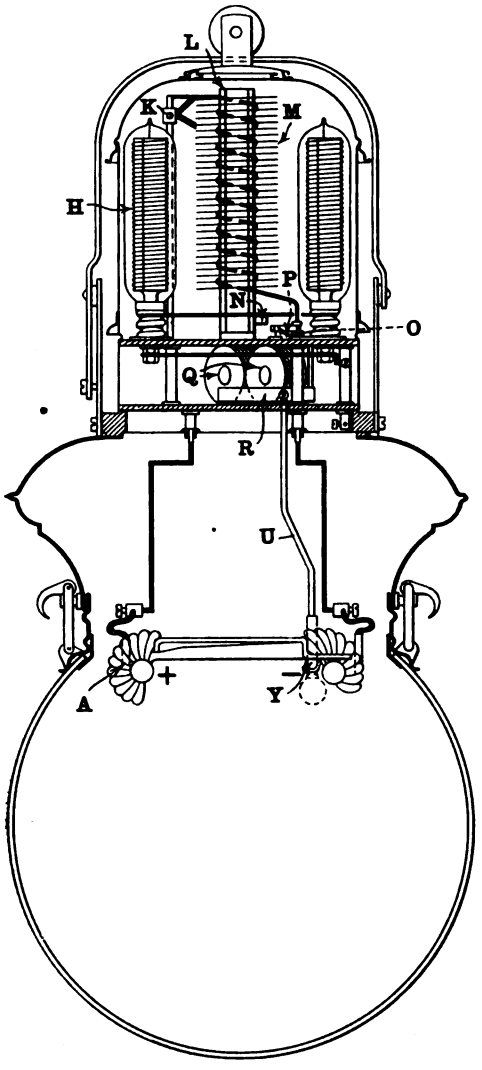
the electrode receptacles are not lying in a horizontal position. The light tube of the burner should not be touched with the fingers, as the moisture of the skin attacks quartz as soon as it is warm. It then plainly shows the impressions of the fingers, which cannot be removed. Should the light tube be accidentally touched with the fingers, it must be cleaned with a rag dipped in alcohol or spirit.

The light given by the quartz lamp is exceedingly rich in the ultra-violet rays, which will cause inflammation of the skin, and particularly in the eyes, even if only exposed for a few seconds; their influence, however, makes itself first felt after several hours through intense pain in the eyes, and by a noticeable reddening of the skin. Spectacles are not sufficient to



SECTION OF QUARTZ MERCURY-VAPOUR LAMP.

protect the eyes unless they have side glasses to prevent the entrance of the rays. On this account quartz lamps should never be allowed to burn without glass globes which entirely absorb the ultra-violet rays. These rays possess insect-killing properties, and are found to destroy all flies, moths, mosquitos, &c., coming within their range. When used for the above purpose, however, the lamps are supplied with a different form of globe. The colour of the light emitted is rather less bluish than the light of the ordinary mercury-vapour lamp, but is nevertheless far from pleasant. The lamp is manufactured by the Allgemeine Elektricitäts Gesellschaft, of Berlin, and further particulars can be obtained from their London representatives, the Electrical Co., Ltd. The lamp is, however, not yet on the London market, but we understand that it is supplied by the A.E.G. Co., of South Africa, for the Colonial market.

Electrical Football League.—The following matches take place next Saturday in the above League:—Metropolitan Electric v. St. James' Electric, at Willesden; Ediswan v. General Electric Co., at Wormholt Farm (No. 8 pitch); St. Pancras Electric v. County of London E., at Swain's Lane, Highgate. The kick-off is at 2.45 in each case.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

ARC LAMPS.—A carefully arranged and well illustrated catalogue is to hand from the Electric & Ordnance Accessories Co., Ltd., of Cheston Road, Aston, Birmingham, in which the various patterns of arc lamps manufactured by this firm are described. Ordinary and inverted enclosed lamps, miniature lamps for indoor and outdoor use, flame-arc lamps, and accessories of all kinds are listed. A useful feature of the catalogue is the series of instructions for fixing and running the various patterns of lamps, all of which are illustrated with diagrammatic sketches showing the connections necessary. The mechanism of the lamps is also described and illustrated. Among the accessories is the new "Victor" clutch, a description of which was given in our second Manchester Exhibition Supplement.

BRUSHES.—Messrs. J. & H. Grevener, of Eldon Street House, London, E.C., have issued a new price list of metal and carbon dynamo and motor brushes. It contains a large range of sizes and detailed directions both for ordering the brushes and for using them.

COAL CRUSHERS.—A pamphlet from the Pennsylvania Crusher Co., of Philadelphia, U.S.A., describes a number of patterns of hammer crushers and coal cleaners for crushing and sorting coal for coking ovens. Magnetic separators and rotary crushers are also described.

ELECTRICAL SUPPLIES.—A stiff board cover has just been issued by the British Westinghouse Electric and Manufacturing Co., Ltd., of Trafford Park, Manchester, in which are filed over forty leaflets, dealing with electrical apparatus and accessories of all kinds. Most of these leaflets have been issued during the present year, and therefore the catalogue is quite up-to-date. A classified list of apparatus and an index to the catalogue numbers is provided for convenience in ordering. The most recent additions are leaflets dealing with the Westinghouse-Bremer flame-arc lamps and accessories, and continuous and alternating-current enclosed arc lamps. The other lists have been mentioned in our columns from time to time, and concern metal filament lamps, fittings, small motors and controlling gear, switchgear, heating apparatus, transformers, instruments, telephones, and various other electrical supplies and accessories.

ELECTRIC HEATERS.—A neat little card is to hand from the Electric & Ordnance Accessories Co., Ltd., of Cheston Road, Aston, Birmingham, on which are illustrated six patterns of electric heaters, including two glow-lamp radiators. One of the latter has a metal network screen to protect the lamps. Consumption and prices of the various patterns are given on the card.

MOTOR-CAR ACCESSORIES.—A new catalogue of motor-car accessories has just been published by Messrs. Siemens Brothers & Co., Ltd. The first half of this catalogue deals with ignition apparatus, including low-tension magnetos, ignition coils, with a new patent interrupter, sparking plugs, accumulators, and the Siemens-Obach dry cells. Pocket ammeters and voltmeters, pole indicators, and a "capacimeter," which is really a low-resistance voltmeter for indicating the terminal voltage of the battery under working conditions, are also listed. Among the items included in the second half are charging sets, speed indicators on the voltmeter principle, electric horns, switches, hand lamps, motor-car lamps, communicators for indicating to the driver the desired speed or other information, and, lastly, low- and high-tension leads for the ignition circuits. Messrs. Siemens Brothers & Co. showed examples of nearly all the above at the recent Motor Exhibition at Olympia

SINGLE-PHASE MOTORS.—Two card leaflets from the British department of the Maschinenfabrik Oerlikon, Oswald-estre House, Norfolk Street, Strand, give particulars and prices of squirrel-cage and slip-ring single-phase motors respectively. The first-named are built for outputs ranging from $\frac{1}{3}$ to 5 h.p., and the slip-ring motors for outputs up to 50 h.p. The figures refer to 50-cycle motors for any pressures up to 250 volts. Complete particulars as to weights are given, and information relating to the necessary accessories is also included.

TELEPHONE APPARATUS.—A pamphlet is to hand from the British Insulated and Helsby Cables, Ltd., of Prescot, Lancashire, in which a new piece of apparatus, termed the "Phantophone," and permitting the application of telephones to existing telegraph and signalling circuits of relatively short length, is described. The instrument is made in three distinct patterns to suit the following three typical sets of conditions:—(*a*) The connection of a telephone circuit to a single line telegraph or block signalling circuit; (*b*) The connection of a telephone circuit across two single wire telegraph or block signalling circuits, each of the latter being worked independently, while the telephone circuit forms a metallic loop; (*c*) the connection of an earthed telegraph circuit to a metallic loop telephone circuit. In the first case the phantophone is joined directly to the line at each end, and an impedance coil is connected in the line circuit at each end to reduce the tendency to interference with the phantophone. In the third case, the telegraph current is

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divided at each end through a differential impedance coil, which is so wound that it is ineffective inductively to the telegraph currents, but offers great impedance to the telephone currents. Further particulars and prices of the above instruments and accessories are given in the pamphlet. Another pamphlet from the same firm relates to self-sealing condensers for telegraph and telephone circuits, made under the Mansbridge Patents. The stock sizes have capacities ranging between 0·05 and 3 microfarads; the approximate weight of the largest, namely, 3 microfarad capacity, is 14 oz.

WIRING ACCESSORIES.—We have received from Messrs. Johnson & Phillips, Ltd., a leaflet describing various patterns of cut-out boards, switches, lamp-holders, wall-plugs, ceiling-roses, and other fittings. Each article is well illustrated, so that its chief features can be seen, and full particulars and prices are given. Messrs. Johnson & Phillips ask us to state that they will send this list to anyone interested who applies to them, mentioning ELECTRICAL ENGINEERING. Another leaflet from the same firm relates to searchlight projectors of different sizes, taking from 10 to 80 amperes continuous current.

LONDON ELECTRIC POWER BILLS

London and District Bill Rejected.

At the conclusion of Mr. J. D. Fitzgerald's speech in reply to the opposition to the London and District Electricity Supply Bill on Wednesday last week, the Chairman, after a brief adjournment, announced that the Committee were unanimously of the opinion that the preamble of the Bill was not proved.

London Electric Supply Bill.

The consideration of this Bill was commenced on Thursday morning. Mr. Balfour Browne, K.C., who appeared with Mr. C. C. Hutchinson and Mr. Tyldesley Jones for the eight companies, stated the objects of the Bill, which are to give authority for linking up the power stations and undertakings of the promoting companies, and to authorise the supply of electrical energy to railways, tramways, canals, docks, &c., even if such energy is not to be used within the area of either of the companies in question. The companies concerned in the promotion are Charing Cross, West-End & City Electricity Supply Co., Metropolitan Electric Supply Co., London Electric Supply Corporation, Chelsea Electricity Supply Co., Brompton & Kensington Electricity Supply Co., South Metropolitan Electric Light & Power Co., London Electric Lighting Co., and the County of London Electric Supply Co.

Evidence in support of the preamble was given by Mr. J. B. Braithwaite, Chairman of the County of London Electric Supply Co.; Mr. C. P. Sparks, engineer to the company; and Mr. J. S. Highfield, the engineer to the Metropolitan Electric Supply Co. There was very little opposition on the preamble of the Bill, but a heated discussion took place at a later period in connection with the various instructions from the House of Commons with regard to the insertion of certain provisions in the Bill, which were not proposed by the promoters. So rapidly was the preamble disposed of that the representatives of the City Corporation and the Westminster City Council were quite taken aback when the Chairman announced that the preamble was found proved. Mr. Rigg, K.C. for the former, and Mr. Blennerhassett, K.C. for the latter, immediately asked to be allowed to give evidence against the preamble, but, having given his decision, the Chairman refused. The special case of Southwark, however, had previously been heard. In Southwark, as has been pointed out very many times during these proceedings, there are two companies and a local authority in competition, and the Borough Council is fearful lest the two companies should link up their two systems, and thus, instead of there being competition between the two companies as well as the Council, there would be competition only between one much stronger company and the Council, to the detriment of the latter. Mr. Vesey Knox, K.C., for the Southwark Borough Council, had asked that in the event of any agreement between the two companies for a supply, the Borough Council should be brought into that agreement and given the option of taking a supply in bulk from the company's undertaking upon the same terms. He also asked that a provision should be inserted in the Bill preventing anything more than the distribution mains of one of the competing companies being taken over by the other, in the process of consolidation which is anticipated in the Bill. His arguments, however, had no effect upon the Committee, and, as stated above, the preamble was found proved.

The Committee then went into the consideration of the clauses, first of all in relation to the instructions from the House of Commons. It will be remembered that one instruction was to the effect that purchase powers on the part of the London County Council should be inserted in the Bill, and another that linking-up powers should be conferred upon the local authorities of London under the Bill.

Mr. G. M. FREEMAN, K.C., for the London County Council, stated that he entirely supported the instruction, he understanding it to mean that the London County Council should be substituted as the purchasing authority for the local authorities, and should be able to purchase all the companies' undertakings in 1931 upon equitable terms. During a very long discussion upon this instruction, it was made clear that the London County Council will have no powers of purchase over the Borough Councils' electricity undertakings, and that operations with regard to the companies will be entirely confined to the county of London.

The special cases of the City of London and the Camberwell Borough Council were the cause of considerable discussion, which almost at one time resulted in the promoters withdrawing the Bill. The City of London Corporation has powers to purchase portions of the undertakings of the City of London Electric Lighting Co. and the Charing Cross, West End & City Electricity Supply Co. before 1931, and strong objection was taken to being deprived of these powers. The same point was argued on behalf of the Camberwell Borough Council, which has powers to purchase that portion of the County of London Electric Supply Co.'s undertaking relating to Camberwell at any time upon the payment of £133 for every £100 of capital expenditure in respect of the supply to Camberwell. The Committee, after hearing the arguments, decided that any rights of local authorities to purchase before 1931 must not be interfered with. This did not quite satisfy Mr. Balfour Browne, for the promoters of the Bill. He wanted the position to be created that no purchase could take place with regard to any of the companies until 1931, and then only by the London County Council. The Committee, however, adhered to the decision mentioned above, viz., that no rights of purchase before 1931 shall be interfered with, adding that if in 1931 such local authorities have not exercised their rights of purchase, then the London County Council shall do so in common with the rest of the companies' undertakings.

The Westminster City Council, represented by Mr. Blennerhassett, entered a most emphatic protest against the Chairman interpreting the instruction of the House as a mandatory instruction. Counsel argued that it was purely a permissive instruction, and that to insert it in the Bill would be to negative the whole object of unification of electric supply in London, inasmuch as there was no power for the County Council to buy up the local authorities. The Chairman interrupted that the County Council could purchase the local authorities' undertakings by agreement. Mr. Blennerhassett, however, continued his argument, and stated that to take away the valuable rights which the borough councils now have of purchasing in 1931 was nothing more than confiscation and robbery; it was the most unheard-of thing to introduce such powers in a comparatively small and unimportant private Bill. The Committee by doing so would be altering the public general law of the country, and there was no doubt in his mind that the instruction did not impose upon the committee the responsibility of taking this tremendous step. The London County Council had never asked for the right to purchase, and to transfer these powers without compensating all the borough councils was monstrous. It may be pointed out, however, that with the exception of Westminster, the City Corporation, and Camberwell, there was no opposition on the part of the borough councils to the London County Council being constituted the purchasing authority in their stead. In fact, the two latter do not oppose the County Council purchasing in 1931, and impression was rather given that the borough councils generally will be only too pleased to be relieved of their powers in this respect. A further special case arises in Southwark, however, in which the possibility of the London County Council, in possession of the two companies' undertakings, would be competing with the borough councils' undertaking. This was pointed out to the Committee, and Mr. Vesey Knox suggested, as a way out of this anomalous position, that when the County Council purchases the two companies who now supply in Southwark, they should also purchase the undertaking of the Southwark Borough Council. In spite of all these arguments, however, the Chairman insisted upon a literal interpretation of the instruction, and inserted in the Bill the bare statement that the London County Council shall be entitled to purchase the electric supply company of London in 1931 upon equitable terms.

When the Committee met on Friday, Mr. Balfour Browne, for the companies, put it to the Committee that the decision of the previous day, that the existing special rights of purchase in the case of the City of London Corporation and the Camberwell Borough Council should not be interfered with, created a serious difficulty. It is the avowed desire of the companies, under the new purchase conditions, to have all their undertakings pur-

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chased in 1931 by the London County Council, thus enabling them to be consolidated into one undertaking. If the special rights of the City and Camberwell were preserved, it was argued that consolidation would be impossible, if they were to purchase their respective undertakings prior to 1931. Mr. Balfour Browne therefore asked the Committee to say that the existing rights in these two special cases should be nullified. This proposition was at once most strenuously opposed both by the City Corporation and the Camberwell Council, represented by Mr. Rigg, K.C., and Mr. Talbot, K.C., both of whom suggested that there was an ulterior motive in this proposal. After a long argument and discussion, the Chairman announced that the Committee was unanimously of the opinion that their decision of the previous day, viz., that any rights of local authorities before 1931 should not be interfered with, must stand.

Mr. BALFOUR BROWNE immediately asked for an adjournment, hinting at the possibility of withdrawing the Bill. Upon this, Mr. H. Lloyd, K.C., asked, on behalf of Marylebone and some other Councils, that such a course of procedure should not be allowed by the Committee; if the present promoters did not wish to proceed, his councils desired to take up the Bill themselves.

The CHAIRMAN, who had Mr. E. Moon, K.C., Speaker's counsel, by his side, queried whether the Bill could be withdrawn, and Mr. Balfour Browne replied that the promoters would consider this also. Consequently it was agreed at 12.30 to adjourn until 2 p.m.

When the Committee met again at 2 o'clock on Friday, Mr. Balfour Browne stated that he had looked up the authorities on the subject of withdrawing the Bill, and after quoting from the standing orders and from the proceedings of the House itself in similar circumstances, said he thought it was quite clear that it would have been competent for him to withdraw the Bill. The Chairman pointed out that there were precedents the other way, and there had been a case in which the opponents of the Bill had been allowed to take it up after the promoters had withdrawn it. One such case, he said, had happened in 1828! Mr. Balfour Browne's reply was that just as many things might happen before 1931, so many things had happened since 1828. Continuing, however, he said he had considered the matter, and although he did not really know the full effect of the decision upon the Bill at the moment, he was not prepared to advise his clients to withdraw the Bill, having regard to the importance of some of its provisions from a public point of view. At the same time, in deciding this, he wished to keep faith with the arrangement made with the Board of Trade, viz., that if the purchase clause did not meet with his approval, he was to have the right to withdraw the Bill. In support of his argument that the special powers of the City and Camberwell should be repealed, he produced a report which had just been issued by the Board of Trade upon the Bills, in which it was stated that the special powers were of comparatively little value, and that it was quite within the Committee's power to repeal them. He wished he had known of this before the adjournment, as he felt that it would have strengthened his case very much. The Chairman interrupted that, as a matter of fact, he knew of the existence of this report before Mr. Balfour Browne's speech, and that the Committee had not seen their way to influence their decision in consequence of it.

Mr. Balfour Browne then brought up a clause stipulating under what conditions the London County Council may purchase. This provided that the County Council should give ten years' notice of its intention to exercise its powers of purchase and that all the companies were to be purchased, and not only some of them. The clause carried out the ruling of the Chairman with regard to the preservation of any existing rights of purchase before 1931, and further laid down that the purchase price for the undertakings acquired by the County Council should not be worse terms than those of Section 2 of the Electric Lighting Act of 1881, which are the minimum which the companies can now obtain. If purchase does not take place in 1931, then the County Council may exercise its powers at every subsequent period of ten years. A further clause provided for the borrowing of money by the companies from the London County Council after the notice to purchase has been given, owing to the difficulty which it is felt the companies will experience in raising capital for any new works that may be required during the latter portion of their existence. The money so loaned by the County Council, however, upon which the companies propose to pay interest at the rate of 3½ per cent., would be deducted from the purchase price paid for the undertakings as a whole. One other proposal was made in this connection, consequent upon a remark by the Chairman, namely, that if the City Corporation and the Camberwell Borough Council do not purchase the undertakings over which they have the rights at the specified times in their agreements, a limiting period of ten years should be inserted in the Bill within which these rights should be exercised, otherwise they should cease.

At the close of the reading of these clauses, Mr. Freeman, for the London County Council, asked for an adjournment in order that they might consider them. So far as he had heard them, he said, they seemed to him to be a "monument of misplaced impudence."

This request for an adjournment, which was eventually agreed to by the Committee, was followed up by an application on behalf of the Lambeth Borough Council that its special powers of purchase should be preserved in the clause, in the same way as those of the City and Camberwell.

The discussion upon these clauses having been adjourned until the following Tuesday, Mr. J. D. Fitzgerald, on behalf of the Metropolitan Water Board, proposed a clause providing that in respect of the new mains to be laid under the Bill for linking up the various power stations of the companies, special protection should be given to the mains of the Water Board. He asked that, instead of three days' notice allowed under the general law, seven days should be given; that a plan of proposed works should be handed by the companies to the Water Board; and that no work should be carried out nearer to a water main than 6 ft. without notice being given to the Water Board. Some evidence upon this matter was given in which it was shown that water mains were frequently interfered with by electric lighting and other companies without the knowledge of the Water Board, causing serious inconvenience and loss. The clause was eventually granted, in spite of the very strong opposition of the promoters.

The Chairman further stated, in announcing the adjournment until Tuesday, that a clause was to be inserted in the Bill granting the Borough Councils power to link up in the same way as those given to the companies.

On Tuesday, at the commencement of proceedings, sympathetic reference was made by the Chairman to the death of Sir Ralph Littler, K.C., who has been appearing before the Committee from the commencement as leading counsel for the City Corporation. Sir Ralph, it may be pointed out, was also leader of the Parliamentary Bar. The Chairman was supported by Mr. Balfour Browne, K.C., on behalf of the Parliamentary Bar, and Mr. H. L. Cripps, on behalf of the Society of Parliamentary Agents.

The consideration of the clauses placed before the Committee on Friday, with regard to the purchase of the companies' undertakings by the London County Council, was then continued. Mr. J. B. Braithwaite, chairman of the County of London Electric Supply Co., was called by the promoters, and expressed the opinion that the companies should be granted compensation, above the terms of the Electric Lighting Act of 1888, by reason of agreeing to the L.C.C. as the purchasing authority, inasmuch as in so doing they gave up their right to compensation for severance, in the interests of consolidation. He attached considerable importance to the words "equitable terms" in the instruction, and without these the companies would not have proceeded with the Bill in the face of the instruction. It appears that the instruction on this point was brought forward by the Board of Trade by agreement with the companies, who hope to get something more than the terms of the Electric Lighting Acts under the words "equitable value," in view of the question of severance. Further, it is stated that the companies understood the instruction to mean that any rights of purchase before 1931 should be extinguished. Mr. Braithwaite went so far as to say that the companies may yet withdraw the Bill on this account. Mr. Freeman, who cross-examined Mr. Braithwaite on behalf of the London County Council, soon showed a very considerable difference of opinion between the Council and the companies. The Council wishes Electric Lighting Act terms, without any additions whatever; they oppose the lending of money during the term of notice, and also the giving of ten years' notice. Further, they do not wish to be compelled to purchase the Willesden station of the Metropolitan Electric Supply Co., which is the case under the proposed clause. The further the instruction to the Committee is considered, the more ambiguous does it become, for it seems that the companies, the Committee, and the London County Council are interpreting it in a different way, and the proceedings as a whole rather give the impression that the Bill is one for altering and amending the Electric Lighting Acts.

Whilst the County Council case with regard to the cumulative effect of the companies clause was being placed before the Committee, the Chairman said the Committee was in favour of some notice being given, but not to anything like the extent mentioned, viz., ten years. Also the rate of interest to be paid upon any money lent by the Council should be left to the Board of Trade.

During further discussion upon the clause proposed by the company, and a counter-clause of the L.C.C. outlined above, the L.C.C. agreed that the arbitrator in 1931 should have power to add a sum for the additional value of the companies' undertakings by reason of linking up. In support of the companies' claim for severance, Mr. Balfour Browne pointed out that, even with the L.C.C. as purchasing authority, there must be severance if the powers of purchase before 1931 are exercised. Portions of various undertakings are purchasable in 1927, 1928, 1941, and 1914, and if these powers are exercised by the local authorities as they can be under the Bill, then there must be severance.

During the discussion Mr. Freeman, for the L.C.C., agreed to a condition that money might be lent to the companies during the period of notice, but he objected to an obligation.

Subsequently the Committee passed the scheme of Mr. Balfour Browne's clause, with the alteration of the period of notice

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from ten years to three years. Some of the Committee, as a matter of fact, were in favour of two years' notice. Some drafting amendments were then made in the clause to provide for certain special purchase terms given to the Charing Cross Co. under their order being preserved. The Committee also decided that the County Council should not be compelled to purchase the Willesden station of the Metropolitan Electric Supply Co., it being understood that the company will have to be paid compensation for severance. A request by the City Council of Westminster that the powers of purchase of the L.C.C. over the companies supplying in their district should be suspended until the next Bill is heard was refused.

Yesterday the Committee decided that the L.C.C. should be compelled to lend money to the companies during the three years prior to purchase. It was also decided that the payment to the companies, when they are purchased, should be half in cash and half in stock.

A new clause was proposed by the L.C.C. for inserting in the Bill a maximum charge for power consumers of £6 15s. per kw. of maximum demand per annum, plus 0·33d. per unit, but after discussion it was decided to leave the exact figure for a conference of all the company and municipal electrical engineers in London in order to arrive at an equitable figure.

THE PARLIAMENTARY SESSION OF 1909

PARTICULARS are now available of some of the Bills which will be deposited in Parliament for the session of next year.

The Central London Railway Co. proposes to extend its line to Liverpool Street, commencing by a junction with the existing railway of the company at the Bank and carrying it under Old Broad Street to a point under the Great Eastern Railway near Bishopsgate Street Without.

The North-East London Railway Co. will seek an extension of time granted by its Acts of 1906, 1907, and 1908, which prescribe the period in which a portion of the capital of the company shall be subscribed. The Bill will also include an application for the extension of the time within which a substantial commencement of the works has to be made.

A Bill promoted by the London United Tramways Co. will provide for the maintenance of through routes, bookings, and fares between the company's tramways and other tramways and railways, and will also seek to alter, vary, or repeal the provisions of the Acts, &c., under which the company may be required to sell the portions of its undertaking in Hammersmith to the London County Council. The Bill also provides for running powers over certain of the London County Council lines, with reciprocal running powers on the part of the Council over some of the company's lines. An extension of time is also sought for the compulsory purchase of lands under the company's Act of 1907, and in connection with the construction of the tramways authorised by the Act of 1904.

The West Kent Electric Co., Ltd., will seek to transfer to itself certain powers now vested in the Kent Electric Power Co. conferred by the Bromley Rural District Electric Lighting Order, 1903, together with certain alterations and amendments of the provisions of that order as to compulsory works and purchase, to authorise agreements for supply in bulk, &c.

An extension of time for the purchase of lands and property, &c., and for the completion of works under its Act of 1906 will be sought by the Baker Street and Waterloo Railway Co. Powers will also be sought for the payment of interest out of capital during construction, for the acquisition of additional land for extending station premises at Oxford Circus, the abandonment of certain subways authorised in 1905, &c.

The National Electric Construction Co. are seeking powers to construct the Folkestone, Sandgate, and Hythe tramways upon the overhead trolley system instead of upon the surface-contact system as stipulated; another Bill seeks to vary the terms of the agreement with the Oxford Corporation for the provision of electric tramways.

A Bill will also be deposited for the incorporation of the City of Bath Electric Supply Co., to which the municipal electric supply undertaking of Bath is to be transferred.

Electric Lighting Provisional Orders will be applied for by the Macclesfield Electric Light & Power Co., the Hindhead & District Electric Light Co., Turton Urban District Council, Herne Bay Urban District Council, Cleethorpes Urban District Council, Yorktown & Blackwater Gas Co. (Camberley), Chesham Electric Light & Power Co., Staines Electric Light Syndicate.

The Oldham Corporation will seek powers to construct some additional tramways and use the trackless trolley system, as also will the Liverpool Corporation, Bradford Corporation, Manchester Corporation, and Salford Corporation. The latter also seek powers to supply electricity in adjoining areas. Additional tramways are also sought to be constructed by the Whitworth Urban District Council, Torquay Tramways Co., London County Council, and Gateshead & District Tramways Co.

The Light Railway Commissioners will seek powers to revive the County of Middlesex Light Railway Orders of 1901, 1903, and 1906, in respect of the compulsory purchase of lands.

In a General Powers Bills, the Bradford Corporation and the Cardiff Corporation seek to supply electrical energy in bulk in adjoining areas.

An application will be made to the Light Railway Commissioners for the construction of a light electric railway between Rhyl and Prestatyn.

The reorganisation, rearrangement, and increase of its capital, will be sought in a Bill by the Anglo-Argentine Tramways Co., and the confirmation of an agreement between the British Electric Traction Co. and the Dudley Corporation is proposed in a Bill by the latter. A consolidation Bill by the Bury Corporation deals with all the Corporation's trading undertakings.

The North Metropolitan Electric Power Supply Co. seek an extension of their powers in Hendon, Finchley, Friern Barnet, Hornsey, Walthamstow, Chingford, and Waltham Holy Cross for the supply and distribution of electrical energy; also to supply for traction purposes.

The County of Durham Electric Power Co. seeks the legalisation of agreements between the various Tyneside power companies, &c.

A Bill will be promoted for the revival of the compulsory purchase of lands under the Watford & Edgware Railway Act, 1903, an amendment of the Watford & Edgware Railway Act, 1906, and an extension of time for the completion of works, &c. A similar Bill has been deposited in the name of the Edgware & Hampstead Railway Co. The abandonment of the Southport Lytham Tramroad forms the subject of a Bill. In a general powers Bill by the Wakefield Corporation, the standby clause is included among other provisions relating to the electricity undertaking.

One of the most interesting notices is that by the Postmaster General to empower the Railway and Canal Commission to hear and determine all questions and matters of difference, which by certain indentures relating to the purchase by the Postmaster-General of the plant, property, and assets of the National Telephone Co., Ltd., are referred to arbitration.

Telegraph Traffic.—On November 19th, official notification was issued that telegrams for Honduras, Salvador, Nicaragua, and Costa Rica were subject to censorship, so that it would appear that matters were not quiet politically. An interruption occurred in the landline between Bagdad and Bassorah, and the submarine cable between Medan and Oleleh ceased working on the 21st inst. Telegrams for Kotaradja and Sabang will be sent by telephone from Pangkalanbrandan, or by post from Penang, Medan, or Pandang. The cables between Oran and Tangier and Zanzibar and Mobassa are both interrupted by reason of repairs which are being undertaken.

Improvement of the Load Factor of Central Stations.—The question of improving the load factor of central stations by utilising the energy during the hours of low load for carrying out electrochemical and electrometallurgical processes was discussed at a recent meeting of the American Electrochemical Society. The conclusion was arrived at that for many electrochemical processes, it would not pay to work intermittently or even with a reduced load for certain hours. On the other hand, intermittent working in the case of small electric furnaces, such as will probably soon be used to a large extent in steel works and foundries, would be easily possible. A case was cited of a Swiss steel plant, where energy was supplied at rates below the ordinary power rates, during certain hours, for working the electric furnaces.

Physical Society.—Among the Papers read at the meeting of the Physical Society of London on November 13th, was one by Mr. A. W. Porter, in which the author described the effect of a normal magnetic field upon the impressions made on a photographic plate placed between the terminals between which a sudden discharge is passed. The image of the spark is broadened into a band of nearly constant width, produced by the glowing gas which surrounds the spark itself. The ramifications are not modified by the magnetic field. Figures obtained when the negative terminal is on the sensitive side of the plate vary according to the surrounding gas, but when the positive terminal is on the sensitive side the figures are nearly the same for all gases. At the same meeting Mr. Porter showed an experiment illustrating the fact that when thin wires are covered with a lagging material it is not possible at once to say whether the covering will keep heat in or assist it to escape. There is a critical radius equal to the ratio of the conductivity of the material to the emissivity from its surface which the outer covering must exceed before it begins to act as a lagger. If a thin platinum wire is coated at intervals along its length with glass of about 2 mm. outer radius, and the uncoated portions raised to a temperature of 800° C., the coated portions do not even glow, but remain at about 100° C. A thickness of coating can be obtained which is such as to allow the same escape of heat as from a practically uncoated wire. To illustrate this, two narrow steam-pipes were shown—one coated with a single layer of asbestos paper, the other with a very thick coat. The two were equivalent in their power of preventing escape of heat. An intermediate thickness of coat would have made a worse-lagged pipe than either of them.

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LOCAL NOTES

ACTON: *Charges against Electricity Staff.*—A long and somewhat heated discussion took place at the last meeting of the Council in connection with a number of allegations against the electric lighting staff, it being stated that in some cases men's time was charged to the Council when they were being employed upon private work for certain members of the electric lighting staff. The Electrical Engineer is to be given an opportunity of explaining the charges, and a further meeting of the Electricity Committee is to be held for this purpose.

ABERDEEN: *Tramway Undertaking.*—A concert was held last week in aid of the funds of the Aberdeen Corporation Tramways Social and Athletic Club.

BARNES: *Omnibus Co. and Street Lamps.*—A short while ago an action by the Urban District Council against the London General Omnibus Co. for damages for breaking 18 public lamps by the company's omnibuses was dismissed by the Wandsworth County Court Judge on the ground that as the omnibuses had been licensed by the police authorities the company were not liable for damaging lamp posts, unless it was shown that the drivers were negligent. On appeal Mr. Justice Bingham has reversed this decision, holding that the onus was upon the omnibus company to show that they had used reasonable care to avoid knocking down the posts In the present case, he said, it has been obviously possible to avoid knocking down the posts as it was daylight when the accidents had occurred.

BIRMINGHAM: *Tramways Undertaking.*—The Tramways Committee report that the amount expended upon street widenings to date is £238,353, whereas the amount authorised to be borrowed only amounts to £203,000. The amount spent upon the tramways undertaking including lands, buildings, rolling stock, and overhead equipment, amounts to £587,476, the authorised borrowing powers being £555,000. The Committee recommend the Local Government Board be asked to sanction the borrowing of the following sums:—Street widenings, £35,353; reconstruction of existing tramways, £32,476; and for the Coventry Road, Smallheath, and Bristol Road lines, £24,216.

BLACKPOOL: *Electric Heating.*—Mr. C. Furness, the Borough Electrical Engineer, has been carrying out some experiments upon electric heating and cooking, with the result that he hopes shortly to put a scheme before his committee for hiring out electrical stoves, &c. It is also proposed in this connection to hold an exhibition in Blackpool early next year. Mr. Furness states that a sum of £300 might be taken from the reserve fund for the purpose of providing electric heaters and cookers, which should be let out on hire at about 3s. per quarter.

BRADFORD: *Tramway Receipts.*—For the half-year to September 30th, the Corporation tramways have earned a profit of about £14,600, against £16,400 for the corresponding period of last year. The decrease is attributable to bad trade and the unemployment in the city.

BRAUNTON: *Electricity Supply.*—Messrs. Crompton & Co. are taking up the question of an electrical installation in Braunton. The scheme, if carried through, will include overhead wires. It is probable that a local company will be formed.

BRISTOL: *The Electricity Committee.*—Alderman G. Pearson has again been unanimously elected chairman of the Electricity Committee, and Mr. A. Lloyd, deputy chairman.

BURNLEY: *Tramway Brakes.*—A general meeting of the Burnley Tramwaymen's Brotherhood was held last week, when Mr. H. Mozley, the tramways manager, addressed the men on the Tramway and Light Railway Association's report on tramway brakes.

BURSLEM: *Accident at Electricity Works.*—Whilst a well sinker was being let down a well at the electricity works last week, he was overcome by an accumulation of gases and fell from the sling, a distance of about 50 ft. Owing to the state of the well it was impossible to reach him for many hours, when it was found that he was quite dead.

BURY: *The New Power Station.*—The Local Government Board have written to the Bury Corporation Electricity Committee, expressing their approval of the proposed new electricity works at Chamber Hall, which are to cost close upon £80.000, but ask for fuller details on certain points before sanctioning the borrowing of £72,000 as asked by the Corporation.

Electricity Supply.—The Electrical Engineer has reported that, for the first time in the history of the department, there has been a reduction in the output for lighting. This has been mainly due to the stoppage of works owing to the cotton trade dispute. On the other hand, applications have been received from twelve power consumers for about 222 h.p.

CAMBERLEY: *Electric Lighting Order.*—The Council has before it applications for sanction to the promotion of provisional electric lighting orders for the district by the Aldershot Gas and Water Co. and the Yorktown and Blackwater Gas Co. A committee has been appointed to consider the applications.

CAMBUSLANG: *Damages against Tramways Co.*—In connection with the death of a cabdriver through his cab coming into collision with a car belonging to the Lanarkshire Tramways Co., in December, 1907, an award of £500 damages was made by the Court of Session, Glasgow, last week.

CANADA: *Niagara Electric Power.*—A commencement has been made with the transmission lines of the Ontario Government from Niagara in connection with the new power scheme, which will supply a number of municipalities. It is not anticipated, however, that the works will be completed under two years.

CARDIFF: *Tramwaymen's Grievances.*—Mr. Arthur Ellis, the tramways manager, is still having trouble with the tramway employees in Cardiff. The present disagreement arises out of a new system of working the cars recently introduced, and the opportunity is being taken, as is usual in such cases, of comparing the general conditions upon the Cardiff tramway service to those upon other systems. The comparison, needless to say, is not favourable to Cardiff.

CARLOW: *Proposed Electric Tramway.*—The question of constructing an electric tramway or light railway from Castlecomer to Carlow *viâ* Queen's County and County Kilkenny coalfields, is under consideration. A local Committee has been formed to take the matter up.

CLEETHORPES: *Metal Filament Lamps.*—In connection with the proposed electric lighting scheme, Mr. C. S. Vesey Brown has suggested that in order to enable single metal filament lamps to be used, it would be advisable to have a small transforming station, at a cost of about £1,700, to reduce down to the necessary pressure. The committee, however, have not fallen in with the suggestion.

DEVONPORT: *Officials' Salaries.*—A scheme submitted by the Electric Supply Committee for fixing maximum and minimum limits of salaries and wages and annual increments of the employees of the electricity department has been rejected by the Council.

DEWSBURY: *Tramways Opening.*—The electric tramways between Dewsbury and Ossett were opened for traffic on Friday last week.

DUDLEY: *Tramway Matters.*—The Corporation will promote a Bill in the coming session to legalise an agreement with the British Electric Traction Co., for a lease of the tramways in Dudley.

DUBLIN: *Action against Tramway Company.*—The Dublin United Tramways Co. have been sued by a bootmaker named Martin for damages in respect of personal injuries sustained through falling off one of the company's cars. The plaintiff alleged negligence on the part of the company's servants. It appears that whilst the conductor of the car in question was on the roof collecting fares, the plaintiff left his seat in order to ring the bell from the conductor's platform for the car to stop. Whilst he was doing this, the car gave a jerk, with the result that he fell into the road and sustained the injuries complained of. The plaintiff was awarded £21 damages in the first instance, but the company appealed, and the appeal judge held that there was no negligence on the part of the company, and further stated that even assuming there had been some negligence the accident was attributable to the conduct of the plaintiff himself in going on the platform and endeavouring to manage the car himself. The decision of the first court was therefore reversed.

Fire at the City Hall.—With reference to the recent fire at the City Hall, Mr. Mark Ruddle, the City Electrical Engineer, has issued a report, in which he clearly shows that this was in no way due to the electric lighting installation. As a matter of fact, there were no electric wires anywhere near the outbreak, and the fuses in the chamber were afterwards all found to be in perfect order, and had not come into operation. Further, at the time the fire took place, the supply to the building was switched off.

GLASGOW: *Tramway Receipts.*—Since the beginning of the financial year, to June 1st, the number of passengers carried has been 102,059,107 compared with 104,483,573 in the corresponding period of last year, the receipts being £414,274, against £422,256 last year.

HANLEY: *New Plant.*—A new 500-kw. generating set was put into operation on Friday.

HERTFORD: *Electric Power Supply.*—The Surveyor in his quarterly report, states that the North Metropolitan Electric Power Distribution Co. has completed the laying of the whole of their cables, and that the cost of reinstating the roads has been repaid by them to the Council. The company has erected a refuse destructor under their agreement with the Council.

INDIA: *Power Transmission.*—It is stated that work upon a water power electric transmission scheme is about to be commenced in Simla.

JAPAN: *Electricity Supply.*—The American Vice-Consul E. G. Babbitt, of Yokohama, quotes, in a report, an article from a local newspaper on the development of the electric industry of Japan from which the following *résumé* has been made:—The authorised capital of electric undertakings in 1903, 28,500,000 yen ($14,193,000), of which 24.000.000 yen

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($11,952,000) was paid up, had risen to 138,000,000 yen ($68,724,000) in 1907, of which 87,500,000 yen ($43,575,000) was paid up. The electric works undertaken chiefly represented lighting and tramways. The number of lights supplied in 1903, 365,000, had increased in 1907 to 859,143. Tokyo and Osaka require each 100,000 lights. Electric tramways show equal development. In 1903 the mileage was 38, which rose to 119 in 1907, and will be largely added to by construction during the present year. After reciting the foregoing progressive electric undertakings the newspaper article concludes as follows: "It is to be specially noted that while the works have been making steady progress not a few of the companies are in serious financial straits."

KALGOORLIE: *Electric Tramways Co.*—Owing to a number of inquiries which have been received concerning the position of the Kalgoorlie Electric Tramway Company's undertaking, and the cause of the recent fall in the prices of the company's stock, a circular has been issued by the secretary, pointing out that the company depend chiefly upon the mining population of Kalgoorlie for its revenue, and that in consequence of the reduction in the number of men employed, the net earnings for the current year at the end of September showed a decrease of about £1,000. For October, however, there was an improvement of £221. The circular also states that owing to new developments at the mines, prospects generally are brighter at Kalgoorlie than has been the case for some time past.

LAUNCESTON (TASMANIA): *Proposed Electric Tramways.* The *Australian Mining Standard* states that a plebiscite of the ratepayers is to be taken with reference to the question of issuing municipal debentures for the purpose of carrying out the proposed electric tramway system through a private company. The scheme presented by a London group of financiers has been defeated by one vote only.

LEEDS: *Guiseley Tramway.*—The work of extending the Corporation tramways from Horsforth to Guiseley has been commenced, and, with reasonably good weather, the Tramways Committee anticipate that the work will be completed by March next year. The estimated cost is about £55,000.

LIMERICK: *Action re Electric Lighting.*—An action is being taken by the Limerick Corporation against Messrs. Crompton & Co., to recover damages estimated at £1,300 for delay in the execution of a contract to deliver and erect electrical machinery in the Corporation's generating station.

LONDON: *London County Council Tramways.*—The electrification of the tramways from Brixton Police Station to Loughborough Junction, Camberwell Green, Tulse Hill, and Norwood, is now completed, and experimental runs are being made over it.

Hampstead: Supply in Hendon.—The agreement come to in 1896 between the then Hampstead Vestry and the Hendon Urban District Council, whereby the former were empowered to lay mains and supply current to premises in Hendon until the latter Council were in a position to supply electricity themselves, has been brought to an end, the Hendon Electric Supply Co. having in March last given the Hampstead Council six months' notice to terminate the agreement. The total cost of mains and services laid by the latter in Hendon was £903, and as the result of negotiations the Hendon Co. have agreed to take over for £200 certain mains which cost the Council £399. The Council are to remove their mains in Cricklewood, and it has been agreed that the cost of opening the ground and making it good, where the trench so opened can be utilised for laying the company's new mains, shall be halved.

Islington: Underground Telegraph and Telephone Wires.—Recently the Borough Council sent a circular letter to the other Metropolitan Councils, asking their support in urging the Government to lay telephone and telegraph wires underground in London. The Councils of Bermondsey, Woolwich, Stepney, Southwark, Camberwell, Finsbury and Bethnal Green have up to the present time intimated their agreement with the suggestion. The Westminster City Council, and the Borough Councils of Wandsworth and Marylebone are against the proposal. Several of the Councils are taking no action.

St. Pancras: Tramways.—The London County Council have intimated to the Council their intention to proceed at an early date with the construction of a number of important tramway routes in the district.

The attention of the Electricity Committee having been called to the fact that no charge is made to power consumers for the extra meters necessary to register the supply of current for factory lighting upon which a rebate is allowed, a minimum rate of 1s. 6d. per quarter for same is to come into operation next month.

MACCLESFIELD: *Electricity Supply.*—At a meeting of the Local Chamber of Commerce last week, the President stated that one of the greatest difficulties with regard to promoting new industries in Macclesfield is the want of electricity, which was a serious hindrance to small industries.

MONTREAL: *Street Lighting.*—In connection with negotiations which have been going on between the City Council and the Montreal Light, Heat, and Power Co., the Council has now made an offer to take a supply from the company for arc lamps at $60 per annum, but the company refuse to accept it. The present contract with the company expires on December 31st, and they suggest that the matter should go to arbitration.

PERTH: *Loss on Tramways.*—The continued loss upon the municipal tramway system is receiving some attention in local circles, it being pointed out that the total loss upon the undertaking amounts to £4,700. The question of the amount of the rate which will have to be levied to make good these losses is being regarded with some misgiving by various councillors. A proposal has been made that the undertaking should be leased to a company.

PRESTON: *Proposed Purchase of Supply Co.*—The Streets and Building Committee have appointed a sub-committee to consider the subject of acquiring the undertaking of the National Electric Supply Co.

SOUTHPORT: *Tramway to Lytham Abandoned.*—The Southport and Lytham Tramway Co., which was formed several years ago with the object of linking together Southport and Blackpool by a tram service, is about to be wound up. The company's intention was to construct a tram route from Banks, Southport, across the Ribble to Lytham and thence to Blackpool, but objections from the Port of Preston and landowners on each side of the estuary necessitated the promotion of three Acts of Parliament for time extension, which swallowed up the major portion of the authorised capital, and has resulted in the abandonment of the project.

TWICKENHAM: *Condition of Tramway Track.*—An invitation from the Town Clerk of Ealing, to send representatives to attend a further conference on the subject of the alleged noisy cars and defective tracks of the London United Tramways Co., at Ealing, on December 8th, has been accepted by the Council.

WEYMOUTH: *Proposed Tramways.*—The introduction of electric tramways is engaging the attention of the Corporation.

WREXHAM: *Electricity Undertaking.*—In criticising the details of the loan applied for in connection with the electricity undertaking, as reported in our "Tenders Invited" column, the Local Government Board Inspector said it was evident that all the previous sanctions had been pooled without any regard being paid to the expenditure under the various sections forming the total amount of the loan sanctioned for the several purposes, and remarked that it was an extraordinary coincidence that the amounts spent upon mains should be the exact amount of the over-expenditure. The Electrical Engineer (Mr. W. G. Pickvance) said that having to account for this over-expenditure, and finding no records at the Borough Accountant's offices, where all details were supposed to have been kept, the only course open to him was simply to take the cost of the latest works that had been carried out, and he had accordingly arrived at the sum by that method. The Inspector remarked that this was a very simple way of keeping accounts. In other words, the amount of £478 could not be accounted for at all, and it might easily have been spent in machinery as well as mains. There was no doubt whatever that this money had been expended on mains. The Inspector then went into the items of the loan asked for, and suggested that the loan of about £2,500 for the purpose of a new generating set, which was not immediately required, should be deferred, but pointed out that after the alterations and additions to one of the present sets had been carried out, the Board would be quite prepared to grant the extra sum when the Engineer had observed the effect of the smaller section of the extensions and the extra set was found necessary. There would be no necessity for a further inquiry. He also suggested that all meters should be bought out of revenue, but after some little discussion on the matter, the Engineer agreed to reduce his application for a loan of £300 to £100, and after this loan had been expended, meters would be purchased out of revenue. The application as eventually amended was for the sum of £4,165 in place of the £6,850 originally asked for. With reference to the Inspector's criticism of the account-keeping, with which, by the way, the Corporation officials agree, it should be pointed out that the reason for this state of affairs was that all accounts of every nature had been kept by the late Borough Accountant at offices quite away from the works, on the assumption that he, as an accountant, was better able to handle figures than the manager of the concern. Mr. Pickvance took up his post a little over twelve months ago, and one of the reforms instated is that the bulk of the accounts are to be kept by the Engineer at his own offices, and this system is entirely approved of by the new Borough Accountant.

YORK: *The Tramways Question.*—Considerable discussion took place at the last meeting of the City Council concerning the absence of information with regard to the tramways. The chairman of the Tramways Committee denied that there has been any delay in the matter, as the Light Railway Order was only sanctioned by the Light Railway Commissioners a week before the November elections, and since then the Tramways Committee had had to be reconstituted.

Manchester Local Section of the Institution of Electrical Engineers.—Owing to Mr. W. Cramp's Paper on "The Electrical Discharge and the Manufacture of Nitrogen Compound" (which was down for reading at the meeting on December 1st) having been accepted by the London Council for reading at their meeting on December 17th, it will not be read before the Manchester Local Section until December 15th.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ALGERIA.—The *Commercial Intelligence* calls attention to the fact that a municipality in Algeria, of which it has particulars, is desirous of entering into a contract for the erection of an electric lighting and tramways undertaking. The town in question is situated in the neighbourhood of important iron deposits, which are about to be exploited on an extensive scale.

BELFAST HARBOUR COMMISSIONERS.—Messrs. Preece & Cardew have prepared plans, &c., with regard to the proposed erection of a combined pumping, electric light, and power station.

BIRKENHEAD.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £20,000 for the electricity undertaking.

ISLE OF THANET TRAMWAYS CO.—Additional plant at an estimated cost of £7,500 will shortly be installed in the company's power-house.

LONDON: *Hackney.*—At an estimated cost of £200, distributing mains are to be extended to the Marconi Wireless Telegraph Works, Ltd., Tyssen Street, Dalston. Mains are also to be extended to 40 Colverstone Crescent and 6 Colberg Place, at an estimated cost of £70 10s.

NEATH.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £18,000 for the electricity undertaking.

RADCLIFFE.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £14,350 in connection with the electricity undertaking. There was some opposition, the argument being made that it would be cheaper for the Council to take a supply in bulk from the Lancashire Electric Power Co., whose generating station is actually in Radcliffe. The inquiry was adjourned until December 2nd.

ROTHERHAM.—The Guardians have been empowered to obtain the advice of an expert in connection with the electric lighting of the workhouse.

WREXHAM.—Mr. H. Ross Hooper, of the Local Government Board, held an inquiry last week with reference to an application by the Corporation to borrow £6,850 for the extension of the electrical undertaking. Loans already sanctioned amount to £37,471, and the amount expended up to the end of March last was £57,949. The application was eventually amended for the sum of £4,165.

Miscellaneous

AUSTRALIA.—Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, up till noon on January 4th, 1909, for the supply and delivery at Brisbane of cable, insulators, iron wire, covered wire, ironwork, and copper wire. Tender forms, conditions, &c., may be obtained at the Commonwealth Offices in London, 72 Victoria Street, S.W.

The Board of Trade correspondent at Melbourne (Mr. M. Hirsch) has forwarded copies of the conditions and specifications relating to the supply of telephone instruments, parts, and accessories, telegraph instruments and parts, switchboards, parts and accessories, accumulators, measuring instruments, protectors and parts, required by the Deputy Postmaster-General at Brisbane, to whom tenders should be sent by noon on January 11th, 1909. The conditions and specifications may be obtained at the Commonwealth Offices in London.

A loan of £5,000 is to be granted for extensions to the electric power station.

BRIDGEND.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £8,250. Of this amount £5,500 is for the purchase of the South Wales Electrical Power Distribution Co.'s undertaking at Bridgend, and the balance for improvements. The period of repayment is 20 years.

CROMER.—The Electric Lighting Co. are being asked to quote in connection with an extension of street electric lighting.

DOVER.—The Harbour Board invite tenders for the supply of stores during the fifteen months commencing January 1st, 1909, including electrical sundries, cables, &c. Particulars from the Registrar of Dover Harbour, and tenders by December 9th.

FELIXSTOWE.—The Council invite tenders for a Diesel oil engine and dynamo. Particulars from Mr. R. P. Wilson, Consulting Engineer, 66 Victoria Street, Westminster (fee £2 2s., returnable), and tenders by December 12th (see an advertisement this week).

HASTINGS.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £1,683 for street lighting. There was considerable opposition on the part of ratepayers, who produced a good deal of evidence that gas would be cheaper. The inquiry was closed.

LIVERPOOL.—Sanction has been received from the Board of Trade for borrowing £12,400 in connection with new tramways.

LOWESTOFT.—The Local Government Board have given their sanction to a loan of £1,000 for free wiring for twelve years.

MANCHESTER.—The Tramways Committee invite tenders for the supply and delivery of (1) steel girder tramway rails and (2) tramcar axles. Particulars from the General Manager, and tenders to the Chairman of the Tramways Committee by December 1st.

The Electricity Committee invite tenders for the supply, delivery, and erection at the Stuart Street generating station of exhaust steam, circulating water and air pump, and discharge pipes. Particulars from the Secretary, Electricity Department, and tenders by December 9th (see an advertisement this week).

NETHERLANDS.—H.M. Consul at Rotterdam announces that the Dutch Government have granted to the Flushing-Middelburg Tramways Co. powers to convert their important tramways between these two places to electric traction.

NEWCASTLE.—The Trimdon Grange Colliery Co. invite tenders for stores during the next twelve months, including electrical fittings. Tenders to the Stores Keeper, Trimdon Grange Colliery Co., Durham, by December 12th.

NEW ZEALAND.—Mr. E. E. Stark, the Dunedin City Electrical Engineer has issued a further report with regard to an installation of a further 2,000 kw. of plant in the municipal power station. His estimates are as follows:—Steam-turbine plant, £24,300; reciprocating-engine plant, £25,600; gas-driven plant, from £37,000 to £40,000.

SPAIN.—The Cia. del Tranvia Urbano de Bilbao have applied to the Direccion General de Obras Publicas of Madrid for a concession for the construction of certain electric tramway lines in the town of Bilbao. Persons desiring to compete for this concession may send in offers, on terms more advantageous to the Government, within a period of one month from November 10th.

Tenders for the installation and working of a telephone system in Ciudadela de Menorca are invited. A plan for the work, presented by Señor Conde de Torre Saure, will form the basis for tenders, and if an offer on terms more advantageous to the Government is accepted, Señor Conde de Torre Saure must be reimbursed for the value of this plan, *i.e.*, 1,000 pesetas. At equal figures the Señor will have a preference. The competition will turn on the reduction in the number of years for which the concession is desired, the maximum period being 20 years.

WARRINGTON.—Tenders are invited by the Electricity and Tramways Committee for the supply of slack coal. Particulars from the Borough Electrical Engineer, and tenders by December 10th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

London County Council.—Tenders are invited for the installation of electric lighting, bells, and fans at the Clapham Secondary School. Particulars from the Chief Engineer to the Council, and tenders by December 1st.

E.—Memorial Hall, Stratford. Architects, G. Baines & Son, 5 and 6 Clement's Inn, W.C.

Extension of copper store, Silvertown. Builders, G. Munday & Sons, Islay Wharf, Poplar.

E.C.—Block of shops and offices, City Road, for Trustees of Sutton Estate. Architect, E. C. Monson, Grosvenor House, Acton Vale, W.

Additions, Royal London House, Finsbury Square. Architect, John Belcher, Hanover Square, W.

N.—Additions to Northern Hospital, Winchmore Hill, Highgate. D. T. Hatch, Engineer, Metropolitan Asylums Board.

Church, Finchley. Architect, Percy Lamb, 1 Clifford's Inn, W.C.

N.W.—Phthisis ward for Hendon Board of Guardians. The Clerk.

Fourteen stables, Golder's Green, Hendon. Builder, J. Gibb, jun., 191 West End Lane, West Hampstead, N.W.

Car repair shops, Edgware Road, for Metropolitan Electric Tramways, Ltd.

S.E.—Building, 188 Rye Lane, Peckham, for the Magnet Printing Press Co., Ltd.

Extension of sack building, Morden Wharf, Greenwich. A. Edmonds.

S.W.—Booking office, &c., for London & South-Western Railway Co., Battersea. Builders, Perry & Co., Tredegar Works, Bow.

Mission Hall, New Road, Battersea. Builders, Lathey Bros., New Road, Battersea.

W.—Billiard room at rear of 168 Ladbroke Grove, Notting Hill. Builders, H. Corry & Son, Pembridge Road, W.

PROVINCES.

BARKING.—Builders at Creeksmouth (in course of erection) for British Coalite Co.

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BATH.—Rebuilding several blocks of shops in Avon Street, for City of Bath Charity Commissioners (£50,000). Architect, Mr. Rolfe, Belmont, Bath.

BOTHWELL (LANARKSHIRE).—Parish Council Chambers (£2,000). Architects, Beattie & Morton, 121 St. Vincent Street, Glasgow.

BRENTWOOD (ESSEX).—Central kitchen, &c., at Essex County Lunatic Asylum (£5,200). Architect, F. Whitmore, 73 Duke Street, Chelmsford.

BRISTOL.—Bank for Metropolitan Bank of England and Wales. Architects, Catley & Lawrence, 26 Orchard Street, Bristol.

BURNLEY.—Extensions to Victoria Hospital, Burnley, are to be illuminated with electricity, the whole work to cost £20,000.

CHESTER.—Freemasons' Hall, Hunter Street (£3,000). Masonic Lodges of Chester.

DARTFORD (KENT).—Church (£10,000). Architect, W. D. Caroe, 3 Little College Street, S.W.

EXETER.—New wing to West of England Eye Infirmary (£3,000). The Secretary.

FLAMBOROUGH (YORKS).—Slaughter house, stables, &c., and alterations to shop. Architect, C. F. Johnson, Westgate, Bridlington.

KILMARNOCK.—The Town Council invite tenders for the wiring of the Infectious Diseases Hospital. Particulars from the Electrical Engineer, and tenders by December 14th.

LANCASHIRE.—Female training college (£43,000), for Education Committee. H. E. Clare, clerk, County Council, Preston.

LLANDRINDOD WELLS.—Rebuilding Bridge Hotel (£9,000). Architect, A. Le Thomas, Church Street, Pontypridd.

LOWESTOFT.—Additions to hospital (£3,026) Surveyor, G. H. Hamby, Borough Council.

MAIDSTONE (KENT).—New bank for London & County Banking Co. Head Offices, 21 Lombard Street, E.C.

PLYMOUTH.—Anglican Church, Peverel Park. Architect, W. D. Caroe, 3 Little College Street, S.W.

SHEFFIELD.—Extension of Town Hall. Surveyor, C. F Wike, Town Council.

STAFFORD.—New church, Spon Lane (£4,000). Architect, E. Wood, J.P., 315 High Street, West Bromwich.

STIRLING.—Extension to Stirling Royal Infirmary (£5,000). The Secretary.

WALLSEND-ON-TYNE.—A theatre will shortly be erected here at an estimated cost of £15,000.

WARWICKSHIRE.—Secondary School (£4,405). E. Field, Clerk to County Council, Leamington.

TENDERS RECEIVED AND ACCEPTED

BRADNINCH.—The tender of Messrs. Christie Bros. & Co., for wiring the Guildhall has been accepted.

DARTFORD.—The tender of Mr. A. T. Ridley for constructing a drain for conveying water from the new condensing plant to the surface-water sewers, has been accepted at £45.

ELECTRIC TIME SERVICE.—The Synchronome Co. have installations of electric clocks in hand at the present time for the following premises :—Messrs. Selfridge & Co., Ltd., New Buildings, Oxford Street; Lloyds, Ltd., and *Daily Chronicle*, Fleet Street; Royal National Orthopædic Hospital (nurses' home and out-patients' department); St. Bartholomew's Hospital (new pathological block).

EPSOM.—The tender of Messrs. Pritchetts & Gold has been accepted for the supply and erection of a new storage battery at the electricity works, at £286.

GLASGOW.—The Tramways Committee recommend the approval of the design offered by Messrs. Somervail & Co., Dalmuir, to erect swing bridges over the Forth and Clyde Canal at Dumbarton Road and Kilbowie Road, for the purposes of carrying tramways. The plans are to be forwarded to the Caledonian Railway Co. for their approval under the terms of the Clydebank Tramway Order of 1901, and to the Board of Trade.

LEITH.—The following tenders have been accepted in connection with the Granton tramway extension :—Points and crossings, Hadfields Steel Foundry Co., £1,772; overhead equipment, Tramway Supplies (Ltd), £1,261; automatic point controllers, Tramway Supplies, £81 each; Portland cement, Johnstons, £2,040; crushed granite, James Robertson, £310; pitch and pitch oil, James Ross & Co., £1,235; tools, M. P. Galloway, £117; anchors, M. P. Galloway, £587; tie-bars, Bayliss, Jones, & Bayliss, £17; pole bases, M. P. Galloway, £50; carting, Alex. Smart, Leith, £1,108; solid drawn one-piece poles, M. P. Galloway, Leith, £1,947.

LONDON: *London County Council.*—The tender of the Anti-Attrition Metal Co. of London has been accepted for the supply of 344 pony-wheel axle bearings at 1s. 1½d. per lb.; 200 driving-wheel axle bearings at 1s. 1½d. per lb.; 100 armature bearings, 3a type, at 1s. 4d. per lb.; and 100 armature bearings, 25a type, at 1s. 5d. per lb.

The following tenders have been received in connection with the reconstruction of tramways from King's Cross to Malden Road, and the construction of new tramways in Crowndale Road. The tender contains provisions for the reconstruction of the bridge carrying Great College Street over the Regent's Canal. John Mowlem & Co. (accepted), £47,584; Mr. W. Manders, £47,642; Dick, Kerr & Co., £47,782; Mr. A. M. Coles, £53,528.

LONDON: *Thames Conservancy.*—The Engineer has reported to the Upper River Committee, that in carrying out the work at Caversham Yard, an economy of about £60 per annum would be effected if the sawmill and other machinery in the new building were driven by electricity instead of by steam, and that as the portable steam engine which now supplies the power is old, the present time is opportune for making the change. The Committee agreed to the Engineer's report, and on Monday the Board accepted the tender of Messrs. Harland, Powden & Co., Manchester, to carry out the work within six months at £220.

Metropolitan Asylums Board.—The Board has placed an order with Veritys, Ltd., at £12 12s., for electric throat lamps for the South-Western Hospital.

Holborn.—The tender of Messrs. Foote & Milne, Ltd., Victoria Street, has been accepted for the electric lighting of High Holborn Library, at £101 10s. Messrs. John Bolding & Sons, Ltd., who previously received the contract to carry out the work at £78 4s. 8d., have withdrawn on account of having made an error in their tender.

LOWESTOFT.—The following tenders have been accepted for the supply of stores for the year ending September 30th, 1909 :—White waste, 26s. per cwt., Jones, Manchester, coloured waste 20s. per cwt.; odd stores, R. Leach, Lowestoft; brass and iron screws, T. E. Thirtle, Lowestoft; wood bushes, Rudd Bros., Lowestoft; oil (crank and chamber), Vacuum Oil Co., London, 1s. 5d. and 1s. 4d. per gallon; oil (dynamo), Wakefields, 1s. 5½d. per gallon.

WEST HAM.—For some time past the Electrical Engineer has been endeavouring to dispose of demand indicators, many of which are now out of use and bad stock. The Reason Manufacturing Co. have taken 100, and the Hendon Electric Supply Co., three, and the difference on the stock price of £160 10s. and the amount realised by the sale, £22 5s., viz., £138 5s., is to be charged to net revenue account. An order has been placed with Messrs. Cory & Son for 14,000 tons of washed pea-nut coal, at 8s. 10d. per ton, delivered alongside the wharf at the electricity undertaking, for twelve months from May next.

COMPANIES' MEETINGS AND REPORTS

AMAZON TELEGRAPH CO.—The gross revenue for the year to June 30th, 1908, amounted to £84,978, and the total working expenses to £43,174. Deducting debenture interest there is a balance to the credit of the revenue account of £14,808, which reduces the debit balance to £51,070, compared with £65,878 for the previous year.

COMPAGNIE GENERALE DE TRAMWAYS DE BUENOS AYRES.—The report for the period from March 5th to June 30th, 1908, states that the company has taken up the unification of lines of a total length of 324 miles, the rolling stock consisting of 350 motor-cars and 700 trailers. The accounts for the financial year show a dividend of 4½ per cent. per annum. There is a balance of 4,235 francs to be carried forward.

DORMAN, LONG & CO.—The report for the year ended September 30th last shows a balance available for distribution of £229,383, including the balance brought forward from last accounts. The new electrically driven rolling mill (ELECTRICAL ENGINEERING, October 15th, p. 540) is ready to be started, and will be in operation in the course of a few weeks. After setting aside £20,000 towards the redemption of second debenture stock and £30,000 for depreciation, a final dividend of 4 per cent., making 6½ for the year, is recommended, carrying forward £64,710.

ELECTROMOBILE CO.—The report states that a mortgage of £20,000 has been arranged on the company's garage, and that arrangements have also been made for the issue of £40,000 6 per cent. mortgage debenture stock, the holders of which have the option of exchanging their debenture stock for ordinary shares at par, during a certain period. Re-valuation of the assets has resulted in items amounting to £15,849 being written off, and there is a deficiency shown in the accounts of £1,444. The company's capital and borrowing powers are to be further increased by the creation of 50,000 new ordinary shares of £1 each.

GENEVA TRAMWAYS CO.—The report for the year ended September 30th states that there are outstanding £5,300 4½ per

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cent. debentures of the Geneva Tramways Co. (old company) to be exchanged, under a scheme of arrangement sanctioned by the Court on November 10th, 1906, for £1,590 debentures and 3,180 shares of this company. For the year covered by the accounts there was a profit of 526,818 francs, and the total balance available, after adding the balance brought forward, is 837,285 francs. After making provision for amortisation, reserve fund, and renewals fund, and a special reserve fund of 30,000 francs to meet capital expenditure, there is a balance of 372,297 francs. A dividend of 1½ per cent. is recommended, carrying forward 72,280 francs.

ISLE OF THANET ELECTRIC TRAMWAYS & LIGHTING CO.—The report for the year ended September 30th, 1908, shows a profit of £13,390. The traffic receipts, owing to the inclement weather in August and September, show a decrease of £580, but the sale of electricity shows an increase of £237 as compared with the figures of last year. The directors have pleasure in reporting that the past year was again free from any serious accident, and they have, in consequence, been able to renew the third party insurance for a year, ending in June, 1909, at a further reduction of £450. The amount of undivided revenue at the disposal of the directors is £5,516, and they propose to transfer to reserve account the sum of £2,500, bringing that account up to £5,500, and to pay a dividend of 1¼ per cent. on the preference shares, which will absorb a further £1,875, leaving £1,141 to be carried forward to the next account. It is proposed to pay the dividend on the preference shares on November 30th. The directors report that the provision of additional plant, in order to extend the lighting business of the company is urgent, and an additional installation of electric plant at an estimated cost of £7,500 is necessary to meet immediate and prospective requirements. Mr. Henry Brown and Mr. W. M. Murphy retire from the board by rotation, and, being eligible, offer themselves for re-election. The meeting is to-day.

PAIGNTON ELECTRIC LIGHT & POWER CO.—A meeting was held last week at Paignton, when the report presented showed that 6,295 shares had been allotted, the sum received being £2,448. Mr. W. J. Ham, chairman of the company, presided, and stated that although they had gone in for what some people would describe as a speculation, he believed their undertaking would turn out well both for the company and for the town itself. The directors who started the company would remain in office until 1909, and no directors' fees would be payable until the company was earning dividends. It was expected a supply would be available before Christmas. The company had entered into an agreement with the Council to erect a refuse destructor in connection with the works. It was also mentioned at the meeting that the Paignton Tramways Co. was pushing forward with its undertaking, and that in all probability a supply would be taken from the Paignton Electric Light & Power Co.

SINGAPORE ELECTRIC TRAMWAYS CO.—The report for the year to December 31st, 1907, shows a gross profit of $26,222. Debenture interest, depreciation, and royalties, however, amount to $30,775, the loss on the year's working thus being $4,552. The report states that the latter part of 1907 was marked by a heavy depression in trade amongst all classes in Singapore, and more especially so amongst the Chinese, who constitute the largest portion of the community. Consequently a very adverse effect upon the receipts was experienced, although the revenue for the year, compared with the year 1906, showed an increase of $96,262, and the passengers carried an increase of 3,271,094. The passenger receipts per car mile increased in 1907 by 11 per cent., and the working expenses showed a decrease per car mile of 3 per cent. The demand for electricity for lighting and power purposes continues to show a gratifying increase, the proportionate percentage of increase of the supply during 1907 over 1906 being 173 per cent., and for the current year to August 31st, compared with 1907, a further increase at the rate of 81 per cent.

UNITED WIRE WORKS CO.—The accounts for the year to September 30th show a profit of £6,323. Deducting the preference dividend for 1907-8, and adding £100 to the special reserve fund, there is a balance available, out of which the contractors recommend a 2 per cent. dividend on the ordinary shares, leaving £1,606 to meet the dividends accrued on the preference shares to September 30th, 1908, which absorb £1,228, leaving £377 to be carried forward.

WELDLESS STEEL TUBE CO.—The accounts for the year ended September 30th, 1908, show a gross profit of £9,673. After meeting debenture interest, preference dividend, and a dividend of 5 per cent. upon the ordinary shares, the balance of £4,301 is carried forward.

WEST INDIA & PANAMA TELEGRAPH CO.—At the half-yearly meeting last week, the report and accounts given in our last issue were adopted.

Audit of Electric Lighting Companies' Accounts.—In answer to a question in the House of Commons yesterday, Mr. Churchill stated that he had no intention of appointing any of the shareholders' auditors to act as official auditors of the accounts of the same electric lighting companies for the present year.

MISCELLANEOUS CITY NOTES

ALLIANCE ELECTRICAL CO.—Petitions for the reduction of capital from £120,000 to £60,000 will be heard before Mr. Justice Eve on December 15th

ANGLO-ARGENTINE TRAMWAYS CO.—A circular has been issued to the shareholders outlining a scheme of reorganisation which is to be submitted at an early date. It is proposed to exchange the existing £266,600 of 6 per cent. debenture stock for 4 per cent. debenture stock, ranking *pari passu* with the 4 per cent. debenture stock already issued, at the rate of £155 of 4 per cent. stock for £100 of 6 per cent. stock; to exchange the £1,300,035 of 6 per cent. cumulative first preference shares for a new issue of 4½ per cent. debenture stock, redeemable in 75 years, and ranking immediately after the 4 per cent. debenture stock, at the rate of £6 13s. 4d. of 4½ per cent. stock for each £5 first preference share, thus giving the holder the present rate of interest—namely, 6 per cent. per annum; to increase the authorised amount of the 10 per cent. non-cumulative second preference shares of £5 each by £400,000, and to convert each of the existing and new second preference shares of £5 each into two 5 per cent. cumulative first preference shares of £5 each, entitled to one vote per share. After the second preference shares have become first preference shares, to convert the existing third preference shares into second preference shares, with the same rights as at present.

BRUSH ELECTRICAL ENGINEERING CO.—Applications have been invited during the week for an issue of £100,000 prior lien 5 per cent. debenture stock, part of a total issue of £125,000. The remaining £25,000 of stock, however, will not be issued without the sanction of the holders of the £100,000 stock now offered. The stock is secured by a first mortgage in favour of the Electric & General Investments Co., as trustees, upon the freehold and leasehold land, buildings, and fixed plant of the company at Loughborough, the value of which stands in the company's books at £269,000. The stock will rank in priority, both as to principal and interest, to the other debenture stocks issued, or which may be issued by the company. The stock is further secured by a third floating charge on the whole of the remaining assets of the company. The stock may be redeemed out of the sinking fund by annual drawings at £105 per cent., or purchased in the market at a price not exceeding £105, the first redemption to take place not later than January, 1911.

COMPANIES STRUCK OFF REGISTER.—The names of the undermentioned companies have been struck off the register of joint stock companies:—Accumulator Syndicate; Californian Electric Power & Mining Development Syndicate; Dorchester & District Electric Supply Co.; Kingsbridge & South Devon Electric Lighting & Traction Co.; New Mutual Telephone Syndicate; "Vernon" Mechanical & Electrical Registers.

COMPANIES TO BE STRUCK OFF REGISTER.—The names of the following will be struck off the register unless cause is shown to the contrary within three months:—Electric Motive Power Co.; Electric Light & Power Co., of Japan; Epstein Electric Accumulator Syndicate; London Electromobile Syndicate; Nuneaton & District Light Railway Co.; Welsh Electric Traction Co.

CONSTANTINOPLE TRAMWAYS CO.—It is announced that only a portion of the new shares of this company will pass into French hands, and that only a portion of the contract for the electrification of the system will be entrusted to French firms. The greater part of the share capital is in the hands of the syndicate headed by the Continental Company of Nuremberg.

WALSALL ELECTRICAL CO.—The capital of this company has now been reduced to £20,620 from £25,000.

Students' Section, I.E.E.—The student-members of the Institution who attended the first annual smoking concert, held on Tuesday evening at Stone's Restaurant, The Broadway, Ludgate Hill, with the idea of spending an enjoyable evening, were not disappointed. There was a good attendance, and an excellent and varied programme of entertainments had been arranged. Songs were given by Mr. C. B. Nadaud (chairman), and Messrs. Allisstone, Dolleymore, Driver, Ellis, and Sack; the humorous songs of Mr. Selwyn Driver were particularly appreciated. Mr. G H. Stevens (hon. secretary) contributed some piano selections, and Messrs. Engelbach, Knight, and H. Nadaud also assisted.

The Johannesburg Gas Plant.—The Johannesburg Municipal Council is taking action against Messrs. D. Stewart & Co. (1092), Ltd., of Glasgow, and Messrs. Beardmore & Co., of Glasgow, claiming £400,000 in respect of the Johannesburg gas-driven generating plant. The defendants pleaded that the matter should be dealt with by arbitration, and further deny breach of contract, claiming that the installation was in full accordance with the specification of the plaintiffs. It is further claimed that any failure of the plant to reach the prescribed tests was due to the unsuitability of the coal used by the plaintiffs. The Glasgow Court has decided that the action shall proceed.

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APPOINTMENTS AND PERSONAL NOTES

The Swansea Harbour Trustees will shortly be advertising for a manager of the harbour electric power station, at a salary of £250 per annum.

Applications are being invited for "A" and "B" class station supervisors at the Hong Kong Dockyard. (See an advertisement this week.)

On Friday last the members of the staff of the Loughborough Corporation Electricity Department presented Mr. W. Allcrott, who has completed his pupilship, and is leaving to take up an appointment with the Valvoline Oil Co., Ltd., at their Birmingham branch, with a combined letter wallet and pocket book, fountain pen, and pocket steel tape.

The salary of Mr. R. Jones, station engineer at the Dartford electricity works, has been increased from £130 to £140 per annum as from January 1st next, with a further increase of £10 on January 1st, 1910.

For the position of junior assistant engineer at the Leek electricity works, Mr. F. H. Minchin has been appointed at a salary of 25s. per week.

Mr. George Verity, chairman of Veritys, Limited, left England on the 19th for India, Singapore, &c., on a combined business and holiday trip. He is due to return early in March, when he takes up his duties as High Sheriff for the County of London, an office which was held on a former occasion by his brother, the late Mr. John B. Verity.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Son, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, quoted on Tuesday night, net c.i.f. port of arrival, was £65 10s. to £66 per ton (last week, £66 10s. to £67 per ton).

"AUTOMAT" LAMPHOLDERS.—Owing to the large demand for "Automat" lampholders since their introduction some few months ago, the Metallic Seamless Tube Co., of Birmingham, have been compelled to increase very considerably their works' capacity for dealing with same. Stocks have also been considerably increased in order to be able to meet the large demand promptly.

BRITISH ELECTRICAL FEDERATION.—The offices of the British Electrical Federation have been removed to Electrical Federation Offices, Kingsway, London.

CRYPTO ELECTRICAL CO.—Owing to the difficulty which has been experienced in getting through on the telephone, and to the increase in their business, the Crypto Electrical Co. have found it necessary to instal a second telephone, the number of which is 12831 Central.

MARRYATT & PLACE.—This firm, of 28 Hatton Garden, London, will in future be carried on under the style of Marryatt & McNaught, Ltd., so far as the manufacturing business at the Askew Works, Shepherd's Bush, London, is concerned. The other portions of the firm's business are unaffected by the new arrangement.

WORKS FOR SALE.—An extensive factory recently erected on the Osmaston estate, Derby, is for sale. (See advertisement this week.)

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the Llandudno & Colwyn Bay Electric Traction Co. will be held at the offices of Messrs. Josolyne, Miles & Blow, 21 Spring Gardens, Manchester, to receive the liquidator's account of the winding up.

NEW PUBLICATIONS

"Elementary Manual on Steam and the Steam Engine." By Andrew Jamieson. Twelfth edition. (London: Charles Griffin & Co.) Price 3s. 6d.

"Elementary Dynamo Design." By W. B. Hird. (London: Cassell & Co., Ltd.) Price 7s. 6d.

"Essays Biographical and Chemical." By Sir William Ramsay. (London: Archibald Constable & Co., Ltd.) Price 7s. 6d.

The Census of Production and the Electrical Trades.—Some few months ago the form, which is to be sent out to manufacturers and engineers in the electrical industry for the purpose of obtaining statistical information in accordance with the Census of Production Act of 1906, was published, and we gave its main features on page 41 of our issue of July 2nd. A special form intended for the general and electrical engineering trades has now been published. This contains only a few of the questions which were included in the previously issued form, and is divided, as before, into two parts—namely, compulsory and voluntary information. Questions relating to capacity of power plant, consumption of copper, constructional work on own buildings, and similar questions which concern only the manufacturer, are omitted.

NEW COMPANIES

J. V. COONAN.—This company was registered on November 10th, with a capital of £1,000 in £1 shares, to take over the business carried on at Church Row, Cleveland Street, Hull, as "J. V. Coonan," and to carry on the business of mechanical engineers, manufacturers of and dealers in all or any apparatus and things capable of being used in connection with the use of steam, electrical, or motive power or otherwise. Private company. The number of directors is not to be more than five; J. V. Coonan is the first. Qualification 50 shares. Registered by C. Doubble, 14 Serjeants' Inn, E.C.

C. GAINER.—This company was registered on November 18th, with a capital of £1,000 in £1 shares, to carry on the business of horticultural, constructional, electrical, mechanical and general engineers, manufacturers of rolling stock, metal and wood workers, &c. Private company. Table "A" mainly applies. Registered office, Western Works, Railway Place, Bath.

GILLINGHAM ELECTRIC & STEAM LAUNDRY CO.—This company was registered on November 9th, with a capital of £2,500 in £1 shares, with objects as indicated by the title. Private company. Table "A" mainly applies. Registered by C. Doubble, 14 Serjeants' Inn, E.C.

LIGHT RAILWAY & GENERAL CONSTRUCTION CO.—This company was registered on November 20th, with a capital of £1,000 in £1 shares, to construct or acquire and turn to account light railways and tramways in the United Kingdom and abroad, &c. Private company. The number of directors is not to be more than four; the subscribers are to appoint the first. No qualification required. Registered by Paines & Co., 14 St. Helen's Place, E.C.

MIDGLEY & SIMPSON.—This company was registered on November 19th, with a capital of £1,000 in £1 shares (996 preference), to acquire the business of electrical, mechanical, and consulting engineers carried on by C. A. Midgley and D. H. Simpson, as "Midgley & Simpson," at Leeds. Private company. The number of directors is not to be less than two nor more than five; the first are C. A. Midgley, D. H. Simpson, and two others to be appointed by the subscribers. Qualification, £250. Remuneration as fixed by the company. Registered office, Aire & Calder Navigation Collieries, Bridge End, Leeds.

MUNSTER ELECTRIC LIGHTING CO.—This company was registered on November 14th, with a capital of £2,000 in £1 shares, to acquire the business of general electricians and contractors, electric light contractors, &c., carried on by J. Hunter, C. H. Wright, J. O'Keeffe, E. Griffiths, and R. H. Bindloss, as the "Munster Electric Co.," at Fethard, Tipperary. Private company. The number of directors is not to be less than two nor more than seven. Qualification left blank in articles. Remuneration as fixed by the company. Registered by Kerr & Lanham, 16 Furnival Street, E.C.

PEMSEL & WILSON.—This company was registered on November 18th, with a capital of £1,000 in £1 shares, to adopt an agreement with A. F. Pemsel, W. L. Wilson, and H. J. Pemsel for the acquirement of the business of motor, electrical, and general engineers and constructors carried on by them, and to carry on the said business and that of electricians, manufacturers of and dealers in motors, motor cars, cabs, cycles, &c. The subscribers are A. F. Pemsel, Hemel Hempsted, Herts, engineer, and W. L. Wilson, A.M.I.M.E., Hemel Hempsted, Herts. Private company. The number of directors is not to be less than two nor more than five; the first are A. F. Pemsel and W. L. Wilson. Qualification, £25. Remuneration as fixed by the company. Registered office, London Road, Apsley End, Hemel Hempsted, Herts.

REGENT ELECTRIC CO.—This company was registered on November 7th, with a capital of £100 in £1 shares, to carry on the business of manufacturers of and dealers in "Holmquist" and other electric light baths, mercury-vapour lamps, and their appliances, electrical engineers, &c. The subscribers are C. M. Holmquist, 52 Regent Street, W., electrical engineer; H. Curry, 9 Priory Grove, South Kensington, S.W., electrician. Private company. Table "A" mainly applies. Registered office, 46 Irongate Wharf Road, Paddington, W.

ROBINSON & HANDS ELECTRICAL CO.—This company was registered on November 20th, with a capital of £1,000 in £1 shares, to carry on the business of manufacturers of and dealers in electrical and gas fittings and accessories, &c. The subscribers are A. C. Robinson and W. C. Hands, 54 Barwick Street, Birmingham, electrical engineers. Private company. The number of directors is not to be less than two nor more than five; the first are A. C. Robinson and W. C. Hands. Qualification, 10 shares. Registered office, 54 Barwick Street, Birmingham.

WEST KENT ELECTRIC CO.—This company was registered on November 11th, with a capital of £100 in £1 shares, to carry on the business of electricians, electrical, mechanical, metallurgical, and chemical engineers, &c. Minimum cash subscription, £20. The number of directors is not to be less than two nor more than seven; the first are P. H. Martin and G. E. Bird. Qualification £10. Remuneration as fixed by the company. Registered by Minet, Pering, Smith & Co., 7 St. Helen's Place, E.C.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Nov. 19th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1907 Patents

26,940, **Resistance Wire Alloy.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). An alloy which does not easily oxidise at even a red heat, and which resists the action of moisture and acids, is described in this specification. It consists of 62 parts by weight of nickel, 20 parts iron, 12 5 parts chromium, 5 parts manganese, and traces of silicon, carbon, and phosphorus. It can be rolled and drawn, and has a specific resistance 70 times that of copper. In the preparation of the alloy, hematite is first introduced into the crucible to decarbonise the nickel, and then the iron and other ingredients are added in succession. Clay-lined crucibles must be used. Four claims.

28,619, **Active Material for Accumulator Plates.** E. C. Ekstromer and M. Ekstromer. The usual active material, which consists of a metallic oxide formed into a paste, is not sufficiently porous to allow the evolved gases to be readily passed off, and for this reason the plates have a tendency to buckle. This invention relates to a new substance, which consists of an albumenoid, such as gelatine, that has been treated so as to be rendered porous and elastic. When this substance is mixed with the active material, the tendency to buckling is said to be overcome, sulphating diminished, and the life of the battery prolonged. Three claims.

1908 Patents

72, **Production of Undamped Electrical Oscillations.** S. Eisenstein. According to this invention it is proposed to use a Wehnelt cathode-ray tube, the cathode of which consists of a platinum plate coated with an alkali oxide, as the oscillator in an oscillating circuit connected on Duddell's system. It is stated that this gives better effects than when a mercury vapour lamp is employed, as regards the production of undamped oscillations. One claim, one figure.

661, **Armature Winding.** E. F. W. Alexanderson. If, in armature windings, only two coils per slot are employed, the leakage reactance between adjacent coils is equally distributed, but if more than two coils per slot are used, this is not so. According to this invention, the leads from the armature coils to the commutator segments are carried once across the armature at the bottom of the slots, and by suitably disposing these in the slots, the inequality in the reactances can be compensated for if four coils per slot are used. By carrying the leads twice across the armature, six coils per slot can be used. Three claims, five figures.

8,416, **Compound Metal Filaments.** Wolfram-Lampen Aktien Gesellschaft. This specification relates to metal filaments for incandescent lamps, consisting of an inner core of sintered niobium, osmium, vanadium, thorium, titanium, or zirconium, or alloys of these metals, with a coating of tungsten. Such filaments can be sintered to a higher degree than a pure tungsten filament, and are therefore stronger; they have also a high specific resistance, and, according to the specification, can be run at 0·5 watt per candle without a blackening of the bulb. The process of manufacture is to coat a filament of carbon and one or more of the above highly refractory metals, with a tungsten paste. The whole is then sintered together and the carbon expelled in the usual manner. The porous internal structure obtained causes the filament to have a very high specific resistance. Three claims.

14,763, **Construction of Commutators.** Akt. Ges. Brown, Boveri & Cie. The special mode of construction described in this specification consists in the use of discs, which are axially elastic, and are mounted on the shaft for supporting shrinking rings shrunk on the ends of the commutator. By the use of such elastic discs, the relative expansion between the shaft and the commutator segments is allowed to take place without friction. Apertures may be made in the walls of the discs to assist the cooling of the commutator. Two claims, two figures.

16,986, **Flywheel Motor Set for Intermittent Loads.** Société Anonyme Westinghouse and R. Brun. This flywheel set consists of a main continuous-current compound-wound motor, to which is coupled a flywheel and an auxiliary generating machine. The armature of the auxiliary machine is put in series with the series winding of the main motor and connected across a resistance which is in series with the main motor. The field winding of the auxiliary machine is connected across a portion of this resistance, and the shunt winding of the main motor is connected across the supply mains. When the motor is running light, the E.M.F. generated by the auxiliary machine exactly opposes the E.M.F. across the resistance, but when the motor is loaded, the latter E.M.F. predominates, with the result that a current flows through the motor series winding, reducing the speed of the set, so that energy is taken from the flywheel. Not only does the E.M.F. across the resistance increase, but the iron of the auxiliary machine becomes saturated; this, together with the drop in speed, augments the effect. In a modification of the above system, the auxiliary machine has two opposing field systems, one of which becomes saturated before the other, and produces a resultant E.M.F. in the motor series winding circuit, when the load comes on. Four claims, three figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

17,635, Milton. Inductor generators.
17,743, Marino. Metallisation of vitreous surfaces so that metal may be electrolytically deposited on them.
23,916, Latour. Single-phase machines.
23,977, Brown & Dearlove. Telegraph apparatus.
23,988, Harrison & Dorman. Process for producing tungsten metal combinations.
24,006, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Electromagnetic relays.
24,234, Reid. Magneto generators.
24,283, Schoop. Welding aluminium.
24,343, Cox, & Edison & Swan United Electric Light Co. Signal lamps.
24,404, Sunderland Forge & Engineering Co., & Blair. Hauling and winding apparatus.
24,550, Fennell & Perry. Electric radiators.
24,933, Gese. Devices for indicating the extent of the charge or discharge of an accumulator.
25,842, Irwin, Robson, & Cook. Distribution of power by transformers.
25,923, Maley. Track brakes for rail- or tram-cars.
27,958, Thomson. Brakes for railway- and tram-cars.

1908 Patents

218, Douse. Steam turbines.
425, Hytten. Telegraphone apparatus.
980, Ransford (*Manson*). Apparatus for straining telegraph and telephone wires.
2,294, Tunbridge. Nut for the terminals of accumulators.
2,492, Wengelin. Means for controlling lamps from a distance.
3,049, How & Partington. Electric connections.
3,391, Leitner. Variable-speed dynamos.
3,602, Jamieson. Steam turbines.
3,662, Kilroy, Needham, & Evershed & Vignoles, Ltd. Apparatus for the production of sound in air or water.
4,371, American Electrical Novelty & Manufacturing Co. Speed indicators.
6,605, Morrison. Lamp globe gallery.
6,939, Royer. Ignition apparatus for explosion engines.
9,620, Bonn & Jones. Hand-fed arc lamps.
9,682, Turner. Fluid pressure brakes.
10,098, Ward & Stevens. Filament for glow lamps.
11,175, Kohler & Kohler. Electrical operation of tramway points from the vehicles.
11,945, Mitchell. Surface contact traction systems.
12,580, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Alternating-current commutator motors.
13,397, Hill & Read. Lock with automatic bell alarm.
13,852, Delage & Woog. Incandescent gas lamps with electric ignition.
15,746, Lafitte. Long distance lighting.
15,875, Moonen. Sparking-plugs for explosion motors.
20,601, Siemens Bros. & Co., & Ferreira. Electrically-controlled railway signals.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

5,089, Savart & Graindorge. Electric tremblers.
18,523, Schmelzer. Metallurgical furnaces.
20,005, Fessenden. Electric signalling.
21,263, Fessenden. Electric transmission of energy.
21,385, Siemens & Halske Akt.-Ges. Metal filament lamps.
22,236, Basset. Electric batteries.
22,562, Voigt & Haeffner Akt.-Ges. Distributing stations.
22,824, Soc. d'Electro-Chimie. Electrolytic production of sodium.
22,951, Schollenberger. Combined trolley wheel and sleet cutter.
23,489, Snook. High potential rectifying switch.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10¼—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½	9⅞—9⅞	
Do. 6% Cum. Second Pref.	10	6	6%	10⅝—10½	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E. L. & Power Co., Ltd.	5	5½	4½*	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—98	
Brompton & Kensington E. S. Co., Ltd.	5	10	5%*	7⅜—7⅝	+⅛
Do. 7% Cum. Pref.	5	7	7%	7¼—7⅜	+¼
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	3⅝—4⅜	+⅜
Do. 4½% Cum. Pref.	5	4½	4½%	4—4⅛	+¼
Do. 4% Deb. Red	Stock	4	4%	97—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3⅝—4⅛	+⅜
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	3—3⅛	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
City of London Elec. Lt. Co., Ltd.	10	6	6%	9⅝—10⅛	+⅝
Do. 6% Cum. Pref.	10	6	6%	12¼—13	
Do. 5% Deb. Red	Stock	5	5%	123—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—103	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3⅝—4	
County of London Elect. Sup. Co. Ltd.	10	5	—	7⅝—8⅛	+⅛
Do. 6% Cum. Pref.	10	6	6%	10½—11	+¼
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	97—100	
Edmunson's Electricity Corp., Ltd.	5	—	—	1⅜—1⅝	
Do. 6% Cum. Pref.	5	—	—	⅝—¾	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	62—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6¼—6½	+1/8
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E. L. Co.	5	10	4%*	7⅛—8¼	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E. L. Cos. Db. Rd.	Stock	4	4%	97—100	
London Electric Supply Corporation	3	2½	—	1—1⅜	+1/16
Do. 6% Pref.	5	6	6%	4½—5	+⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	90—93	+1
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	5—5½	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5¼	+⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—109	+½
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4⅜—5½	-⅛
Do. (fully paid)	5	8	2½%	4⅜—5⅜	
Do. 5% Pref. Do.	5	5	2½%	5⅛—5⅜	
Do. Do.	5	5	2½%	5—5⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5½—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	7⅜—8¼	+¼
Do. 7% Non-Cum. Pref.	5	7	7%	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½%	87—91	+1
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅞—1⅛	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2¼—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—⅞	
Do. 7% Cum. Pref.	1	7	7%	1—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	99—102	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅞—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	-⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8—8½	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3%*	65—67	-8
Do. 4% Preferred.	Stock	4	4%	86—88	
Do. Deferred	Stock	2	—	51—53	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	86—88	+1
City and South London Cons.	Stock	4½	1½%	32½—33⅝	
Do. 4% Perp. Deb.	Stock	4	4%	9⅞—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—109	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—1	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	7⅜—8¼	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	—	
Metropolitan Cons.	Stock	½	½%	36½—37½	
Do. 3½% Preference	Stock	3½	3½%	85—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	76—78	
Metropolitan District	Stock	—	—	12¼—13	
Do. 6% Perp. Deb.	Stock	6	6%	123—125	
Do. 4% Deb.	Stock	4	4%	80—83	-2
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—27	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	+2
Underground Elec. Railways Co of London 5% Prior Lien Bds.			5%	92½—93½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅞—1¼	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅛	+1/16
Do. 6% Cum. Pref.	10	6	6%	3½—4	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	3—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%	%		
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	3—4	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	—	¾—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Street Tramways Co.	4	4/6	2½%	⅜—⅞	
London United Trs., Ld., Cm. Pf.	10	5	—	1⅛—1⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	4⅜—5½	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	70—75	
Do. 5% Cum. Pref.	1	5	5%	⅜—⅝	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	⅞—1⅛	
National Elec. Construction Co. Ltd.	1	2/-	—	92—95	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅜—⅝	
North Metropolitan Trams Co.	£4 10s.	1/-	—	¼—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	95—100	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	2½%	⅜—⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93 xd	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜—5½	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	+1
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	2⅜—3⅜	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	58—61	
Do. 6% Pref. Ord.	Stock	6	6%*	102½—103½	-1
Do. Def. Ord.	Stock	1	—	17½—17⅝	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	89—91	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4¼	4¼%	13¼—13⅜	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	101—103	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	100—102	
Do. do. (Mauritius Sub.)	25	4	4%	90½—101½	
Eastern Ext. Australasia & China	10	7	5%	11½—12	-⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½%*	133—136	-1
Do. 3½% Pref.	Stock	3½	3½%*	84—86	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2%*	56—59	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	-1/16
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	117—119	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5 1/16—5 1/16	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	101—103	
Western Telegraph Co., Ltd.	10	7	6%*	12¾—13½	-¼
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅜	
Do. 6% Cum. Pref.	1	6	7%	¼—⅜	
Babcock & Wilcox, Ord.	1	20	16%*	3¾—4	
Do. 6% Pref.	1	6	6%	1 1/16—1 1/8	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6½—6⅝	
Do. 6% Cum. Pref.	5	6	—	6—6⅛	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	—	
Do. 6% Pref.	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	50—54	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5½—5⅝	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅝—1⅝	
Do. 6% Cum. Pref.	1	6	6%	1 1/16—1 1/16	+1/16
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	¾—⅞ xd	
Do. do. (fully paid)	5	4/2	2/6*	1⅜—2½ xd	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	+1
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	—	1—1½	-¼
Do. 4½% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	6¾—7¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4	4%	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10¾—11½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—109	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16⅝—17⅜	
Do. 4% Deb. Red.	106	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	31½—33½	-½
Do. 4% Deb. Bds. Red.	100	4	4%	101½—103½	
Willans & Robinson Ord. Shres.	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅝—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	70—74	

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A NEW telephone exchange is approaching completion in Cardiff, where hitherto the Post Office and National Telephone Co. have been in competition. The new exchange has been built by the Post Office, and is to be rented to the National Telephone Co. (whose existing exchange is full) until the expiry of the company's license in 1911. A feature is a new subscribers' operator's cord circuit, in which the repeating coil is not employed. (Page 721.)

AT this evening's meeting of the Borough Council of St. Marylebone, the proposal to adopt electric lighting in all the streets in the borough in which mains are laid will be discussed. It is proposed to use the old gas lamp-posts, merely substituting two metal-filament lamps for the present incandescent gas fitting in each lamp, and to connect each lamp-post separately to the ordinary service mains. The Lighting Committee would pay an annual sum to the Electricity Department which would bear all capital charges connected with the change over. (Page 724.)

MR. W. R. Cooper, in his Paper read last Thursday before the Institution of Electrical Engineers, considered the various methods of charging which had been proposed from time to time in relation to a supply both for lighting and domestic heating and cooking. He condemned all existing systems, especially the maximum demand system, and proposed one involving the payment of a fixed sum per annum, based on the total wattage of the lamps installed, plus $\frac{3}{4}$d. per unit used. The latter portion dealt with electric cooking and domestic heating in a somewhat superficial manner. The discussion turned principally on the first part of the Paper, but no satisfactory agreement was arrived at as to a suitable tariff. The general opinion expressed, however, was that the progress of electric heating and cooking was not so much a question of tariff as of the cost and design of the apparatus. A long communication was received from Mr. F. A. Wilkinson (Electrical Engineer and Manager, Marylebone), which gave the results of practical experience in electric heating and cooking, and definite figures of current consumption. (Page 725.)

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MR. G. C. Lloyd, who has been secretary of the Institution of Electrical Engineers since 1904, has been appointed secretary of the Iron and Steel Institute, in succession to the late Mr. Bennett H. Brough. (Page 729.)

THE proposal of the German Government to impose a tax on electricity, gas, and illuminating apparatus is meeting with considerable opposition. A committee of representatives of the various branches of the electrical and gas industries has been formed for the purpose of collecting information and of organising opposition to the Bill. In an article in a German contemporary, Dr. Fasolt criticises the statements made in the explanatory memorandum published with the Bill, and points out that the tax will affect the working classes quite as much as the upper classes, and is therefore not a tax on a "luxury." We give some figures, showing the probable influence of the tax on the cost of coal mined in the Ruhr district. (Page 730.)

LETTERS appear in our correspondence columns replying to an inquiry for small remote control switches, and relating to the losses in small 25-volt transformers. A correspondent also describes an interesting method of obtaining unusual frequencies for testing purposes. (Page 730.)

IN a Paper on the application of storage batteries to alternating-current systems, read before the American Institute of Electrical Engineers by Mr. L. Woodbridge, the author discusses the most suitable methods of regulation for various different conditions of load. Preference is given in a number of instances to the "split-pole" converter, and a special type of exciter is also described for controlling the field of a booster or split-pole converter, in response to variations of load on an alternating-current system. (Page 731.)

THE reading of Mr. W. N. Y. King's Paper on natural and induced draught was followed by a discussion, in which a number of well-known engineers took part. The basis on which a comparison of cost should be made was discussed, and several speakers emphasised the desirability for entirely re-designing a natural draught system, if it is to be converted to induced draught. Several combined systems were mentioned. (Page 734.)

THE Fire Brigade Committee of the London County Council have presented a report dealing with fires upon tube railways, in which certain recommendations are made with regard to inspections of the fire appliances, automatic indicators showing when the current is on or off, &c. (Page 734.)

IN a Paper read recently before the Rugby Engineering Society, Mr. J. Findlay dealt with the subject of carbon and tungsten filament incandescent lamps, and urged the view that it was uneconomical to run tungsten lamps at an efficiency higher than 1·25 watts per c.p. (Page 735.)

A SHORT article describes an improved form of alternating-continuous converter for charging accumulators and similar purposes. (Page 735.)

UNDER "Electrometallurgy and Electrochemistry" a new and partly electrolytic method of winning copper is described, and a note is given on a German patent connected with the preparation of electrolytic zinc. (Page 736.)

WE give particulars of some further Bills which will be promoted in the next session of Parliament. (Page 736.)

A DEPUTATION of the London County Council waited upon the Prime Minister on Thursday, urging the creation of a Traffic Board for dealing with locomotion questions in London, as recommended by the Royal Commission in 1905. The Prime Minister replied that his own opinions were rather that London suffered from a superfluity of authorities in this connection, but promised that the proposal should have consideration. (Page 736.)

BOTH the London Electric Supply and the London (Westminster and Kensington) Electric Supply Bills have been passed by Sir Luke White's Committee of the House of Commons, and reported for third reading. The former Bill contains provisions constituting the London County Council the purchasing authority of eight of the London companies in 1931, the Council being compelled to give three years' notice of their intention to purchase, and to furnish the companies with the necessary capital for developing their undertakings during the period of notice. Should the Council not purchase in 1931, it may purchase at subsequent periods of ten years. The County Council has not been constituted the purchasing authority of the companies named in the second Bill, but should legislation be promoted in the future to this effect, the companies have pledged themselves not to oppose. A report has been issued by the Parliamentary Committee of the London County Council, in which strong exception is taken to the provisions in the London Electric Supply Bill, in so far as these concern the Council, and a recommendation that the Bill should be opposed, unless drastic alterations are made, was carried at Tuesday's meeting. Notice to reject the Bill on third reading has been given by five members of the House of Commons, four of whom are members of the London County Council. A deputation representing 15 metropolitan borough councils and 13 local authorities owning electricity works outside the County of London waited upon the President of the Board of Trade on Thursday to ask the Board of Trade to assist in the passing of the later subjects in the Electric Supply Bill, and also to re-introduce the Electric Supply Bill which was introduced several sessions in succession by the Board of Trade, one of the main provisions of which was to enable electrical undertakings to give and take supplies of electricity in bulk. Mr. Winston Churchill replied that as the Bill just passed by Sir Luke White's Committee only dealt with the County of London, it would be necessary for the Board of Trade to re-introduce the other Bill, which would allow authorities outside the metropolitan area to link up in a similar manner. (Page 741.)

AMONG the specifications published by the Patent Office on Thursday last is one by Q. Marino, in which a process for preparing vitreous surfaces for electrolytic deposition is described. A specification by F. Harrison and C. H. Dorman relates to the manufacture of an organic compound of tungsten, which is a conductor of electricity, and an improved flux for use in the welding of aluminium is covered by a patent granted to M. U. Schoop. In a specification by C. W. Cox and The Edison & Swan United Electric Light Co., Ltd., a high-tension vacuum tube lamp for flash signalling purposes is described. An electromagnetic coupling for electric cranes, hoists, and winding-gear is the subject of a specification by The Sunderland Forge & Engineering Co., Ltd., and W. Blair, and another by J. T. Irwin, W. E. Robson, and J. L. Cook relates to automatic switches for auto-transformers. A split-tube cable-connector has been patented by H. D. How and W. W. Partington, and a patent for an improved lamp-globe gallery has been granted to A. Morrison. A patent by G. J. Schoeffel for an electrically controlled steam whistle expires during the current week. Abstracts of all of the above specifications are given in our Patent Record. (Page 740.)

A FURTHER offer has been made to the Acton Urban District Council by the Metropolitan Electric Supply Co. for a supply in bulk. The rate now quoted is £5 per kilowatt per annum of maximum demand, plus 0·33d. per unit; but the Council have instructed the

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Town Clerk to negotiate with the company for the complete working of the Council's undertaking.—The Bridgend Council has formally taken over the local power station of the South Wales Power Co.—An offer by the Reason Manufacturing Co. to provide electric radiators at a quarterly rental in Brighton, the Corporation merely to collect the accounts, has been accepted.—An agreement has been entered into with the Poplar Borough Council by the L.C.C. for the lighting of Blackwall tunnel.—The Stepney Borough Council has before it a report by its Works Committee, protesting against the suggestion in the report of the Board of Trade Traffic Department that it is impossible to use the conduit system in the Mile End Road.—Damages to the extent of £200 have been awarded to a passenger who was injured on the Manchester Corporation Tramway system.—An offer has been made by a British syndicate to purchase the St. Petersburg Municipal tramway system.—The Weymouth Corporation is considering the trackless trolley system. (Pages 741-742.)

A 2,500 kw. turbo-alternator is required by the Cardiff Corporation; motors of various sizes are required by the Birmingham Corporation; and electrical stores by the Edinburgh and District Tramways Co. and the Powell Duffryn Steam Coal Co. New plant to the extent of £7,000 is to be installed by the Sheffield Corporation; a loan of £9,000 is to be taken up by the Hammersmith Borough Council; 33,000 incandescent electric lamps are required by the Melbourne City Council, and an expenditure of £250,000 is contemplated upon the telephone service in Austria. The Salford Corporation have accepted the tender of Messrs. Balcke & Co. for water-cooling plant at £12,344, and the tender of the British Thomson-Houston Co. for a turbo-alternator at £2,400 has been accepted by the Watford Council. (Pages 742-744.)

The scheme of arrangement in connection with the reconstruction of Messrs. Bruce, Peebles & Co. has now been sanctioned by the Courts, and the first directors of the new company have been appointed. It is stated that the accounts of the South Wales Electrical Power Distribution Co., when made up at the end of the year, will show that the reconstruction has been successful. (Page 745.)

The rejection of the London and District Electricity Supply Bill would seem, if anything, to have accentuated the difficulties surrounding the unification of the existing supply undertakings in the metropolis. The net result of the prolonged Parliamentary proceedings this session is that the London County Council, through the medium of some of its members, who also sit in the House of Commons, has taken upon itself —in the absence of certain proposed amendments—the responsibility of blocking both the Bills dealing with the purchase of the companies' undertakings, which were passed by Sir Luke White's Committee last week. The present position, it is to be feared, is largely due to a want of clearness on the part of the Government in their pronouncements upon the subject, which has been reflected in a marked degree in the various decisions of the House of Commons Committee to which the interpretation of the Government instructions was subsequently entrusted. Thus, although in respect of eight companies, the London County Council is constituted the purchasing authority in 1931, yet the question of who shall purchase the West End companies is left over for future legislation, which may or may not be successfully resisted. But the real point upon which the County Council has determined to take drastic action concerns the terms of purchase. The instruction to the Committee stated that the County Council shall purchase "upon equitable terms," and it appears as if the companies, as the result of a conference with the Board of Trade, have been led to believe that this signified, as the Committee have construed it, something over and above the ordinary terms of the Electric Lighting Acts, in consequence of the increased value of the undertakings, due to the linking up. To this the strongest possible objection was taken before the Committee by the London County Council, but without avail. To add to the confusion of ideas on the subject, Mr. Winston Churchill's remarks to a deputation on Thursday amount to the statement that whilst the Department were prepared to facilitate linking up between the undertakings inside the county with those outside, every effort must be made to prevent the companies getting terms any more advantageous than those set forth in the Electric Lighting Act of 1888. Thus the views of the companies as to what they had been promised, the views of the Committee regarding the announcements of the Board of Trade, and the intentions of the Board of Trade itself would seem to be all at variance, and we are afforded the spectacle of both parties at Spring Gardens united to prevent the companies securing advantages, under their Bill, which would not have come to them had the original position remained unchanged. This aspect of the question, of course, leaves out the great advantage to the County Council of having a more or less complete undertaking handed over to it in 1931, instead of a number of isolated undertakings, upon which large sums of money would have to be spent for the purposes of consolidation. But however all this may be, there seems little desire on the part of the authorities to deal with the problem in a statesmanlike manner, although no clear reason exists why this should be so.

Mr. W. R. Cooper's Paper at last Thursday's meeting of the Institution of Electrical Engineers dealt with a subject about which comparatively little is known, and neither the Paper nor the discussion can be said to have added much to this small sum total of knowledge. The points which appear to have been most clearly brought out were the unsuitability of every existing tariff system for a mixed lighting and heating load, and the hesitation that is being shown in adopting such heating and cooking apparatus as is already obtainable, partly from ignorance, partly on the score of high first cost, and partly from the idea that the running costs of electric heating and cooking are prohibitive. The tariff question is not one that will be solved until more is known about the proportions and nature of the load that will arise when electric heating and cooking have come to stay, when possibly Mr. Mordey's dream of a universal flat rate will be realised. In the meantime, as additional wiring is practically always necessary on account of the heavier current, the separate-circuit system, with all its disadvantages, will probably continue to be used, except in cases of a few small radiators, where plug meters can be employed. Apart from cooking, domestic electric heating seems to be already finding its own place, and this is strikingly shown in the figures relating to the growth of the heating load at Marylebone on page 729. For large rooms, general house-heating and long-

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hour purposes, electric heating at present supply prices is practically out of the question, but for bedrooms, small sitting-rooms, and the like, its comfort, cleanliness and economy are rapidly receiving their due appreciation. It may also be said that the convenience of such appliances as electric flat-irons, and other small domestic utensils, only requires to be known to lead to their very general adoption, although the amount of current they take is too small to materially affect the question. The subject of electric cooking is somewhat different. Very little is known either of actual running costs or the behaviour of the apparatus now obtainable in the hands of the English cook, and even the author of the Paper had to admit that he did not speak from experience. Such experiments as have been carried out—and as to these Mr. Wilkinson's communication is of value—appear to indicate that with a reasonably low cost of energy, the working cost does not compare unfavourably with that for gas, while its greater cleanliness makes it far preferable. The expense of maintenance, like that of first cost, will not reach a steady state for some time to come, as it is only extended experience which can lead to improvements in construction, which will minimise the wearing parts, and ensure their easy and cheap replacement. A great deal has been done already in this direction, and it is only increased activity on the part of both supply authorities and manufacturers which can lead to that appreciation of the facilities already available which will give the impetus necessary for further progress.

THE arguments placed before the Prime Minister last week by the deputation of the London County Council, which urged the creation of a Traffic Board for London, did not exactly put into effect the recommendations under this head of the Royal Commission on London Traffic in 1905. All that the County Council seem to require carried out would seem to be quite capably done at the present time by the Special Traffic Branch of the Board of Trade; we might almost say more capably done than would be the case with an elected body. The Royal Commission on London Traffic obviously intended that its proposed Traffic Board should exist in a much more tangible form than a mere adviser, whose opinions might or might not be acted upon. Reading between the lines, it was evidently intended that all schemes affecting locomotion and transit in the whole of Greater London should be examined, in co-operation with the parties promoting them, and a report presented to the Parliamentary Committee considering them, and that this report should be treated as an official communication, upon which the Committee would be bound to act, much in the same way that reports from the Local Government Board and the Board of Trade are regarded at the present time. Such a Traffic Board must be endowed with official powers far in advance of those of an advisory body pure and simple, otherwise the whole object of its existence would be rendered nugatory. That this was the feeling which prompted the wording of the report of the Royal Commission is evident from the expression of opinion that, after scrutiny by the Traffic Board, there would be no necessity for Bills to go before two Parliamentary Committees, as is at present the case, but that having been previously investigated by the Traffic Board, schemes would need only to be considered by one Committee or a Joint Committee of both Houses. Unless this attitude were taken up in relation to the constitution of such a Board, there would be little justification for its existence, for, as pointed out by the Prime Minister, it would merely add another to the already superfluous number of authorities with which London and Greater London are burdened. We are therefore inclined to deprecate the attitude adopted in this matter by the Council. It must be remembered also, if only for geographical reasons, the problem is one that must be handled by an authority with a wider sphere of action than a committee of the London County Council.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, DECEMBER 3RD.

Civil and Mechanical Engineers' Society.

8 p.m. Meeting at Caxton Hall, Westminster. Paper to be read :—"The Influence of Track upon Railway and Tramway Carriages," by J. Sutherland Warner.

Röntgen Society.

8.15 p.m. Ordinary general meeting at 20 Hanover Square, London. Paper to be read :—"Phenomena Observed in Electrical Currents of Continuous Oscillation," by Dr. Horace Manders.

MONDAY, DECEMBER 7TH.

P. & O. Batti-Wallahs Society.

7.45 p.m. Smoking Concert at Great Eastern Hotel, Liverpool Street, London.

TUESDAY, DECEMBER 8TH.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Meeting at the Municipal School of Technology, Whitworth Street, Manchester. Paper to be read :—"Single-Phase Railways," by P. C. Jones.

Institution of Electrical Engineers: Glasgow Local Section.

8 p.m. Ordinary meeting at 207 Bath Street, Glasgow.

WEDNESDAY, DECEMBER 9TH.

Association of Engineers-in-Charge.

7 p.m. Meeting at St. Bride's Institute, Bride Lane, Fleet Street, London. Paper to be read :—"Coal : Its Composition and Combination," by W. H. Booth.

THURSDAY, DECEMBER 10TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster. Paper to be read :—"Output and Economy Limits of Dynamo Electric Machinery," by J. C. Macfarlane and H. Burge. Time permitting, the following Paper will be read :—"Commercial Electric Heating," by John Roberts.

FRIDAY, DECEMBER 11TH.

Physical Society.

8 p.m. Ordinary meeting.

Telephony in Austria.—Owing to the enormous development of the telephone traffic on the two lines between Vienna and Berlin, two new lines are to be laid. According to the Vienna correspondent of the *Standard*, the Austrian post-office intends to spend a quarter of a million sterling on these and other lines next year. The two new trunk lines are to connect Vienna with Berlin and Frankfort respectively, the latter passing through Munich. The lines at present in use consist of one direct line to Berlin *via* Prague, and one made up of many connections. The new line to Berlin will render communication between Vienna and Hamburg, and even Trieste and Hamburg, easy of accomplishment, so that there will be a direct link between the shipping interests of the Adriatic and the North Sea. In Austria itself a new trunk line is to be built between Vienna and Prague, and local conditions are also to receive consideration. The important manufacturing towns in Bohemia, Moravia, and other districts are also to be connected. In Vienna itself the existing telephone system is to be reorganised, and accommodation for 110,000 subscribers provided, which is more than five times the present number. New main cables will be laid, and new exchanges will be built in various parts of the city.

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NEW COMMON BATTERY EXCHANGE AT CARDIFF

By T. Devereux

A NEW common battery exchange is at present in course of construction as an extension of the Cardiff Post Office. Although constructed by the Post Office, it is intended for the use, until 1911, of the

Fig. 1.—Arrangement of Apparatus at Rear of the Sections.

National Telephone Company, whose central exchange in Cardiff has outgrown the capacity of the building in which it is at present located. The new exchange will have a capacity for approximately 10,000 subscribers, and an equipment for 4,600 has been provided at present.

The street cables will be jointed to silk- and cotton-covered cables in the external chamber outside the building, and the latter will then be led to the horizontal side of the main distributing frame, where they will be terminated on porcelain strips fitted with fuses. The main frame is situated in the basement, in the same room as that containing the main frame of the Post Office existing common battery exchange, for hitherto there have been competing telephone systems in Cardiff. A two-position engineer's desk, equipped with the necessary apparatus for testing the lines, is also fixed in this room.

The vertical side of the main distributing frame is fitted with lightning arresters and heat coils, each strip accommodating 120 circuits. The lead-covered silk and cotton-covered cables (each of which accommodates 200 circuits) conveying the lines to the apparatus room are taken up the existing chute on their way to the intermediate distributing frame, which is situated on the first floor. Fig. 2 shows the lay-out of the apparatus room. A lamp cabinet does not form part of the equipment, as the lamp resistances have been dispensed with (see Fig. 4). The 24-volt battery passes through the line relay on to the subscribers' *B* line, and line leakage on the *B* line is shown up by the glowing of the subscriber's calling lamp. A 4-volt tap is not used, and no provision is made for automatically showing up a fault on the *A* line. The line and cut-off relays are wired from the vertical side of the intermediate distributing frame, and are numbered to correspond with the operator's panel numbers.

A large proportion of the lines to be joined to the exchange are rented by unlimited service rate subscribers, and consequently only 2,300 service meters have been provided. These are wired by means of 21-wire cables to 100-tag connection blocks fixed at the top of the vertical side of the intermediate frame.

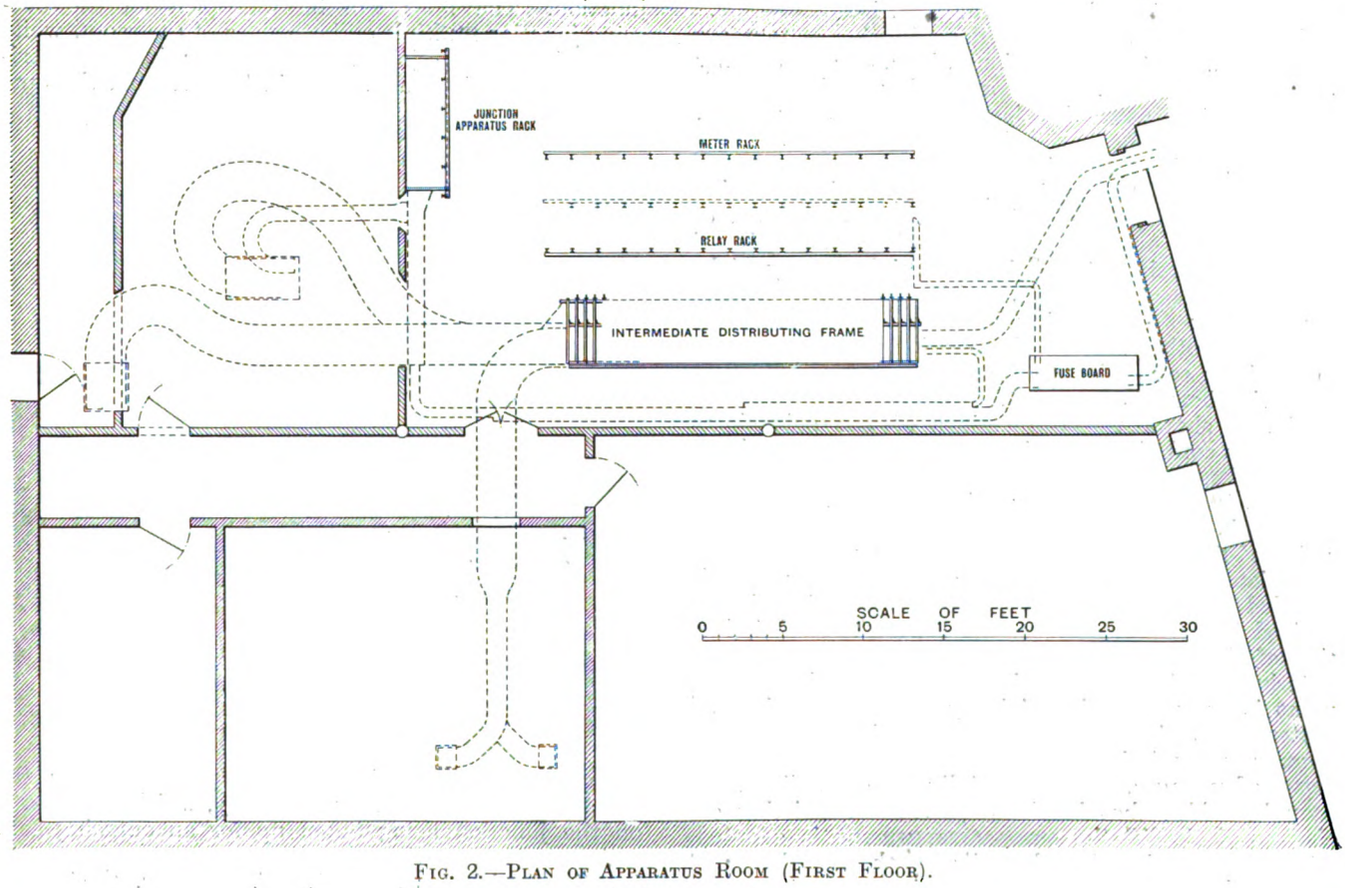

Fig. 2.—Plan of Apparatus Room (First Floor).

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Single "jumper" wires will be run from the "test" connection of the tags on the horizontal side to these blocks in the cases of the subscriber's circuits requiring the use of meters. On those circuits to which no service meters are connected, the operator's meter will be sensitively adjusted to operate through the cut-off relay. This adjustment is rendered necessary by the fact that under normal conditions the 30-volt battery passing through the operator's meter is insufficient to energise

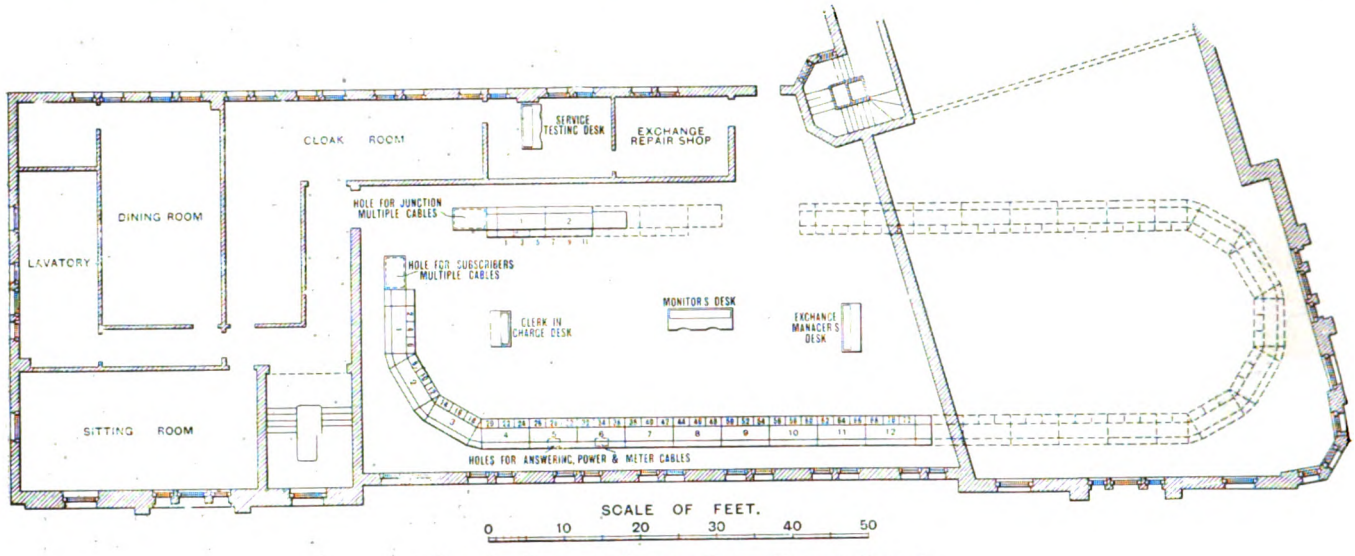

Fig. 3.—Plan of Switch Room (Second Floor).

it until the 40-ohm coil of the service meter has been brought in.

The fuseboard has a capacity for approximately 1,900 fuses, which will be of the bead indicator type.

The subscribers' or *A* positions in the switchroom comprise twelve 9-panel sections with a 3-panel dummy section at each end. The answering positions have capacity for 50 answering jacks and lamps per panel, the present equipment being 40 per panel. Each operator's position contains three panels, and will thus accommodate 120 subscribers. The outgoing junction shelf has capacity for 600 lines, with an equipment of 100 multipled every six panels, and the subscribers' multiple comprises 4,600 lines multipled every eight panels. The last operator's position is fitted as a testing position; no answering jacks or lamps are fitted, although in other respects the position is fully equipped to facilitate conversion to an answering position when the switchboard is extended.

Fig. 5 shows the connections of the subscribers operator's cord circuit, which may be briefly described, as it differs somewhat from the more widely known systems in which repeating coils are used. A steady current is fed out from the battery on to the subscribers' lines through the supervisory relays and retardation coils, and a path for the speech waves is afforded through the condensers, which it will be noticed form a shunt across the coils. The self-induction of the coils prevents the speaking currents from entering the battery. It is found that this arrangement is fully equal in efficiency to the repeating-coil system used by the Western Electric Company as regards transmission; while for reception it possesses some advantages, more especially on short lines. It may be added that in the department's existing exchange at Cardiff the same arrangement is adopted, with the exception that the coils are there each wound to 100 ohms, and that the relay is placed in the *A* or tip side of the plug, and the retardation coil in the *B* or ring side.

On the junction side of the switchroom two 3-position sections, each position to accommodate 27 in-coming junctions, are provided with a two-panel dummy section at each end, and a cable-storing section. The junction sections are wired for 81 trunk junctions, 27 magneto junctions, 42 "two-way" junctions, and 12 junctions in-coming from the department's existing exchange in the same building. These latter are for intercommunication purposes between the subscribers of the two systems. The subscribers' lines and the outgoing junctions are multipled on the *B* positions every six panels. "Busy back" and "Don't answer" signals are provided on the *B* positions, but not on the *A* positions.

Fig. 6 shows the connections of the "two-way" junction. The lines will be multipled on the outgoing junction multiple on both sides of the room, while they will also be joined to the *B* or junction positions for incoming calls. It will be seen that the out-

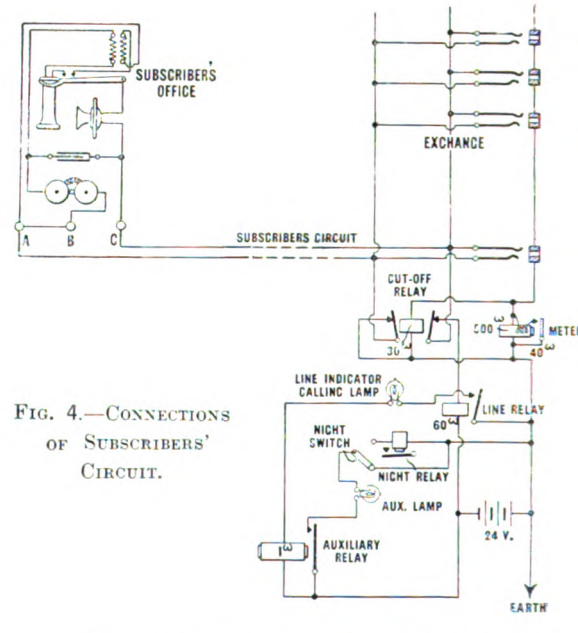

Fig. 4.—Connections of Subscribers' Circuit.

going portion of the circuit is completed through the armatures of the 30-ohm cut-off relay, which is actuated on the junction being taken up for an outgoing call, while at the same time the apparatus on the in-coming junction position is cut out. If, however, the circuit is being taken up for in-coming purposes, the "engaged" test is put on the outgoing junction multiple bush through the 1,000-ohm spool and the left-hand contacts of the 350-ohm relay. The current through the 1,000-ohm spool and the 30-ohm relay is

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insufficient to actuate the latter, and the normal conditions required for incoming calls are thus retained. Two pairs of supervisory relays and retardation coils are required for each circuit, the relay on the left being energised when the lines are looped through the operators' telephone at the distant exchange and lighting the calling lamp, while the right-hand relay controls the supervisory lamp.

The connections of a junction circuit in-coming from the trunk exchange are shown in Fig. 7. The trunk operator, on inserting a plug in the trunk junction multiple, puts the battery tone test is put on the sleeves of the trunk junction plugs to inform any other operator making the engaged test that the subscriber is connected to a trunk line.

The five-point jack is provided for the insertion of a plug in cases where a subscriber engaged locally consents to take a trunk call, and is arranged to send a flashing signal to the *A* position where the subscriber is at the time connected.

The sections are constructed so far as possible of non-inflammable materials. The skeleton framework is of iron, and Quebec ash is used inside the sections. The fronts of the sections are of polished mahogany, which is backed with uralite. The plug-shelf and the

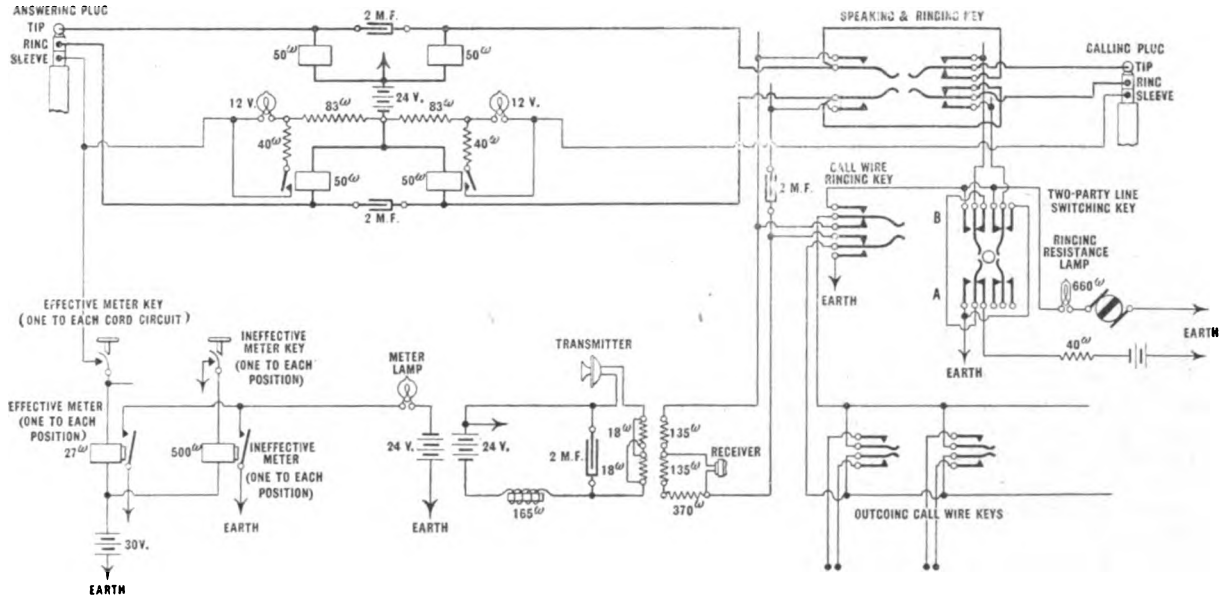

Fig. 5.—Subscribers Operators' Cord Circuit.

on the bush. The current splits equally through a 500-ohm spool at the trunk end and a 500-ohm relay at the junction position. The energising of this relay causes the 12-volt calling lamp to glow, the current also passing through a 40-ohm relay through the armatures of which the line connections pass. At the same time, current from the battery flows from the junction position through the left-hand contacts of a 350-ohm relay, and bridging coils on to the *A* and *B* lines and to earth at the trunk end through the operators' cord-circuit relays, lighting a red lamp on the trunk position. On the junction plug being placed in the subscriber's multiple, a double 83-ohm relay is actuated, and completes the *A* line

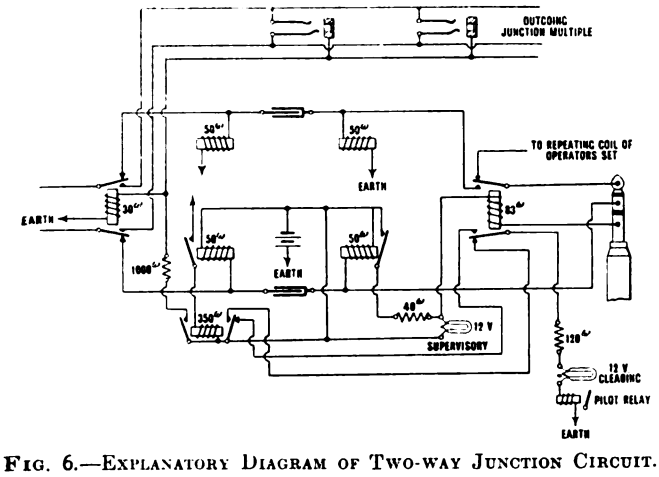

Fig. 6.—Explanatory Diagram of Two-way Junction Circuit.

connection through the top contacts, while at the same time the 12-volt calling lamp is shunted by the 40-ohm relay. When the subscriber replies, a 50-ohm supervisory relay is energised, and a path is provided for battery through the 350-ohm relay, breaking the left-hand contact and the path of the battery to the trunk exchange. The red lamp is thus darkened, intimating to the trunk operator that the subscriber is in attendance. The trunk operator clears to the junction position by breaking the circuit of the 500-ohm relay, and the calling lamp again lights at the junction position owing to the 40-ohm relay which was shunting the lamp being cut out. A special

portion of the key-shelf in which lamps are located is covered with leather, let in flush with the surface of the woodwork. The key-shelf slopes upward in continuation of the plug-shelf. The space above the multiple equipment line is filled in with polished mahogany slabs backed with uralite.

The apparatus associated with the operators' cord circuits is fixed on hinged mounting plates in the lower part of the sections at the rear of the positions, as shown in Fig. 1. The arrangement does not interfere with the changing of faulty cords, which can be effected without removing the wood panels at the front of

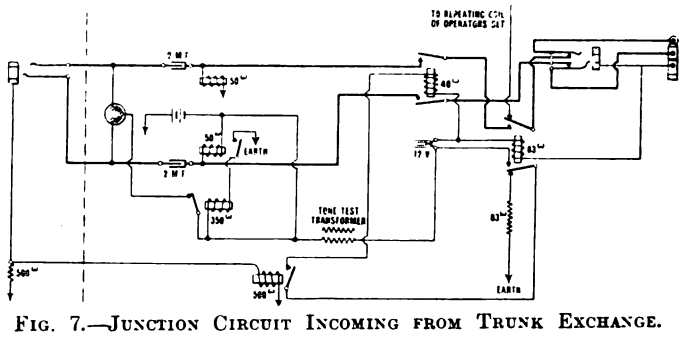

Fig. 7.—Junction Circuit Incoming from Trunk Exchange.

the section. The sections are closed at the rear by means of sliding panels of sheet-iron.

Desks for the chief operator, exchange manager, and monitor (the two latter each with two positions) are provided, the wires to the desks being conveyed in 42-wire lead-covered cables run in wrought-iron pipes laid in the floor. An instruction circuit to the "A" positions, by means of which conversation can be effected with all the operators simultaneously, is wired to the monitor's desk.

When a plug is inserted at the desk, a lamp, provided with a green cap, glows on each of the three operators' positions at

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each section. Each operator, on receiving the glow, depresses a spare call wire key, to which the instruction circuit is wired, and by so doing brings her telephone across the line, and at the same time, by means of two special springs, completes the circuit of a 350-ohm relay and cuts off the lamp. The operator then listens to the instruction required to be given from the desk, the circuit being again normal when the instruction circuit key is released, and the plug withdrawn at the desk.

A service-testing desk is fixed in a separate room adjoining the switchroom, to enable observations to be made in cases where it is required to watch the working of any subscriber's circuit. It is equipped at present with 30 lines.

In addition to the bees-waxing of all the cables, special precautions have been taken to maintain the insulation of the equipment, in view of the adverse atmospheric conditions which obtain in South Wales. On the main distributing frame, the cable forms are lapped with tape, which, with the laced wires, is afterwards coated with shellac varnish. On the horizontal side of the intermediate distributing frame the lead sheathing of the cables is covered with fire-resisting tape, where it is likely to come in contact with laced portions of other cables, and where the cable forms are tied to the framework the latter is first covered with bulldog tape. The whole of the cable forms and lacings in the intermediate distributing frame-room are also coated with shellac varnish. In the switchroom the keyboard cables are first lapped with bulldog tape and afterwards with fire-resisting tape, while the portions of the cables not treated with tape are shellaced. In no case are laced wires allowed to come in contact with the ironwork.

A system of emergency and fire-alarm circuits is also provided. The former consists of an arrangement of keys, electric trumpets, and lamp signals for calling together the male staff in case of emergency, and the fire-alarm circuits include a number of press buttons and alarm bells to be used when it is necessary to warn the whole staff to quit the building.

The exchange will be run from the existing power plant, with the exception that sufficient plates will be added to the two sets of secondary cells, which are at present only partially fitted, to bring them up to their full capacity of 3,060 ampere-hours at the nine-hour discharge rate.

The power plant comprises two motor generators for charging, one of 16 h.p. driven from the Corporation supply at 400 volts, and the other of 7½ h.p., driven from the Department's 105-volt supply. There are two smaller motor generators of 0·18 h.p. for ringing, both driven from the Department's supply, one of them being used for trunk-ringing purposes. There is also a reserve motor generator for ringing, which is driven from the 30-volt meter battery. Separate recording ammeters will be placed in the 24-volt and 30-volt battery leads to the new exchange, so that the amount of current taken to work the exchange may be measured.

An extensive scheme of underground work is being carried out in conjunction with the exchange equipment, cement ducts varying in capacity from 20-way to 3-way being laid along the principal thoroughfares. In the outlying parts of the town distributing poles will be erected, and the cables will be taken to these poles from the duct lines by means of 3-in. cast-iron pipes.

The writer is indebted to the British Insulated & Helsby Cables, Ltd., who have been entrusted with the carrying out of the exchange equipment, for the copies of diagrams, &c., accompanying this article.

A New Australian Engineering Journal.—The first number of a new monthly journal entitled the *Australian Mining and Engineering Review*, which is to hand from Melbourne, contains general notes and articles on the progress of mining and other engineering in Australia, and includes a special electrical section. Comprised in this there is a fully illustrated technical description of the electrical equipment of the Broken Hill Property Co., and an abstract of Mr. C. H. Merz's report on power supply in Victoria.

STREET LIGHTING IN MARYLEBONE

A SPECIAL Committee was appointed some few weeks ago by the Marylebone Borough Council on the recommendation of the Electric Supply Committee to consider a proposal to adopt electric street lighting generally instead of the present incandescent gas lighting. In a note on page 626 of ELECTRICAL ENGINEERING of November 5th we gave some details of the consulting engineer's report, according to which the total cost of electric lighting in those streets in which the mains are already laid would amount to £8,650 per annum; this figure would include the cost of the change over and all other extra charges. The cost of the present gas lighting for the same streets is £8,818 per annum. The report further states that after ten years this annual charge for electric lighting would be reduced to £8,130. The Special Committee will submit a report to the Council at the general meeting this evening, and we shall be able to publish the exact nature of the report and the results of the discussion in our next issue.

By the courtesy of Mr. F. A. Wilkinson, the Electrical Engineer and Manager to the Marylebone Electricity Department, we are able to publish the following particulars of the proposals. The number of lamp-posts in the streets in which the mains are already laid amount to about 2,000. Some have single, some have double, and some triple incandescent gas-burners, and it is proposed to put in two metal filament lamps in series in each lamp, of such candle-power that the light given is the same as, or slightly better than, that given by the present gas-mantles. In some special cases, two or more groups of two lamps in series will be used. The lamp-posts and the lanterns themselves will not be altered. Each lamp will be connected direct to the service mains with the necessary switch and fuses, but meters, of course, will not be used. The men who at present light up and extinguish the gas lamps will be required to switch on and off the electric lamps, as the cost of installing an electric control system—as, for example, that in use in Berlin for controlling the arc lamps (see ELECTRICAL ENGINEERING, November 19th, 1908, page 666), in which a single control conductor only is needed—would be too high. As the times of switching on and off are definite, the consumption of the lamps will be easily estimated. The present station plant is, of course, quite capable of dealing with the increase in the peak load which the above scheme would cause, and the steady load through the dark hours of the night will be a valuable means of improving the load factor.

With regard to the method of payment, it appears that the Lighting Committee will pay to the Electricity Department an annual sum about equal to that which has been paid to the gas company, for which the Electricity Department will have to bear all the capital charges connected with the change over, to maintain the lamps, and to supply the current. Although flame arc lighting is such a prominent feature in Oxford Street, we understand that no alternative proposal for arc lighting of other streets in the district has been considered. In this connection it may be interesting to mention that the cost of the Oxford Street arc lighting with eighty-seven flame arc lamps amounts to somewhat over £1,600 per annum. As the lamps only burn sixteen hours with one pair of carbons, the cost of trimming is somewhat high, and the total cost of carbons at 3d. per pair is also a large item over the whole year.

Underground Telephone and Telegraph Wires in London.—A reply has been received from the Postmaster-General to the London Borough Councils' letter recommending the placing underground of all telephone wires in order to provide work to alleviate the distress among the unemployed. Broadly speaking, the Postmaster-General states that he has no overhead wires at all in Central London. Such light lines as have been erected overhead in the outer and semi-rural districts of the London area could not be placed underground except at excessive cost. The suggestion of the Council does not appear to him to be practicable, but he is pressing forward extensions of the main underground telegraph system of the country which can be rightly claimed as a good and profitable investment.

The Electrochemical and Electrometallurgical Industries in France.—The following information is taken from the report of the British Consul in Lyons. The production of aluminium in France increased from 1,647 tons in 1904 to 3,396 tons in 1906; the total for 1907 is not yet available, but will probably be less than that for 1906. The following companies have established a supply of energy in large quantities for electrochemical purposes:—The Grenoble Power & Light Co., who have power stations at Moutiers, Avignonnet, and Bellegarde; the Central Electric Energy Co., who transmit power generated on the Drac as far as St. Etienne; and the Mediterranean Littoral Electric Energy Co., who supply the whole of the South of France from stations on the Durance. The principal electrochemical products are cynamide and nitrate of lime.

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ELECTRICITY SUPPLY AND DOMESTIC HEATING AND COOKING

A PAPER by Mr. W. R. Cooper relating to the use of electricity for domestic heating and cooking purposes was discussed last Thursday at the meeting of the Institution of Electrical Engineers. The author considered the subject as affected by the price at which the supply can be obtained, and incidentally reopened the discussion on systems of charging.

Mr. Cooper remarked at the outset that almost all existing tariffs had discouraged the use of electric energy for domestic power purposes because they were devised primarily for consumers requiring light.

In reviewing existing tariffs, the flat rate, in spite of its simplicity, was dismissed as unsuitable, because the flat rate, to be remunerative for lighting, must be much too high to induce any consumer to consider the problem of electric heating and cooking.

There was no doubt that the maximum demand system, as introduced by Mr. Arthur Wright, was sound in principle, but it was formulated at a time when lighting alone had to be considered. The system was still largely in use, and out of a total of 405 stations it was maintained in about 170.

Nevertheless, it had not been a complete success for the following reasons: (1) Owing to the popular difficulty in understanding the system, it has generally been necessary to give as an alternative a flat rate, having for its value a figure about midway between the limits used for the maximum demand. Thus if energy were supplied at 7d. for the first hour and 2d. thereafter the flat rate might be, say, 4½d. or 5d. The effect of introducing such a flat rate was to rob the maximum demand system of much of its value, because consumers chose the system that was likely to be the cheaper, and the supplier was certain to be left with all the short-hour consumers on a comparatively low flat rate. (2) In the light of recent progress the limit imposed by a maximum demand has proved to be undesirable in domestic supply because it necessarily restricts the use of the supply for other purposes. This point is all the more important now that metallic filament lamps are coming rapidly into use. Such lamps reduce the load and thus also the maximum demand. The consumer will, therefore, hesitate more than ever to connect up even a 500-watt kettle, which alone is equivalent to nearly seventeen 30-watt lamps. (3) One great disadvantage of the maximum demand system is that it does not discriminate between different times of day. It is highly desirable, no doubt, to keep down the load in a house during times of peak load at the station, but there is no object in imposing a maximum demand at other times of day. In fact, the station engineer would welcome such loads, but any progressive spirit in the consumer is hampered by the demand indicator.

He said that the "contract" demand system proposed by Messrs. H. W. Handcock and A. H. Dykes was not suitable for domestic supply on account of the "contract demand," akin to maximum demand, on which it is based.

In order that a domestic power or heating load shall be cultivated, the tariff must have the following characteristics:—It should be simple; it should permit the use of electrical energy for both lighting and power equally; it should exclude two distinct tariffs with duplicate wiring; it should be independent of a maximum demand; it should, nevertheless, discriminate in some way between the lighting and the power load because these loads differ essentially in their total cost of supply.

Fortunately the character of domestic lighting does not vary much during times of peak load. One consumer may run lamps through the night or have dark passages requiring illumination by day, whereas another consumer may use his light merely during the time of heavy load. As far, however, as the capital charges connected essentially with lighting are concerned, we need only consider the characteristic peak load, any more extended use of the light being considered simply as power. The charges peculiar to this peak load must be provided by a special yearly payment in some form or special rate, the rate per unit being otherwise small and uniform. The particular part of the load to which reference is here made is indicated in Fig. 1, which shows the mid-winter load curve of the Richmond (Surrey) generating station. Although there are a number of motors connected to the mains of this station, the load is almost a purely lighting load, and the curve is doubtless characteristic of lighting as distinct from power. It need scarcely be remarked that such a load curve is very far from ideal, but it is typical of many undertakings where industrial developments cannot be expected. From the point of view of tariffs this load may be divided into two parts—the shaded and the unshaded parts in Fig. 1. The shaded part is what is here termed the lighting load, and the unshaded part the power load, although part of the latter no doubt consists of lighting.

Tariffs dependent upon Rateable Value.—The tariff introduced by Mr. F. M. Long at Norwich, and recently adopted at Wrexham, affords a means of providing for these capital charges. The Norwich Corporation make an annual charge of 12 per cent. on the net rateable value of the consumer's premises and a further charge of 1d. per unit. At Wrexham the Council have decided to charge 12½ per cent. on the rateable value and a flat rate of 1¼d. per unit, less a discount of ¼d. Rateable value in itself, however, is by no means a constant quantity, and does not depend merely upon the size of a house. Not only so, but the same size and class of house may vary widely in the extent of the wiring, and materially in the candle-power of the lamps in use.

Tariffs based on Two-rate Meters.—The peak load cannot be conveniently restricted by imposing a maximum demand, because this prevents the demand being exceeded during other times

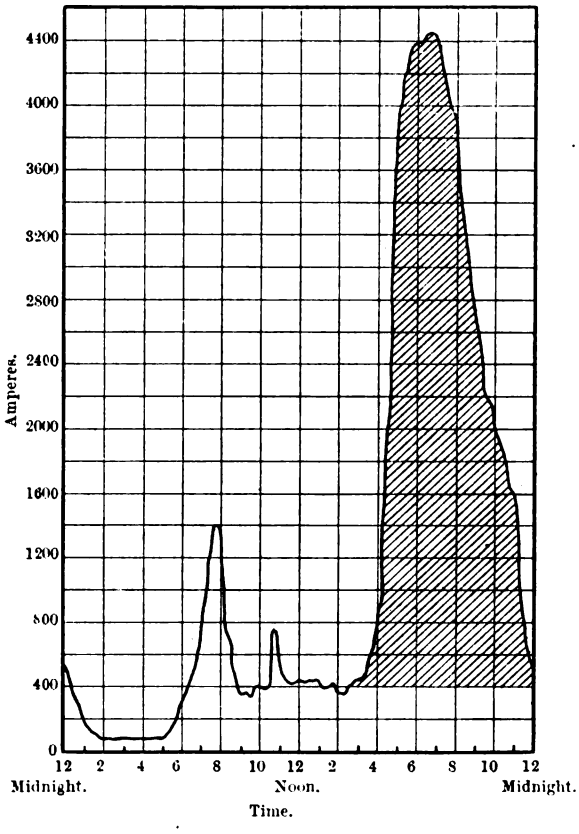

FIG. 1.—MIDWINTER LOAD CURVE OF THE RICHMOND (SURREY) GENERATING STATION, FRIDAY, JANUARY 10TH, 1908.

of day when the load would be acceptable. This objection, however, does not apply to the imposition of a higher price during certain hours of peak load. Difficulties are, however, introduced by the fact that the load curve varies very much according to the time of the year, as shown by the examples in Figs. 1 and 2. The virtue of the system is really its inherent defect. A peak load would certainly be discouraged, but consumers could scarcely be expected to suspend all heating and cooking operations between any particular hours; yet if the consumer indulged in such operations within those hours he would be penalised by the higher price. On the whole, it must be admitted that this system, sometimes referred to as the Kapp tariff, does not provide a satisfactory solution, the more so because it involves the use of two-rate meters, which would necessitate further complication and expense in a branch of the business where simplicity and cheapness should be the characteristics as far as possible.

Tariffs based on the Lamps Installed.—Another basis for a suitable tariff is the equivalent number of 8-c.p. lamps installed. This system has the advantage that the charge has a definite relation to the commodity purchased; it is easily applied, and differentiates between the use of 8-c.p. lamps and 16-c.p. lamps, or between metal filament lamps and low-efficiency carbon

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lamps. But there are one or two practical difficulties. It will be urged that lamps are liable to be changed; that 8-c.p. lamps may be replaced by 16-c.p. lamps in their renewal, and that low candle-power lamps might be wilfully replaced by high candle-power lamps after an inspection. Possibly it might be desirable to consider lamps in lavatories, and other situations where the use would be very intermittent, as forming a class to themselves, a reduced annual charge being made in such cases. The tariff based on assessment has the one advantage of simplicity, but a tariff based on lamps installed has the further advantage that the consumer benefits if he uses high-efficiency lamps, and pays according to his demand. This kind of tariff

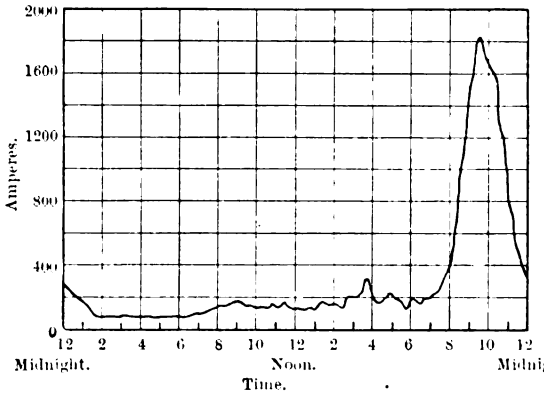

FIG. 2.—MIDSUMMER LOAD CURVE OF THE RICHMOND (SURREY) GENERATING STATION, TUESDAY, JUNE 30TH, 1908.

was at one time tried at Manchester by the late Dr. John Hopkinson, but was abandoned—probably because it was before its time.

The tariffs under discussion, continued the author, practically consist of, or are equivalent to, a lump annual sum for standing charges for lighting, plus a flat rate which must provide the running charges for light and power and any other legitimate charges in regard to the latter. If electric heating and cooking are to be seriously encouraged it is essential that the flat rate part of the tariff should be low. It will be generally admitted that 1d. per unit is a limit above which the public cannot be expected to go, and it is worth while to consider whether a lower limit may not be taken with advantage. In estimating costs in a case of this kind it is always difficult to decide how far one is justified in taking merely the *additional* cost of the units involved as a basis for the tariff.

Estimated costs were then gone into in the Paper for the purpose of showing that the upper and lower limits of the cost to the generating station of supplying domestic power, might be taken as 0·18d. to 0·45d.

This cost does not include any profit, and, therefore, cannot be regarded as giving a satisfactory figure for the charge to the consumer. So long as no additional plant or mains are required to meet the demand for domestic power, this point need not be seriously considered, but if further plant is required (as it certainly would be if such a demand were stimulated), the question of profit becomes important. For this item it is difficult to take definite figures in the general case, but in many cases it will, no doubt, be permissible to take £50 per kilowatt as the cost of *additional* generating plant and mains for domestic power purposes. Assuming the efficiency of distribution to be only 80 per cent., and the load factor to be 25 per cent., then 5 per cent. on this additional capital outlay will be 0·34d. per unit. A profit of 5 per cent. can only be regarded as a minimum, but with an increasing output this figure might be expected to increase to a more satisfactory amount. Thus for the "total cost," including interest on capital, we arrive at 0·77d. per unit as the lower limit and 1·12d. as the upper limit for this class of supply. Although ½d. per unit as the flat rate part of the tariff would leave a small profit under favourable circumstances, it is probable that such a low figure could not be adopted without risk. A charge of 1d. per unit is an upper limit above which the public are not likely to take up domestic power to any serious extent. The intermediate figure of ¾d. per unit includes a considerable profit, and in many cases might be adopted with advantage for consumers taking energy for lighting.

The Economic Aspect of Electric Heating and Cooking.—A small room of 1,500 to 2,000 cub. ft. can be heated by burning, say, ¼ to ⅓ cwt. of coal per day of 12 hours, and at 25s. per ton this would cost 4½d. to 5d. per day. If a radiator were used requiring 1 kw., which is an ordinary figure, the consumption per day would be 12 units if kept on continuously at full rate, or 9 units if used at half-rate for half the time. From this it is apparent that 1d. per unit is not a very encouraging tariff. The electric radiator must depend upon other virtues than its efficiency if it is to become really popular; and the heating of houses on a large scale electrically cannot be expected by this means with electric energy at present prices. Fortunately its virtues are sufficient to make the radiator popular, at least for auxiliary heating, if the charge for energy is reasonably low. For auxiliary heating the radiant, or lamp, form of radiator is certainly preferable because it has a cheerful appearance when in use, its effect is felt at once on switching on, the heat can be directed where required, and the heating elements are replaced very easily. There is no doubt that such radiators have a large field of usefulness before them in small sitting-rooms and bedrooms if electric energy is supplied at 1d., or less, per unit.

The prospect of heating houses entirely by electricity seems somewhat remote. The only method that appears practicable is to heat bodies of water at night, thus forming a kind of thermal storage system. Those who have travelled in cold European countries during the winter will have noticed the large earthenware stoves there in use; these are often heated in the morning by burning quite a small quantity of wood in them, the heat being first absorbed by the stove, and given out during the later parts of the day, thus maintaining a comfortable temperature at a minimum of cost. Similarly bodies of water in different parts of the house might be heated during the night, energy being provided at a much lower rate through a two-rate meter between, say, midnight and 6 a.m.

There is one little electric heating device that could probably be put to much more useful service in this country than at present: and that in the electric flat iron. In America this device has been found very useful for arousing the householder's interest in electric heating and cooking, and once this interest has been aroused the chance of introducing other electrical apparatus is much increased.

A little consideration will show that electrical methods are inadmissible for cooking as a whole unless separate coal-fired plant is installed for the water system. Such plant would be economical, and it is quite possible that this method will come into favour; also that flats will be supplied with hot water from a central service, as in America. In that case the prospects of electric cooking would be much improved. Meanwhile, however, it seems that electrical methods will be used as an auxiliary rather than as a main agent, somewhat in the same way as gas, which likewise suffers through the hot-water difficulty. In competition with this rival, although perhaps not so cheap, electric cooking has some marked advantages which should be borne in mind. Briefly these are as follows:—(1) Cleanliness; (2) ease in regulation; (3) better quality of cooking owing to greater certainty of results, and in certain operations, such as grilling, better than gas because of freedom

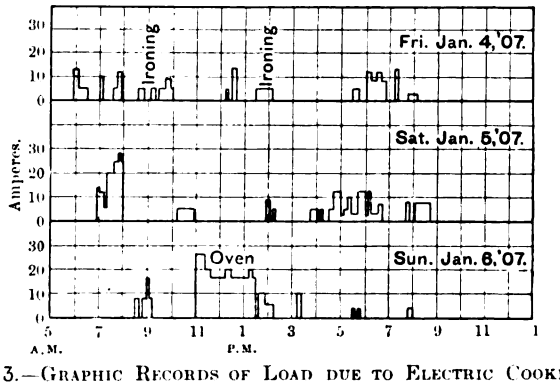

FIG. 3.—GRAPHIC RECORDS OF LOAD DUE TO ELECTRIC COOKING, BY J. R. CRAVATH.

from any taint; (4) very little smell; (5) coolness, thus rendering the method very advantageous in summer; (6) great adaptability, so that cooking need not be entirely restricted to the kitchen.

When we come to the important question of the relative cost of electric cooking we find that very little information is available. Practically nothing on this subject appears to have been done in this country. In America more keenness has been shown.

Mr. J. R. Cravath kept careful records of electric cooking in his home at Chicago during one month. Hot water was supplied otherwise. From the results it appears that if the price of electricity is more than 1½d. per unit it is more expensive than gas at 4s. 2d. The load diagrams in Fig. 3, obtained by

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a recording instrument during the month referred to, are of interest as showing the variation of the load from day to day, and they indicate that a good diversity factor may be expected from electric cooking.

At the Convention of the Canadian Electrical Association last year, and again at the Convention of the National Electric Light Association, the opinion was expressed that the consumption per person per meal may be safely taken at 300 watt-hours, and this figure is borne out by the records mentioned above.

The General Electric Company have found experimentally the cost of cooking a good plain dinner for eight persons electrically to be 4½ units.

Messrs. Isenthal & Co. have kindly supplied the figures of comparative experiments on the cost of electric cooking for three persons carried out in Switzerland over a period of three months, which show that the cost per day with energy at 1d. per unit would be from 2·19d. to 2·24d.

The cost of cooking with paraffin oil for the same household averaged 3·3d. per day (1½ quarts of oil), thus showing an advantage in favour of electricity. For a larger number of persons the cost would not, of course, be proportionately heavy.

We thus get some idea of the consumption, and can now arrive approximately at a suitable price from the consumer's point of view. Returning to the case of a household of eight persons to which reference has already been made, the consumption per meal would be 2·4 units, or, assuming three meals per day, 7·2 units per day; or allowing for contingencies, say 8 units per day, which is probably on the high side for eight persons. This consumption, which does not provide hot water for general purposes, must be compared with the cost previously mentioned of cooking with coal, including the heating of water, at a cost of 9½d. per day. It is thus apparent that a charge of 1d. per unit will permit electric cooking to be adopted to a considerable extent in competition with coal, though a lower charge would certainly be desirable, more particularly with gas in the field. Possibly electricity at 1d. might be taken as being equivalent to gas at 3s.

Considering the ease with which electric energy is converted into heat, it is a little curious that the apparatus for electric heating and cooking should be so expensive. This high first cost is certainly retarding development; but, on the other hand, cheap apparatus, if inferior, is still more harmful. A bad effect has also been produced at times by placing unsuitable apparatus on the market. Manufacturers would do well to retain the services of an experienced cook rather than to gain experience at the expense of their customers. Thus only harm can be done by selling grills which burn the meat instead of grilling it, and give rise to objectionable smell; or toasters which convert bread into pudding instead of toast. One such unsuitable piece of apparatus (and they are common enough) is sufficient to make a prospective customer condemn the whole system. A somewhat high figure for maintenance is also a difficulty at the present time, though doubtless this will diminish with time.

In regard to efficiency, Mr. C. H. Archer, of the General Electric Company, has kindly placed the following experimental results at the author's disposal. The efficiency of a self-contained heater vessel for boiling water varies from 87 to 92 per cent. If a hot plate, or separate heater, is used the efficiency is generally much reduced, the extent of the reduction depending on the state of the surface of the vessel and the goodness of the contact between the vessel and the hot plate. Thus if the bottom of the vessel is practically perfectly flat, and it is *clamped to the hot plate*, the efficiency is 92 per cent. of the above, or the resulting efficiency is 84½ per cent. But if the vessel is merely placed on the hot plate the efficiency may drop down to 35 per cent. of the 92 per cent. first mentioned, or a resulting efficiency of only 32 per cent. Suppliers of electricity would do well to hire out the simpler forms of apparatus for both heating and cooking more generally than at present, on the lines of the gas companies, for it must not be forgotten that successful apparatus is the best possible advertisement of the supplier, and will in many cases lead to further trial. The use of electrical domestic apparatus of all kinds is certain to extend largely in the near future.

A field that is more easily attacked than the private house is the hotel or the restaurant. Hotels are beginning to realise that electric cooking has passed the experimental stage. A large grill taking 3 kw. per compartment is in use at the Waldorf Astoria Hotel in New York; London hotels also have the question under consideration. Restaurants are finding the advantage of the electric grill, partly because of the convenience and good results, and partly because it interests the customer. An electric grill and other apparatus is at present being used experimentally by the James Fleming Restaurants in London with satisfactory results, and plant for cooking is also being given a trial at one of Messrs. Slater's Restaurants, at Messrs. D. H. Evans & Co., and elsewhere. Mr. Fleming has carried out a short test (3 hours) between his electric grill and a gas grill of about the same size, and he has kindly supplied the following approximate figures. The electric grill consumed fully 3 units, and the gas grill required 75 cub. ft. of gas; thus with electricity at 1⅛d. and gas at 2s. 10d., the electric grill cost about 3½d. as compared with 2½d. for the gas grill. With a 1d. rate, which is more usual, the figures would be roughly as 3d. to 2½d. The time taken to cook a chop with either grill was the same, but Mr. Fleming is inclined to think that, were both the grills worked at their full capacity, the better distribution of heat in the electric grill would give it some advantage over gas.

DISCUSSION.

Mr. C. P. Sparks (Engineer-in-Chief, County of London Electric Supply Co.), who opened the discussion, said he was not an advocate of the maximum demand system, nor of that employing two-rate meters. The use of two meters and two circuits was the standard system at present, and it was meeting the difficulty to some extent. Systems of making a charge based upon the wattage of the lamps, as suggested by the author, had been tried before, but difficulties had been encountered in regard to the quarterly inspections, not only on account of the time and cost involved, but also due to the aversion of householders to the servants of public bodies, such as electric supply companies, entering their premises for such purposes. In his opinion, the slow growth of the heating and cooking portion of the electric supply business was not so much due to the tariffs as the apparatus. It was the heavy capital outlay that had to be met either by the consumer or the supply company that was really the drawback, and he very much regretted to see the very low efficiencies given in the paper of that class of apparatus which he had hoped would prove a solution of the question, viz., the hot plate or separate heater. If they could find a separate method of heating so that only a small investment was necessary in a hot plate, or separate heater, which would allow all the ordinary culinary appliances to be used, then he believed they would be able to go forward. He regretted, therefore, to see that an efficiency of only 35 per cent. could, under normal circumstances, be looked for. The question of apparatus, therefore, in his opinion, was of far greater importance than any of the tariffs put forward in the Paper.

Mr. A. M. Taylor (Chief Assistant Electrical Engineer, Birmingham Corporation) sent in a written communication, which Mr. J. F. C. Snell read.

In this communication Mr. Taylor confined his remarks mainly to the question of dealing with peak loads, such as that shown in the curve in Fig. 1 of the Paper, and argued that the use of accumulators instead of additional plant would obviate the necessity for any annual fixed charge to the consumer and in some cases the happy ideal of a common flat rate for both light and power might be reached. He considered the author's estimated costs altogether too optimistic.

Mr. J. F. C. Snell was of the opinion that a simple tariff system was the thing to be aimed at, in addition to a simple system of wiring and simplicity in the design of electric heating and cooking apparatus. He agreed, however, that it was not so much a question of tariffs at the present moment as the first cost of the apparatus itself. The greater simplicity and design of gas cooking and heating apparatus was most striking, and he did not know that a complicated design need be an inherent part of an electrical cooker or heater. In fact, he believed that the ingenuity of the electrical engineer would overcome this defect. So far, there had been a lamentable lack of attention to the whole question. He did not agree with the author's figures for costs; apparently no allowance had been made for redemption of capital. In fixing a tariff, the whole of the costs of production must be taken into account. To base a tariff on running costs alone was simply to head straight for destruction. A great mistake was made in many cases in trying to sell energy for power purposes as a by-product, and he hoped the heresy of attempting to base charges for heating and cooking upon running costs alone would not be entertained by the members of the Institution.

Mr. H. W. Handcock (Messrs. Handcock and Dykes) agreed with the last remark of Mr. Snell. The best system, in his view, was a contract demand system, the whole object of which was to charge the consumer in proportion to the actual outlay that he has cost the station, and if the load due to heating was to be greater than the load due to lighting, then the maximum demand in that case should be based on the heating and not on the lighting load. The present results from heating and cooking were disappointing, and before it would become universal, the initial cost of the apparatus must be reduced and the efficiency improved. Mr. Wilkinson, of Harrogate, was introducing a system by which the consumer might instal any number of lamps, and a fixed charge for an unlimited consumption of energy was made according to the number of lamps installed, so that no meter was required. Free wiring, he

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thought, must form part of any system which was to popularise electricity for heating and cooking. Once this was done, they were increasing still further the ratio between running costs and the costs due to interest and depreciation, and, finally, they came to a point when it did not matter so much so long as they restricted the consumer to the hours of darkness, whether he burned his lamp for long hours or short hours. Following on these lines, a system was to be introduced at Egham. The supply authority supplied current from dusk to dawn, they wired the premises and charged a fixed sum per annum, no meter being put in. All the consumer had to do was to supply the lamps. Having gone very carefully into the matter, they had come to the conclusion that they could name a sum that would leave a very handsome return to the undertaking and at the same time enable the consumer to get light at less than the present cost of gas.

Mr. E. W. Cowan (Key Engineering Co.) said he was unable to accept the view put forward by the author and by many other engineers that the price of electricity supply should be fixed according to the cost of production. In his opinion, the price should be according to the commercial value of the use of the energy, in the same way that shipping and railway companies varied their tariffs according to the nature of the goods they carried. He had only that week wanted a rate for a port in Africa, and the shipping authorities told him that the freight they would quote depended absolutely upon the contents of the case. Again, why did we have to pay a rate 50 per cent. higher for a case of brass castings from Manchester to London than for a case of iron castings. In this, of course, he came into collision with Mr. Snell and others; but his opinion was that, in considering this matter, they could entirely disregard any question of equity as between one class of consumer and another, although not between individual consumers. For instance, in the case of two consumers, one for lighting and one for power, from the ethical point of view it had nothing to do with the question whether one was charged, with reference to the cost of production, a lower price than the other. In fixing such a tariff, provision must be made for the future, otherwise, as Mr. Snell had pointed out, in trying to sell power as a by-product—which it really was not—they would land themselves in financial disaster. He felt convinced that if station engineers would look at the problem from this point of view, they would secure the domestic power consumer to a much greater extent than had been the case hitherto. They would have to run some risks, and have some trouble, but he thought it was worth while.

Colonel R. E. Crompton said he had some difficulty in following some of the speakers, including the author, without knowing what was in their minds. Were they thinking of the ideal tariffs which might be produced in the future if there were no Board of Trade or no London County Council, or even such things as Committees of Parliament? But as there was not much chance of such a state of things, we must consider matters as they were now, and consider how far their masters, the Board of Trade, for instance, would allow them to go. As a matter of fact, he thought they knew pretty well the length of their rope. It was, that however they shaped their tariffs, they could not go beyond 8d. per unit, and it could only be in most exceptional circumstances, such, for instance, as a millionaire, who only used his house one day in the year, and then had it lighted from basement to attic, that they could make this charge. He rather agreed with the author that double wiring must be avoided; certainly in the West End of London it was the great bar to the use of electricity for cooking and heating. Probably the easiest way of working was with a two-rate meter, the disadvantages of which he did not think were sufficient to put it out of court. He had been using such a meter experimentally himself for years, and although he was not altogether satisfied, yet he had come to the conclusion that by it they could charge 8d. for the very short period of maximum demand in the middle of the peak, and come down to 1d. for the remainder of the twenty-four hours, and work on single circuits. He had been one of the pioneers of electric heating, and his firm had spent a lot of money in this direction, and the reason they gave it up was on account of apparatus being continually ruined by the carelessness of servants, who would allow a kettle to boil dry, which was followed by great overheating. This was an aspect of the question, however, in which considerable improvement had taken place recently. Mr. Cooper had left out one very valuable use of electricity, namely, the production of cold, and there was room for a simple invention for producing cold by electricity in a compact apparatus, which would be useful in this country, as well as in countries like India.

Mr. W. R. Rawlings, after commenting upon the somewhat remarkable fact that this was a second time within six months that a Paper of interest to electrical contractors had been read before the Institution, said he was gratified to learn from Colonel Crompton that he was not in favour of double wiring. As a matter of fact, upon the Kensington and Knightsbridge Co.'s system there were three methods of taking services into the house, namely, one for heating and cooking, one for cellars and basements, and one for the general house lighting, which was, in a fourth degree, subject to certain rebates. Therefore, if they could get rid of this quadruple method, it would be a very satisfactory thing. He disagreed with the author's suggestion that a tariff should be enforced, based upon the total wattage of the lamps installed divided by 30 to give the equivalent number of 8 c.p. 30 watt lamps. The author stated that this system had the advantage that the charge had a definite relation to the commodity purchased, but he doubted this, and compared the case of a grocer's shop, for instance, in which 30 lamps were always being used, and a private house with 100 lamps installed, but only 30 at the most being used at one time. He agreed with Mr. Sparks's views upon the question of quarterly inspections, and mentioned that, as a rule, in the West End, there was generally some excuse why a man could not be admitted into the house, no matter what time of the day he went. Further, he thought that unless a man carried a 20-round ladder with him, he would find it impossible to check the lamps owing to the positions in which they were placed. He also strongly protested against the man making inspections, adjusting switches, &c.; as an electrical contractor, he claimed that to be his work. The author had stated that this kind of tariff had been tried at Manchester by the late Dr. J. Hopkinson, and abandoned probably because it was before its time. He certainly thought it was still before its time. He was further of the opinion that the system would discourage wiring, and drew a picture of householders taking out lamps wholesale, whereas under present conditions they were installed as a matter of convenience and not so much for continual use. In fact, he had been informed by one consumer that he would certainly do this. Summing up, Mr. Rawlings thought that the adoption of such a tariff would do a great deal of injury to contractors, supply companies, and manufacturers alike.

Mr. A. P. Trotter (Electrical Adviser to the Board of Trade), in reference to the remarks of Colonel Crompton concerning the Board of Trade, said that it would be perfectly legal to charge a tariff of so much per annum based upon a man's income tax, divided by the square root of the number of his waistcoat buttons if the supply authorities so wished, but the only restriction which the Board of Trade put upon it was that it must not exceed 8d., and that it must not be refused to anyone else who asked for it under the same circumstances. With these provisos, he was not aware that there was any objection to any tariff. He had nothing further to add, with the exception of this one remark: he was not a commercial man, but he did agree that the price of a thing was what it would fetch.

The President having asked any other members who wished to speak to send in their remarks for inclusion in the Journal,

Mr. Cooper briefly replied, and will deal further with the discussion in writing. He said he must continue to disagree with Mr. Sparks as to the double wiring system, for he was sure that consumers would not go in for the duplication and cost and trouble involved. He had two meters in his own house, but even that was no inducement to make him go in for electric heating or cooking. The speakers who dealt with the difficulty attending quarterly inspections rather overlooked the fact that in pushing electrical heating and cooking, they wanted to deal with existing consumers. They need not worry so much about those West End consumers where is was always inconvenient for the man to be allowed in, but it was worth while to take the matter up with the smaller consumers, and he did not think the difficulty was so serious as it appeared. He agreed that the capital outlay upon heating and cooking apparatus was a difficulty, but if they had unsuitable tariffs, they could go on making the apparatus cheaper and cheaper, but they would not get them installed. Mr. Taylor and some other speakers had disagreed with the costs which he had given. It was always easy to disagree with estimated costs, and he would like to ask one question in this connection. The upper limit he had given was something over 1d.; Mr. Taylor suggested that this should be the lower limit. If that was really so, why were a considerable number of station engineers already supplying at 1d.? Surely they ought not to do so. He agreed with Mr. Snell that there was a certain amount of risk in going on running costs alone, but if they did not take any risks, they would never cultivate a demand; it was a risk which had been taken with regard to power, and he did not think it was so serious in this case. He thought Mr. Wilkinson's tariff would lead to a good deal of difficulty, and this was a point that must be borne in mind. He found it a little difficult to follow Mr. Cowan's idea of a tariff. With regard to Mr. Rawlings's remarks concerning the charge per lamp per annum, he did not wish to fix any particular sum.

Mr. Rawlings: It is not the figure, but the principle that I object to.

Mr. Cooper, continuing, said that he had dealt purely with domestic houses in the Paper, and therefore the other points raised by Mr. Rawlings in his comparison of a grocer's shop and a private house did not apply. He did not think the question of the inspector dealing with switches was so serious as Mr. Rawlings had made out, and the same remark applied to the suggested restrictions in wiring as the outcome of his system.

The President, in proposing a vote of thanks to Mr. Cooper for his Paper, thought the discussion had brought them a little further towards the elimination of the maximum demand

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system. He thought a clearer recognition that the peak load could not definitely be restricted by imposing a maximum demand would carry them a little bit further towards simplicity of methods of charging. Personally, he believed we should eventually come to a flat rate both for light and power, and not differentiate at all. This would take some years, but he believed it was what we should come to, as it was what everyone else did. A grocer charged so much a pound for his sugar, and did not vary the price according to whether the shop was full of people when the customer called, or whether the customer came when the shop was first opened.

The following written communication was received from Mr. F. A. Wilkinson (Electrical Engineer and Manager, Marylebone) :—At Marylebone we have always recognised the truth of the contention that the future of electricity supply in a district mainly residential lies in development of the domestic power load, and for two years we have been actively pushing this class of business. At the outset it was found that prejudice was very hard to overcome, but recent results in the direction of heating have been most encouraging, and there appears no doubt that the next two or three years will witness considerable extension in the use of radiators. We make a practice, where required, of lending these to consumers for a few days free of charge, and this year, of the many we have put out in this way we have not had one returned. In 2½ years the number of radiators connected has risen from 281 to approximately 600, and we can see very many more ahead. The special circuit difficulty has, of course, been experienced, but it has now been very effectively met by the use of plug submeters rented at 1s. per quarter. Despite the fact that our pressure of supply has been changed from 100 to 240 volts, and that, therefore, the majority of the wiring in the borough is ample in copper, we have met with several cases where a radiator or cookery range would have overloaded the wiring, and this certainly constitutes a difficulty which it is beyond the power of tariffs to remedy.

As regards cooking, results are not so satisfactory, and this appears to be attributable to the high cost of apparatus, prejudice (principally of servants), and the entire ignorance of the average consumer in the very elements of the subject. It will clearly be necessary to do a vast amount of educational work before anything like good progress is made, and in this, as Mr. Cooper says, we are handicapped by the meagreness of comparative data of cost. It has been our experience that manufacturers of electrical, gas, and coal cooking apparatus cannot supply and substantiate any definite practical figures, and the chefs of various restaurants that we have approached appear to have only the haziest of ideas on the subject of costs. It is in consequence of this that wherever possible we are instituting comparative tests under practical conditions, but we find it by no means an easy task to persuade suitable firms or persons to allow us to experiment. Mr. Fleming, of Fleming's Restaurants, Ltd., very kindly gave us every possible assistance, with results that Mr. Cooper has mentioned. The grill used in this test has in many ways been brought to special notice, and the reliable comparison the test affords should be of value. There is no doubt that Mr. Fleming is correct in saying that at full capacity the electric grill would be cheaper than gas, and from an intimate practical knowledge of it I have no hesitation in saying that such a grill split up into a number of sections, instead of only two, would at 1d. per unit be cheaper than the gas grill against which it was tested. Electric ovens, as comparatively large consumers of current, are of particular interest, and the following details of a test carried out for two weeks under practical conditions in a large restaurant will perhaps be useful.

Results obtained with Large Electric Oven in Actual Practice.

Test.	Article cooked.	Weight, lbs.	Time to cook, hrs.	Time to cook, mins.	Units consumed.	Units per lb. of meat.	Remarks.
A.	Meat	41	4	10	8	0·195	
B.	,, ...	48	6	0	13	0·271	
C.	Pork.....	43·5	5	30	11	0·252	Half heat after 4·25 hrs.
D.	Meat	41·5	4	0	9	0·216	Half heat after 1·5 hrs.
E.	,, ...	32	5	0	9	0·281	
F.	,, ...	41	5	30	9	0·219	
G.	Meat & two puddings	22	4	0	8	0·363	
H.	,, ,,	25	4	30	9	0·360	
I.	Meat	77	7	0	14	0·181	
J.	,, ...	53	6	20	11	0·207	
K.	,, ...	87	7	30	14	0·161	
L.	,, ...	41	5	0	10	0·243	
M.	,, ...	38	5	0	9	0·237	
N.	,, ...	58·5	7	40	13	0·222	
O.	,, ...	40·5	4	0	11	0·271	

When working at its full capacity, so far as we have been able to ascertain, the cost at 1d. per unit is certainly not above that of gas. The nearest comparison we were able to make was with a large and efficient gas oven of first class manufacture. This consumed 400 cubic feet of gas per hour, at a cost of 1s. 2d., and had a capacity of 500 lbs. of meat. Taking the capacity of the electric oven at 80 lbs., the cost of cooking is practically the same. We have lent out a considerable amount of cooking apparatus free on trial, and are continuing to do so, as we recognise that this is at present the best means of popularising it. In all but a few cases we have met with opposition from chefs and cooks, and this constitutes one of our chief difficulties. Mr. Cooper rightly lays emphasis upon the bad impression that inefficient or unsuitable cooking apparatus produces. I have found this borne out in several cases, and a bad impression is most difficult to eradicate. Manufacturers are of course well aware of this, and there is no doubt they are improving their goods every day; still, there are one or two points in the average piece of apparatus to which, as a user, I may perhaps be allowed to draw attention. Taking ovens, in the majority on the market, the loss of heat by radiation is very large, and the usual lagging arrangements are entirely inadequate. Consumers object to this radiated heat, and in some cases in our experience it has been sufficient to turn the scale against us. A first class gas oven is in this direction far ahead of most, if not all, of its electrical competitors. Bad heat distribution in the oven is another point upon which we have received complaints, and inaccessibility and neglect of small details which enhance convenience have also been mentioned. In many similar directions, there is distinctly room for improvements that will cheapen and encourage electric cooking. We must, however, bear in mind that the same may be said of gas and coal apparatus, which in many instances is obviously capable of great improvement, and there appears every likelihood that the cost of gas cooking would be materially reduced by means of more efficient apparatus were there any real competition. The fireless cooker, so popular in Sweden, has never been exploited in this country. An American writer states that the cost of electric cooking may be reduced 50 per cent. by means of this principle; surely it is worth while to investigate it. With regard to the future of electric cooking, beyond the question of tariff, it seems to me that the amount of publicity necessary for a quick realisation of our aims cannot adequately be attained on the usual lines of each supply authority, contractor, and manufacturer acting independently, and in too many cases not acting at all.

To popularise electric heating in a reasonable time some concentrated effort calculated to awaken all classes to its possibilities and give it the widest publicity is necessary, and this for very obvious monetary and other reasons can only be attained by some comprehensive form of co-operation.

Secretaryship of the I.E.E.—Mr. G. C. Lloyd, the secretary of the Institution of Electrical Engineers, has been appointed secretary of the Iron and Steel Institute, in succession to the late Mr. Bennett H. Brough. It will be remembered that Mr. Lloyd was assistant to Mr. Brough when, in 1904, he was appointed to his present position. Mr. Lloyd served his apprenticeship with Messrs. Robert Stevenson & Co., marine and locomotive engineers, of Newcastle-on-Tyne, and in 1884 commenced his career as a marine engineer, which lasted for a number of years, during which he made many trips abroad, including Brazil, River Plate, West Indies, Philippine Islands, and the Straits Settlements. Having spent a number of years in constructional work at home, he was appointed assistant secretary to the Iron and Steel Institute in 1901, as mentioned above.

Progress of Domestic Heating in Marylebone.—In spite of the rather general pessimistic feeling with regard to electric heating, and the by no means low power rates in vogue in the borough of Marylebone, considerable progress has been made in the last few months in the sale of electric radiators. As Mr. F. A. Wilkinson, the Borough Electric Engineer, mentioned in his contribution to the discussion on Mr. Cooper's Institution Paper, the total number of radiators in use in Marylebone now exceeds 600. The net increase in the kilowatts connected in the form of radiators and heating appliances from April 1st last up to the end of November was 265 kw.; the corresponding figure at the same time last year was 195 kw., and between April 1st and Nov. 30th, 1906, about 130 kw. was connected. The effect of circularising the consumers is well shown by means of the following comparison :—In the two months, October and November, 1906, 30 radiators were connected, but in the same two months of the following year the net increase in the number connected was 110. In most cases plug meters are used. The difficulty with the tariff is got over as follows :—The maximum demand of the radiators is assumed at a certain figure, and from the reading of the plug meters the charge is made on the basis of the Marylebone power rate of 2d. and 1d. The plug meter readings are subtracted from the main meter reading, and the assumed maximum demand of the radiators is subtracted from the main demand meter in order to calculate the charge for lighting. This method has proved successful where one or at most two radiators are in use, as it may be assumed that both are used at once sometimes. Where more than two radiators are used, the consumption must be metered separately by means of a separate heating circuit. This latter is also necessary for another reason—namely, the fact that the house wiring, as a general rule, is not sufficient to carry the extra load.

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THE PROPOSED TAX ON ELECTRICITY IN GERMANY

THE opposition to the proposals of the German Government to impose a tax on electricity, gas, and illuminating apparatus is now being organised. A committee, consisting of representatives of the various branches of the electrical and gas industries and representatives of the consumers, has been formed under the auspices of the Berlin Chamber of Commerce to offer organised opposition to the Bill which will be dealt with by the Reichstag this session. According to the *Elektrotechnischer Anzeiger* the committee is constituted as follows:—Dr. E. Rathenau (A.E.G., Berlin), Prof. Budde (Siemens and Halske, A.-G.), Dr. Linde (Director of the Verein Deutscher Ingenieure), Dr. Körting (Verein Deutscher Gas- und Wasserfachmänner), Dr. von Borscht (Mayor of Munich), Dr. von Mortius and Dr. Wenzel (Society of the German Chemical Industry), Herr G. Dettmar (General Secretary of the Verband Deutscher Elektrotechniker), Prof. Dr. Kallmann (City Electrical Engineer, Berlin), Dr. Fasolt (Wirtschaftlicher Verein der Deutschen Elektrotechnik), &c. The business of the committee will be conducted by Dr. H. Lux and Dr. Bürner.

In a long article in the *Electrotechnischer Anzeiger*, Dr. Fasolt criticises the statements made in the explanatory memorandum published with Bill, an abstract of which was given on page 677 of ELECTRICAL ENGINEERING of November 19th. He first objects to the argument employed in the memorandum, that the industries affected by the proposed taxation will quickly throw off the retarding influence of the tax by means of improvements in the methods of utilising power for industrial purposes and other technical developments, and then points out that, although the total figure of 30 million marks (approximately £1,500,000) for the revenue from electrical sources only may be taken as correct, the costs of administration have been considerably under-estimated. With regard to the way in which this load will be distributed among the different kinds of consumers, he mentions the figures recently published by a German electrical association, which show that the electrical energy consumed for illuminating purposes is distributed as follows:—Private houses, 22·2 per cent.; shops and other trade premises, 22·4 per cent.; workshops, factories, banks, and offices, 16·7 per cent.; hotels, restaurants, and theatres, 18·5 per cent.; public buildings, 10·3 per cent.; public street lighting, 5·4 per cent.; hospitals and asylums, 3·7 per cent.; and sundry consumers, 0·8 per cent. These statistics show, says Dr. Fasolt, that the tax will not be a tax on a "luxury" of the well-to-do classes, but will affect all classes. The tax on energy for power purposes will also be felt very severely by the working classes, as, according to the statistics published, a large number of small motors are used by artisans, carpenters, bakers, &c., in Germany; indeed, it is estimated that about 60 per cent. of the energy delivered by public central stations for power purposes is used by small trade consumers.

With reference to the tax on illuminating apparatus, Dr. Fasolt points out the way in which the carbon filament lamp will be handicapped in its struggle against the metal filament lamp, even in the case of low current charges. As the tax depends on the watt-consumption of the lamp, a 32 c.p. carbon filament lamp will be taxed to the amount of 30 pfennigs, or nearly 60 per cent. of the market price; while a metal filament lamp of the same candle-power will be taxed to the amount of only 20 pfennigs, or 9 per cent. of the market price. Again the method of taxing arc lamp carbons by weight, without reference to quality, is severely criticised. The difficulties which will arise due to the clause, which states that the tax is to be 0·4 pfennig per unit if the average selling price exceeds 8 pfennig, are then emphasised. In the case of a central station supplying one or two large power consumers at a very low price, the figure of 0·4 pfennig per unit will have to be paid on the consumption of the large users, although it may exceed 5 per cent. of the total generating costs if the average selling price exceeds 8 pfennigs. In conclusion, Dr. Fasolt describes the Bill as the product of an official mode of thought far removed from all practical and economical consideration. The Bill, if passed, he says, will not only retard the progress of the many applications of electricity in the country, but will considerably diminish the country's power of competing with foreign countries.

With regard to the effect of the proposed tax on the coal-mining industry of the Ruhr district, the following figures given in the *Elektrotechnische Zeitschrift* are of interest:—If the estimated yearly consumption of electrical energy is taken at 700 million units for the mines in the Ruhr district, the tax amounts to some £140,000, to which must be added some £10,000 as the amount of the tax on lamps and carbons. By dividing the total of £150,000 by the amount of coal mined per year, which in the case under consideration is some 80 million tons, the extra cost due to the tax amounts to about 0·45d. per ton. As, however, only a few of the mines use electric power to a large degree, the amount may rise to over twopence per ton in these cases.

CORRESPONDENCE

SMALL REMOTE CONTROL SWITCHES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In answer to the letter from Wm. P. M. in to-day's issue of your paper, we should be glad if you would kindly put us into communication with this gentleman, as we should be pleased to make him a switch such as he mentions. We should like to know whether the switch is to be both closed and opened automatically, and how he proposes to operate it. Thanking you in anticipation,

Yours faithfully,
For VENNER & Co.,
ERNEST E. SHARP.
(Manager.)

6, Old Queen Street,
Westminster,
London, S.W.
November 26th, 1908.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Your correspondent will find that he can get the article he requires from Messrs. A. Emanuel & Sons, Ltd., George Street, Manchester Square, London, W., at 4s. 6d. each, plus postage.

Yours faithfully,
W. H. ALLEN,
Borough Electrical Engineer.

Corporation Electricity Department, Bridge Street,
Loughborough, Nov. 27th, 1908.

25-VOLT TRANSFORMERS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Referring to Mr. A. H. Dykes's letter in your issue of 26th inst., I would advise that the 17-watt total losses for the balancer are the maximum losses when the loads in the various circuits are out of balance—compared with Mr. A. H. Dykes's figures for the same conditions, 28-30 watts. I regret that my previous letter was not quite clear in this particular.

Yours very truly,
K. FAYE-HANSEN.

British Westinghouse Works, Trafford Park,
Manchester, Nov. 27th, 1908.

UNUSUAL FREQUENCIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I recently had occasion to test some single-phase apparatus which was designed for connection to a supply at 80 periods. The highest periodicity which could be obtained from the works supply was 50, and some means had to be taken to increase this to the desired value.

To the three-phase supply the stator windings of a three-phase slip-ring motor were connected. The rotor pulley was belted to that of a variable speed direct current motor, and driven backwards, *i.e.*, in the opposite direction to which it would have rotated under normal conditions, the slip being approximately 200 per cent.

By adjusting the speed at which the rotor was driven it was possible to obtain from the rotor slip-rings exactly the periodicity required.

I think the above method may be of use to some of your readers as it affords a convenient means of obtaining unusual frequencies.

Yours faithfully,
F. J. MOFFETT.

Union Chambers,
Temple Row, Birmingham.
Nov. 28th, 1908.

Institution of Electrical Engineers.—The following is the result of the ballot for new members at the meeting on Thursday:—Member: W. Slingo; Associate Members: F. J. Alsop, J. O. Balshaw, W. B. Boyd, W. Bridges, A. S. Campbell, S. de Beer, A. H. S. MacCallum, J. M. S. Maxwell, L. F. Mountfort, H. V. Pegg, J. Roothaan, F. C. Sellens; Students: E. Barlow, W. J. I. Casewell, A. E. E. Cheal, C. V. K. Chetty, E. C. Creagh, J. Doust, G. V. Duffill, J. K. Hwoo, W. D. C. Juritz, C. Mark-Seymour, N. B. B. Patel, W. Ryley, W. B. Smith, T. S. Wallis, H. O. White.

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STORAGE BATTERIES ON ALTERNATING-CURRENT SYSTEMS

A PAPER on the above subject was read by Mr. J. L. Woodbridge before the American Institute of Electrical Engineers, at their annual summer meeting this year. In the introduction to the Paper, the author points out that in many cases where alternating currents are developed, the advantages of a regulating storage battery are even more pronounced than in direct-current service. For instance, alternating-current generation is particularly applicable to main railway lines on which heavy trains run at comparatively infrequent intervals, producing fluctuations of load abnormally high as compared with the average. The auxiliary apparatus required in connection with a storage battery adapted for regulating an alternating-current system may, he says, also be used for changing the frequency or controlling the power factor.

The conditions to be met in the various alternating-current systems include a number of different combinations which may be classified broadly in five cases.

The system illustrated in Fig. 1 is that in which alternating current is generated and transmitted to direct-current sub-stations for supplying a direct-current fluctuating load such as that of the ordinary interurban direct-current trolley system. The early applications of storage batteries to systems of this kind involved the installation of a battery at each of the several sub-stations to regulate the fluctuations of direct-current load at that point. This required nothing more than the ordinary direct-current controlling apparatus. The author states that in

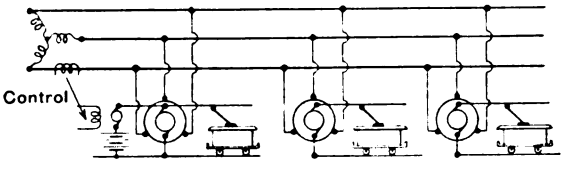

FIG. 1.—ALTERNATING-CURRENT TRANSMISSION AND DIRECT-CURRENT LOAD; REGULATION WITH BATTERY BOOSTER.

some recent installations, however, the conditions have been such that it has been found advantageous to concentrate the battery capacity at one point, a single battery being installed arranged to control the total combined fluctuations of load on the entire system. In cases where the transmission is wholly in one direction from the power house, the nearest sub-station may be selected. In such cases the battery, with its regulating booster, is connected to the direct-current sub-station bus-bars in the usual manner, but the booster is controlled by means responsive to the total alternating-current output of the generating plant. Its control is accomplished by means of current transformers located in the main alternating-current bus-bars or transmission lines, between the converter station and the generators, whose secondaries will furnish alternating-current to the battery controlling apparatus proportional to the total output of the power station. In some cases current transformers are located in the individual generator circuits, their secondaries being connected in parallel to give a combined output proportional to the total generator load.

By this arrangement the same converters which are required for supplying the local direct-current load on the sub-station are also used for transforming the battery current, and in many cases no greater converter capacity is called for on account of this latter function. For example, the total load on the system may vary from 500 to 3,000 kw. with an average of 1,500 kw. The direct-current demand on the sub-station where the battery is located may vary from zero to 1,500 kw. Converting apparatus must therefore be installed at this sub-station of sufficient capacity to handle a momentary load of 1,500 kw. It is evident that with the battery regulating on the total load this converting apparatus will never have to deliver more than 1,500 kw. to the sub-station, since this is the total output from the generators, and this amount of energy will be supplied to this sub-station only at rare intervals when the total load on the rest of the system is zero. Nor will this converting apparatus be called upon to transmit energy in the reverse direction to a greater amount than 1,500 kw., since the total maximum load on the entire system is 3,000 kw., of which the main generator is always supplying 1,500. The general operation of the battery in this scheme is to relieve the sub-station of more or less of its direct-current load at times of increased load on the rest of the system, thus preserving a constant load on the generating units. It being necessary on account of the direct-current load to maintain constant voltage on the direct-current bus-bars, a battery booster will be required to cause the battery to charge and discharge, this booster being controlled from the alternating-current circuit.

The case next considered by the author is illustrated in Fig. 2. Current is generated and utilised as polyphase alternating current, there being no direct-current circuit, under which conditions, of course, the battery (placed either at the main generating station or at the centre of load) will have its

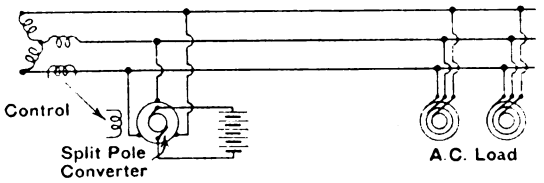

FIG. 2.—ALTERNATING-CURRENT LOAD; REGULATION WITH SPLIT-POLE CONVERTER.

entire output converted into alternating current, so that converting apparatus must be provided of sufficient capacity to handle the maximum battery discharge. If a motor-generator set is used for control, the charge and discharge of the battery may be accomplished by varying the voltage of the direct-current machine in response to fluctuations of the alternating-current load. Synchronous converters are preferred by the author for this purpose, particularly if the fluctuations of load are extremely rapid. If a motor-generator is called upon to transfer energy from the battery to the alternating-current circuit, it will deliver energy to the latter circuit only after its armature has been driven somewhat ahead of its normal phase position, and owing to the inertia of the armature some appreciable time must elapse after the battery has begun to discharge into the direct-current machine before the alternating-current machine is delivering the equivalent energy to the alternating-current circuit, and a time lag is thus introduced. With a synchronous converter this effect is practically eliminated. With the latter type of machine, however, special means must be provided for varying the direct-current voltage at the battery terminals to compel the battery to charge and discharge. If a standard converter is employed, a battery booster may be employed for this purpose, provided with a field-control system responsive to the fluctuations of alternating-current load.

In order to dispense with the battery booster, however, a synchronous converter providing for a variable ratio between the alternating- and direct-current voltages has been developed. This machine has been designated the "split-pole" converter owing to the fact that the control of the transformation ratio is brought about by dividing each pole into two or more sections whose excitations are separately controlled. By this means the direct-current voltage of the converter is varied to cause the battery to charge and discharge while the alternating-current voltage is maintained practically constant. This type of machine, it is claimed, offers considerable advantages in the way of simplification and increased efficiency of operation over apparatus involving boosters or motor-generator sets, and is adapted for handling extremely rapid fluctuations of alternating-current load, in such cases in which a constant-potential direct-current bus-bar is not required.

In the case shown in Fig. 3, power is generated as alternating

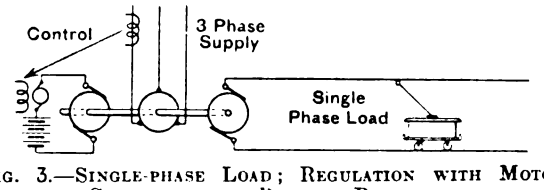

FIG. 3.—SINGLE-PHASE LOAD; REGULATION WITH MOTOR GENERATOR AND BATTERY BOOSTER.

current and is supplied to a single-phase circuit. One of the most noted examples of this class of installation is found at the frequency-changing station of the Spokane & Inland Railway Co. at Spokane, Washington. The equipment of this station includes four frequency- and phase-changing motor-generator sets, each set consisting of three direct connected machines, viz., a 60-cycle, three-phase induction motor of 1,000 h.p. capacity, receiving power from the incoming transmission line; a 1,000-kw., single-phase, 25-cycle, 2,200-volt generator, delivering current to the railroad; and a 750-h.p., 500-volt, direct-

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current machine, which is connected to the battery and acts as a generator or a motor when the battery is respectively charging or discharging. The battery consists of 275 cells having a capacity of 1,920 amperes at the one-hour rate, and is provided with two motor-driven boosters which may be operated in parallel. The boosters are controlled by apparatus which responds to the current in the incoming 60-cycle transmission line in such a way that small variations of this current vary the booster voltage, thus causing the battery to charge from or discharge into the direct-current machine to absorb the fluctuations of load on the single-phase circuit. This is one of the cases, the author says, in which the financial results from a battery installation may be very clearly demonstrated, inasmuch as the power for the operation of the railway system is purchased on the maximum demand basis, and it is estimated that the reduction in the power bills effected by the battery in relieving the transmission line of load fluctuations will be sufficient to repay the initial investment in about three years.

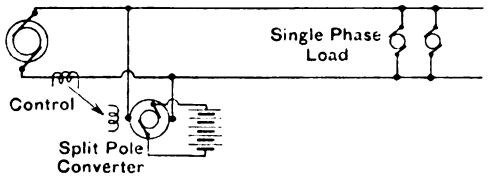

FIG. 4.—SINGLE-PHASE LOAD; REGULATION WITH SPLIT-POLE CONVERTER.

Instead of the scheme above described, he suggests, however, the employment of the split-pole converter running as a single-phase machine connected to the single-phase circuit with suitable transformers. The output of the battery will then be delivered to the railway circuit without the intervention of mechanical transmission, and the efficiency on discharge, and therefore the net alternating-current output for a given battery discharge will be greater. This is illustrated in Fig. 4.

The cases next considered are those in which both alternating-current and direct-current generators supply a load which is partly alternating- and partly direct-current, the two circuits being interconnected by suitable converting apparatus. If the fluctuations of the direct-current load preponderate, a battery booster is required to keep the voltage of the D.C. busbars constant, and this machine must be of sufficient capacity for practically the total battery output. The booster control would not differ in any way from the standard direct-current controlling apparatus. In order to take up the fluctuations on the alternating-current circuit by the battery, the author again suggests the split-pole converter, and as the direct-current busbar voltage is practically constant, only a very small change in ratio of conversion would be necessary, just sufficient to overcome the internal drop in the converter and static transformers.

Another method suggested for providing for this automatic control of the converting apparatus consists in mounting on the shaft of the converter an alternating-current booster whose windings are connected in series between the alternating-current terminals of the converter armature and the collector rings. The field of this booster is controlled automatically in response to fluctuations of load on the alternating-current circuit, thus adding to or subtracting from the alternating-current voltage of the converter and thereby causing it to transmit energy in either

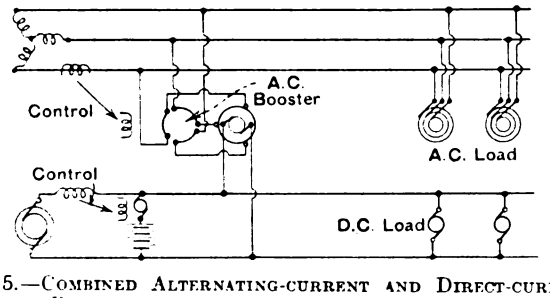

FIG. 5.—COMBINED ALTERNATING-CURRENT AND DIRECT-CURRENT LOAD; REGULATION WITH ALTERNATING-CURRENT BOOSTER.

direction between the alternating- and direct-current circuits as may be required to maintain constant load on the alternating-current generators. This latter arrangement is illustrated in Fig. 5.

When the alternating-current load fluctuations preponderate, a smaller battery booster is, of course, sufficient to handle the fluctuations of direct-current load, if the fluctuations of alternating-current load are transmitted directly to the battery terminals instead of to the direct-current bus-bars. The split-pole converter is again recommended for this purpose, and is in this case connected between the alternating-current circuit and the battery terminal, and so controlled as to transmit directly to the battery the fluctuations of load originating on the alternating-current circuit. This is the scheme which has been adopted for controlling the load fluctuations at the electric power plant of the Indiana Steel Co., at Gary, Indiana. For this plant there is being installed a battery consisting of two series of cells arranged to operate in parallel, each series consisting of 125 cells, having a one-hour capacity of 4,320 amperes. Provision has been made for the future extension of this plant by the addition of two more series of cells of the same capacity. Two direct-current boosters are provided, having sufficient capacity to handle the fluctuations of direct-current load, which will be

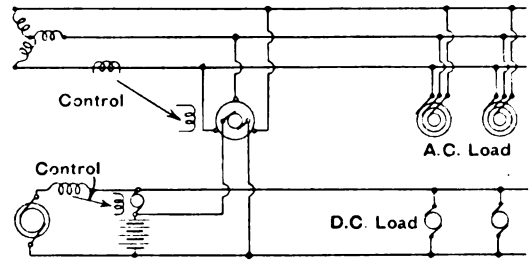

FIG. 6.—COMBINED ALTERNATING-CURRENT AND DIRECT-CURRENT LOAD; REGULATION WITH SPLIT-POLE CONVERTER AND BATTERY BOOSTER.

only a small part of the total load fluctuations. For handling the fluctuations of alternating-current load a split-pole converter of 2,000 kw. capacity is being installed, designed to provide a range of direct-current voltage from a minimum of 200 to a maximum of 300 volts with constant alternating-current voltage. The regulating field of this converter will be controlled by a special alternating-direct-current exciter, designed as described hereinbelow. Provision has been made for a second converter of the same design and capacity. This case is illustrated in Fig. 6.

AUXILIARY APPARATUS.

Under this heading the author describes as follows three pieces of auxiliary apparatus which have been developed for controlling the operation of a battery in connection with an alternating-current circuit:—

The first of these devices, the carbon regulator, calls for only passing notice, as its general design and operation are well known in connection with direct-current regulating plants. It is shown diagrammatically in Fig. 7, in which x and y are two piles of carbon discs subjected to variable pressure by means of the lever, L, which is pivoted between the two piles in such a way that any motion of this lever will increase the pressure on one pile and decrease that on the other. At one end of the lever is an adjustable spring, T, while from the other end is suspended the iron core of a solenoid, S, which carries the current to be regulated, or a current proportional thereto. The two carbon piles are electrically connected in series across the battery, B, while the field coil, F, which is to be controlled, is connected between a point in the circuit between the two carbon piles and the middle point of the battery. The variation of resistance in the two piles due to change of pressure causes a flow of current in one direction or the other through the field coil, F, which is therefore made responsive to the current in

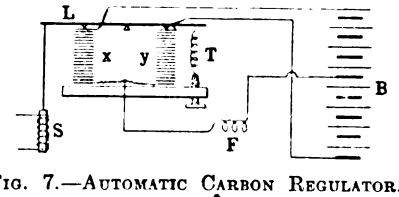

FIG. 7.—AUTOMATIC CARBON REGULATOR.

the solenoid, S. The application of the regulator to alternating-current control involves the substitution of an alternating-current solenoid for the usual direct-current coil. In those installations where the power factor is normally maintained approximately at unity, such as the usual alternating-current generating plant supplying current to converter sub-stations for direct-current railway service, a single coil supplied with alternating current proportional to the current output of the alternators will give entirely satisfactory results, this current being practically proportional to the true watt output of the machines. If, however, the power factor is normally consider-

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ably less than unity, or if it is subject to wide variations, it may be necessary to control the carbon regulator by means responsive to the energy component of the current and two coils may be used, one of which will produce a constant magnetic flux, while the other carries current which is in phase with the flux at unity power-factor, or whose energy component is in phase with the flux at power-factors other than unity.

The second piece of regulating apparatus which has been developed for this class of service is the split-pole converter. This machine is constructed with each pole sub-divided into three parallel sections with suitable windings for varying the relative excitation of the three sections, the object being to secure a variation of direct-current voltage while maintaining

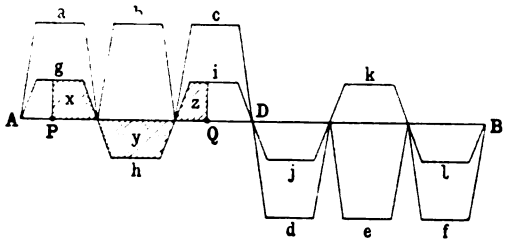

FIG. 8.—DIAGRAM OF FLUX DISTRIBUTION OF SPLIT-POLE CONVERTER.

a constant alternating-current voltage. The theory upon which this design was based may be illustrated by reference to Fig. 8, in which is shown an assumed distribution of field flux around the periphery of the armature. The line, A B, represents the developed armature periphery, the direct-current brushes being located at A and D. The lines a, b, and c, represent the field strength of the three sections of one pole, and the lines d, e, and f, that of the other pole under normal conditions of excitation. The result of this excitation will be a certain ratio between alternating- and direct-current voltage. If, now, the excitation of the outer pole sections a, c, d, and f, be increased, and that of the middle sections b, and e, be decreased, the field distribution may then be represented as the resultant of the auxiliary field, g, h, i, j, k, and l, superposed upon the normal field. If, now, we consider the electromotive force developed in a section of the armature between the points P, and Q, which may be taken to represent two of the three phase taps located 120° apart, it will be seen that the auxiliary field will have absolutely no effect on the voltage in this section at any point in the revolution; for the sum of the shaded areas x, and z, is always equal and opposite to the shaded area y. The auxiliary field therefore interposes into the armature section between the points P, and Q, equal and opposite amounts of field flux, which exactly neutralise each other in the generation of electromotive force between P, and Q. The effect, however, of the auxiliary field on the direct-current voltage between the points of brush contact A, and D, is to produce an increase in that voltage for the reason that between these two points there are two areas of positive flux and only one area of negative flux due to the auxiliary field. Theoretically, therefore, this auxiliary field would produce an increase or decrease in the direct-current voltage without any effect whatever on the magnitude or wave shape of the alternating voltage, between the points P, and Q, provided these points are spaced 120° apart. Practically, however, it is necessary to allow a neutral area of zero field strength at the points A, and D, for commutation. This modification produces some disturbance of the wave shape of the alternating counter electromotive force, which, however, is not sufficient to interfere with the practical operation of the machine.

The third piece of auxiliary apparatus described is an exciter designed to control the regulating field of a booster or split-pole converter in response to variations of load on an alternating-current circuit. This machine is illustrated in Fig. 9, and as there shown consists of an armature, B, provided with a bi-polar winding revolving in a four-pole field frame. This armature is connected by suitable collector rings (not shown in the drawing) to the secondary windings of three current transformers T_1, T_2, T_3, whose primaries are connected in series with the alternating-current circuit 1, 2, 3, supplied by a source, A, whose load is to be controlled. The alternating current thus transmitted through the armature winding would, if the latter were stationary, produce a revolving field proportional to the output from the source, A. The armature is, however, rotated by means of a synchronous motor in the opposite direction to that of the field rotation so as to hold this field stationary in space. There will result a stationary field whose axis is in the line of the arrow, K_1. A commutator, C, is connected to the armature winding upon which bear two pairs of brushes, 4–5 and 6–7. The effect of the field K, would be to produce a direct-current electromotive force between the brushes 4 and 5. A shunt winding, 8, on the four poles of this machine, controlled by the rheostat, R, may be adjusted to neutralise the field K_1 at any predetermined output from the source, A, thus reducing the electromotive force between the brushes 4 and 5 to zero. These latter brushes are then short circuited. If now, a slight increase of load on the source A should occur, the field K_1 would no longer be neutralised by the shunt field winding and an electromotive force would be produced between the brushes 4–5, causing a considerable flow between these brushes. This flow produces a secondary field, K_2, at right angles to the first, and of appreciable magnitude; and this second field produces an electromotive force across the other pair of brushes, 6–7, which are connected to the regulating field, F. In series between the brush, 7, and the corresponding terminal of the field, F, is connected a series winding on the poles of the exciter, designed to neutralise the magnetomotive force of the current through the armature winding between the brushes 6 and 7, so that the output from these brushes will have no disturbing effect on the exciter field.

This type of exciter possesses a number of important features in connection with alternating-current regulation, which may be briefly enumerated as follows:—(1) It will be seen that it acts as a multiplying device by reason of the magnifying effect of the current between the short-circuited brushes, and can therefore be made exceedingly sensitive to small changes in the alternating-current load. (2) It can be made to respond to any desired phase component of the alternating current by a suitable angular relation between the exciter armature and the armature of the synchronous motor which drives it. Thus for controlling the charge and discharge of a storage battery this exciter would be adjusted to respond to the energy component of the alternating current. (3) For controlling the power factor on the alternating-current circuit the two pairs of brushes, 4–5 and 6–7, may be interchanged so that the latter are short-circuited while the former are connected to a field winding on any synchronous apparatus connected to the alternating-current circuit. The

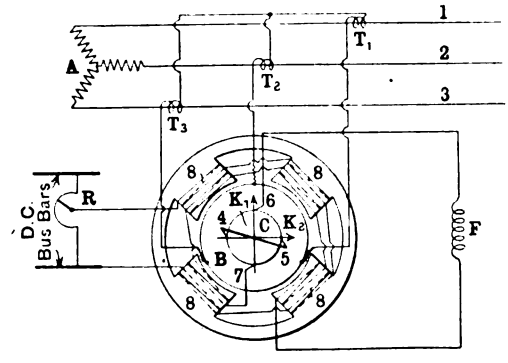

FIG. 9.—AUTOMATIC FIELD CONTROLLING EXCITER FOR BOOSTER OR SPLIT-POLE CONVERTER.

exciter will then be responsive to the wattless component of the alternating current, and can be made to control the field of the synchronous apparatus in such a way that this apparatus will supply practically all or any desired proportion of this wattless current. For controlling both the energy fluctuations and the power-factor two such exciters may be operated, one of which is responsive to the energy component and the other to the wattless component of current.

Another advantageous feature of this exciter lies in the fact that the secondaries of the current transformers may be short-circuited at any time, with the result of merely killing the regulating function. It is not necessary to disconnect the connections to the collector rings before doing this, even with considerable excitation in the shunt-field winding of the exciter, since the armature reaction is so great that a short-circuit will produce only a nominal flow of current sufficient to demagnetise the fields. Similarly, in putting the apparatus into service the rheostat, R, if properly calibrated, may be set for any desired constant load on the source, A, and, after all, the main connections are closed so that the battery is merely floating on the system, the short-circuiting switch across the secondaries of the current transformers may be opened and the load on the source, A, will immediately be held at the constant predetermined value for which the rheostat, R, has been set.

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A COMPARISON OF NATURAL AND INDUCED DRAUGHT SYSTEMS

WE give below a report of the discussion which followed the reading of Mr. W. N. Y. King's Paper with the above title at the meeting of the Leeds Local Section of the Institution of Electrical Engineers on November 25th. The Paper itself, which was given at some length in our last issue (page 701), contained figures giving the cost of a particular plant and sketches showing its arrangement, a set of curves connecting height of chimney, draught pressure, and chimney temperature in the case of natural draught, and also a number of general considerations with regard to induced draught plant.

Mr. J. R. Williams (Sheffield Tramways), in opening the discussion, said there was nothing to be gained by raising the temperature of the gases in the chimney to above 400° F. The ideal method for a steam plant was to have all the boilers connected to one main flue, using natural draught for ordinary loads, and induced draught for peak loads. This would entail a minimum capital outlay with high efficiency.

Mr. Graham (Sheffield) did not feel able to criticise the Paper at length, as he had not previously had an opportunity of reading it, but he would have liked the author to have given more comparisons of results obtained with both systems. Speaking from an extensive experience with induced draught, he detailed several installations where a considerable increase in efficiency had been obtained by its adoption. Not only a large saving in fuel, but less boiler power was required to obtain the same amount of steam. Referring to the question of pre-heating the air by means of the heat in the flue gases, he affirmed that for every degree of heat extracted from the gases, the furnace temperature was increased two degrees. In comparing the relative costs of the two systems, the correct method would be to include the whole cost of the boiler plant. In an installation of over four boilers, the first cost of an induced draught system with hot-air economiser was less than with natural draught. The speaker referred to a patented system of combined forced and induced draught which allowed the furnace doors to be opened for stoking without letting in cold air, thus overcoming a prejudice which at present exists against the use of these systems.

Mr. W. B. Woodhouse (Yorkshire Electric Power Co.), in criticising the tests given in the Paper, said they were difficult to analyse, owing to the many assumptions included. It was a frequent though unfortunate practice in Papers dealing with efficiencies of steam plant to consider the combination as a whole, whereas the efficiency of the boiler should be treated separately from that of the combustion. He would like to know how much the efficiency was improved or altered by increasing the draught by fractions of an inch.

Mr. R. H. Campion (Electricity Works, Dewsbury) considered it would be preferable to design a natural draught plant in the first place on modern lines, using expanding flues, &c. Induced draught was usually only added to overcome original bad design. Referring to the heat losses, those resulting from banking the fires were always very great, and should be guarded against. In his opinion, one of the chief drawbacks to the induced draught system was the difficulty experienced in keeping the bearings of the motors cool.

Mr. Wilson Hartnell (Leeds) pointed out that to obtain the best results with induced draught, the plant must be totally redesigned as the conditions were so different. A quick combustion was far more economical for high evaporations. Although there were advantages with induced draught, the mechanism required renewing more often than a chimney. For natural draught the chimney should be designed so that it would carry away all the gases with a draught of about 10 ft. per second.

Mr. H. Dickinson (City Electrical Engineer, Leeds) was of the opinion that for a constant and steady load there was no advantage in induced draught. For central station work it, however, was a considerable help for peak loads. At night it enabled one to keep less standby boilers in service, and reduced the number of boilers necessary for the load. He noticed there was no mention about trouble from grits coming out of the chimney. In Leeds they had trouble in this respect, although the chimney was 210 ft. high, and many plans had been tried to overcome the difficulty.

Mr. King, in reply, agreed there was no advantage to be gained by increasing the temperature in the chimney above 400° F. The life of a brick chimney might be taken at 100 years, and a fan outfit at about 10 years. The base of a steel chimney, if self-supporting, must be well splayed out, nearly as large as a brick chimney. He agreed the capital cost of economisers should be included, but he had found it difficult to include everything in a short Paper, which was written more with the intention of promoting a discussion than as a complete Paper on the subject. The bearings of the motors should be amply designed, and in practice did not give trouble if properly water cooled. The smoke problem, he said, was really a question of proper combustion. Replying to Mr. Dickinson's remarks re trouble with grits coming out of the chimney, he admitted that such was the case, but in Sheffield it was only small compared with what was ejected from neighbouring steel works.

FIRES ON TUBE RAILWAYS

THE Fire Brigade Committee of the London County Council have reported upon the question of precautions against fires in underground railways. This is mainly due to a report by the chief officer of the fire brigade on the fire which occurred on July 16th, 1908, on the City and South London Railway. In this report the following recommendations are made :—

(1) The fire appliances on all tube railways, whether constructed before or since 1904, should be periodically inspected by the chief officer of the fire brigade with a view to seeing that they are efficiently maintained, and in making such inspection the chief officer should deal with any points which may occur to him affecting the general question of protection from fire, and should communicate direct to the Board of Trade any suggestions which he may desire to make.

(2) There should be provided on all tube railways, whether constructed before or since 1904, automatic signal lights, or preferably an illuminated sign, which would show on the platforms of the stations concerned and also on the street level when the current to the live rail is cut off in either direction.

(3) The owners of all tube railways constructed before 1904 should be called upon to comply, with as little delay as possible, with the requirements made in that year, or if this is considered impracticable, such railways should at least be provided with—(*a*) fire-appliances as far as possible in conformity with the minimum requirements made in 1904; (*b*) a hydrant, with sufficient hose, fitted 100 yards down each tunnel from each end of each platform; and (*c*) an incombustible platform between and at the sides of the rails for persons to walk upon.

(4) The minimum requirements, &c., as regards fire-appliances made in November, 1904, should be varied by the omission of the observation (*d*) as to the fire brigade being practically of no avail in the event of a fire obtaining a hold in a tube railway and the substitution therefor of the following observation—"In the event of a fire in a tube railway not being readily extinguished by the railway employees, notification should be immediately given to the fire brigade by telephone and by the nearest fire-alarm."

The Supply of Tungsten.—In view of the fact that a large amount of tungsten is now being used in the manufacture of metal filament lamps, the following information with regard to the sources of the minerals from which the metal is obtained is of interest. The chief ores are wolframite and scheelite, the former a tungstate of iron and manganese containing up to 76 per cent. tungstic acid, the latter tungstate of lime containing up to 80 per cent. tungstic acid. As was mentioned in a short article on the subject on page 23 of Vol. III. of Electrical Engineering, the greatest producing locality in the United States is Boulder County, Colorado, where the ore occurs as a wolframite breccia. A small amount of wolfram is found in the tin mines of Cornwall, but it has only been separated recently. The mines in Portugal have a good output, and the amount exported increased from 9 tons in 1905 to 570 tons in 1906. Valuable deposits of wolfram exist in the Nagpur district of the Central Provinces of India, and the deposits in Queensland are still being worked with great success.

Physical Society Exhibition.—The annual exhibition of apparatus is to be held by the Physical Society on Friday evening, December 11th (from 7 p.m. to 10 p.m.), at the Royal College of Science, South Kensington. The following firms will be among those exhibiting :—Cambridge Scientific Instrument Co., Casella & Co., A. C. Cossor, Ltd., J. H. Dallmeyer, Ltd., Elliott Bros., Everett, Edgcumbe & Co., Gallenkamp & Co., Gambrell Bros, J. J. Griffin & Son, A. Hilger, Ltd., India Rubber, Gutta Percha & Telegraph Works Co., Marconi's Wireless Telegraph Co., Nalder Bros. & Thompson, Newton & Co., R. W. Paul, James Pitkin & Co., Siemens Bros. & Co., Snell & Tinsley, J. Swift & Son, Alexander Wright & Co., and Carl Zeiss, Ltd. From the programme, of which we have received an advance proof, there appear to be many items of considerable interest to both physicists and electrical engineers. We understand that invitations have been given to the Institution of Electrical Engineers, the Faraday Society, the Optical Society, and the Röntgen Society. Admission, however, except to Fellows of the Physical Society, will be by ticket only, and therefore members of the societies just mentioned desiring to attend the exhibition should apply to the secretary of the society to which they belong.

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INCANDESCENT LAMPS

A PAPER was read recently by Mr. J. Findlay before the Rugby Engineering Society on incandescent lamps. The first part of the Paper was devoted mainly to the carbon filament lamp, and was prefaced by some introductory historical remarks.

"Reading over early patent specifications," he says, "it is difficult to understand why some of the lamps there described were not successful. It is probably the case that some of the inventors lacked perseverance, and discontinued their efforts on encountering difficulties. One is confirmed in this view on coming to Edison's specifications. It is quite plain that he kept trying one thing after another with great perseverance, and when he struck the right track he went into the work with great thoroughness. The first British patent to be classed under "Incandescent Lamps" was granted to A. N. Lodiguine, of St. Petersburg, in 1872. The first to mention an exhausted glass vessel was granted to S. W. Konn, in 1875 (Konn was, I think, the agent of Lodiguine). A patent granted to C. W. Harrison, in 1878, describes the manufacture of metallised carbons. Edison's first patent is dated October 23rd, 1878, and very curiously, in addition to mentioning carbon as a possible material for the filament, it mentions, among other things, titanium oxide and osmium, or other metals having a high melting point. In the following month, Edison filed another application, in which mention is made of zirconium oxide, silicon, and boron, all materials which have figured largely of late in the efforts to find substances of higher efficiency than carbon. Edison's patent, dated November 10th, 1879, speaks of 'a carbon filament of high resistance in a vacuous glass bulb.' This sentence aptly describes the carbon filament lamp of the present day."

The Paper then dealt with the defects which have to be watched for in incandescent lamps, emphasising more particularly the results of a bad vacuum. If the bulb is insufficiently exhausted, and enough residual gas is left in it to conduct across from one platinum wire to the other, the normal current of the lamp will be a very small part of the total current which may pass over the leading-in wires. It is even stated that as much as 25 amperes will pass as a vacuous discharge in a poorly-exhausted lamp. Manufacturers generally test the vacuum of their lamps on a spark coil, and judge the vacuum by the glow. A method which is much handier for the purchaser is to tap the bulb sharply with the finger, and notice the vibration of the filament. If the filament continues to vibrate for some time and comes to rest gradually, the vacuum is good, but in the case of a poor vacuum the filament will very soon cease to vibrate.

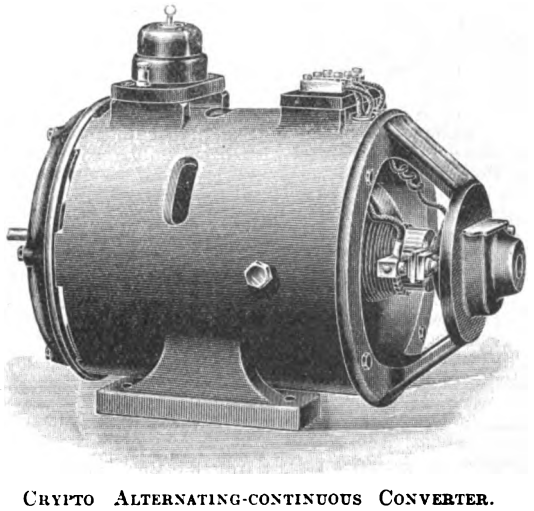
The subjects of candle-power efficiency, life testing, and effect of variation of voltage on carbon filament lamps were then briefly dealt with, and in the latter portion of the Paper the author passed on to speak of metal filament lamps, continuing as follows:—

"The idea of using tungsten for filaments is not new, but the successful manufacture of filaments made from this metal is, on a commercial scale at least, quite recent. In January, 1893, A. de Lodiguin, a Russian, residing in Pittsburg, Pa., filed an application for a United States patent for a method of manufacturing filaments from tungsten, molybdenum, and chromium. Lodiguin seems to have devoted most of his attention to chromium, which later investigation proves has not the possibilities of tungsten. Certain patentees apparently claim for themselves the sole right to manufacture filaments of *pure* tungsten, although the patent specification in which this claim is made describes a method of manufacture which results in a trace of carbon being left in the filament, while Lodiguin's specification, now almost 16 years old, describes a method of manufacture which leaves positively no trace of carbon or other impurity.

"The tungsten lamp has not yet been in use for a long enough period to enable us to tell how it will act under different conditions with the same precision that we can now do regarding carbon filament lamps. The efficiency of the tungsten lamp is sometimes advertised as 1 watt per candle. This is undoubtedly done to increase its superiority in efficiency in comparison with other types of lamps, but it appears to be overstating the case. Advertisers take advantage of the fact that this lamp, being of Continental origin, has in its home been rated in watts per hefner, and they, when advertising the lamp here, apparently see nothing wrong in translating hefner into candle, while failing to change the figures to correspond with the changed unit. A hefner unit is about 10 per cent. less in value than a British parliamentary candle, so that the equivalent of 1 watt per hefner is 1·1 watts per candle. This is too high an efficiency at which to rate lamps for use on the ordinary supply lines. It might be all right under ideal conditions, say where the voltage was never more than one per cent. above normal. It is very often stated that on account of the resistance of a tungsten filament increasing with temperature instead of decreasing, as in the case of carbon filaments, that the tungsten lamp is far less susceptible to change of voltage than the carbon filament lamp, and that the life is not so adversely affected by a rise in voltage. This may all be true when the efficiency is 1·1 watts per candle-power or poorer, but when we operate the lamp at efficiency of over 1·1 watts per candle, there is reason to doubt if all of this statement will still hold. Figures are not readily available, but there is reason to believe that the life of a tungsten lamp burning at 1¼ watts per candle, is four times as long as it would be if burned at 1 watt per candle-power. This difference in temperature will be caused by a difference of 10 per cent. in voltage, and will be accompanied by a rise of 40 per cent. in candle-power, and 5½ per cent. in amperes. Making calculations to get the total cost of light, we find that if we pay 4½d. per unit for current and 4s. for lamps, a 30-candle-power lamp, burning for 250 hours at 1 watt per candle, will cost 32·7 pence per 100 hours, while a 30-candle-power lamp, burned at 1¼ watts per candle for 1,000 hours, will cost 21·7 pence per 100 hours. So long as lamps remain at their present price, there can be no economy in burning them at anything under 1¼ watts per candle, and it will probably pay to buy lamps even when rated at 1¼ watts per candle, of a voltage two or three per cent. higher than the declared voltage, so that the lamps may be able to withstand temporary rises in the line voltage. Experience reported from the United States confirms this view. When the tungsten lamp was first put into service in America, many complaints were made of bulbs blackening and of early burn-outs. Reports were made later from many different points that this trouble had been overcome to a large extent by ordering lamps of a voltage five per cent. higher than the voltage of the supply line."

A SMALL ALTERNATING-CONTINUOUS CONVERTER

THE accompanying illustration represents a compact and convenient set, forming a combined alternating-current motor and continuous-current generator, specially intended for charging ignition cells from alternating-current mains. The makers of the apparatus, the Crypto Electrical Co., of 155 and 157 Bermondsey Street, S.E., have for some time specialised in this class of apparatus, but the machine illustrated is an entirely new pattern, re-designed throughout. With the old, well-known set it was not possible to take more than about 100 watts output from the secondary side without overheating, and as a somewhat larger output is generally convenient, both the motor and generator have been enlarged. The present set is listed for seven amperes at 15 volts, but can easily be loaded up to eight



Crypto Alternating-continuous Converter.

amperes or 120 watts. Carbon brushes are now used instead of copper gauze. The motor is a single-phase induction motor, and is provided with an auxiliary starting winding. In order to prevent this winding from being left on after the motor has been brought up to speed, a double-acting tumbler switch is provided. To start the motor, the knob is pressed one way, and after it has gained its normal speed, the knob is pressed back the other way. In the first position the starting and running windings are in parallel, and in that position the switch will open unless held over. In the second position, the running winding only is in circuit. If the switch is put in the second position first, the motor will not start, but no harm is done.

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ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN the *Elektrochemische Zeitschrift* of November, Dr. O. Froelich contributes an interesting article upon a new copper winning process. He first describes the present processes, where it is necessary to roast, then furnace, and finally refine the copper electrolytically or by further furnace methods. The great advantage of electrolytic over furnace refining, although it is more expensive when worked for copper alone, is the easy recovery of the noble metals, gold, silver, and platinum. A satisfactory process for producing copper from its ores directly by leaching out and then electrolysing has not up to the present been found. The method here described depends not upon roasting copper sulphide ores, as has heretofore been done, and driving off the sulphur as sulphur-dioxide, but in heating it out of contact with air to a temperature of from 200°–800° C. The copper ore is then converted into cuprous sulphide, and iron sulphide with liberation of sulphur.

$$2\ FeCuS_2 = Cu_2S + 2FeS + S.$$

The sulphur can thus be directly obtained, and there is no necessity to have a sulphuric acid plant built in the neighbourhood of the works, which must be done if sulphur as sulphur dioxide is to be saved.

The ore, after heating, is leached out with ferric chloride, which dissolves the copper, converting it into cupric and cuprous sulphide. A particular form of digester is employed for this, which consists of a wooden vat, having suspended in its centre a porcelain or wooden perforated cylinder. Within this cylinder there is a wooden screw which lifts the liquid and throws it over the top of the cylinder into the upper part of the vat, solution from the lower part where the cylinder is surrounded by the broken ore running in to take its place. This method of circulation causes a very thorough circulation of the liquid.

Iron is then added to the leaching liquid. The copper is thrown out, and the iron passes into solution. The copper is then washed and cast into ingots. These can either be purified by electrolytic means or by furnace methods. One interesting point is that the noble metals are obtained in the leaching solution, and can be readily recovered from this by electrolytic means. Either poor or rich copper ores may be used satisfactorily for this process. For example, with ores containing only 1 per cent. of copper, not more than 0·1 per cent. is left in the gangue after it has been leached.

According to the German Patent No. 195.033 of Messrs. Siemens & Halske, electrolytic zinc can be obtained in a compact form from solutions of zinc sulphate without the employment of a diaphragm by employing anodes of compact lead peroxide. The anodes may either have a metal core, coated with the peroxide, or may be made entirely of compact lead peroxide.

Electrical Engineers' Ball, 1909.—It has been decided to hold the 1909 ball on Friday, February 5th, at the Hotel Cecil. A large and influential committee has been formed, with an executive committee consisting of the same gentlemen as on the last occasion. The honorary treasurer is Mr. Robert Hammond, and the honorary secretaries are Mr. A. M. Sillar and Mr. H. Alabaster.

Rugby Engineering Society.—The proceedings of this society for the session 1907-8 have just been published. Besides the various Papers read before the society and reports of the discussions, the volume includes a list of the officers for the session, the rules of the society, the library list, a list of the premium awards for the last five sessions, and other information with regard to the society. Among the Papers included is one on the Diesel engine, by A. E. Thompson, and another by A. W. Graeme on the "British Locomotive." The Paper by Mr. Bernard Hopps on petrol-electric systems for motor omnibuses (see ELECTRICAL ENGINEERING, Vol. III., p. 275), which contained a complete description of the British Thomson-Houston Co.'s petrol-electric system, is also in this volume. Lastly, there is a Paper by H. O. Eurich and F. P. Whitaker on the "Systematic Design of Direct-Current Stationary Motors."

Covered-top "Electrobuses."—In a note on page 444 of ELECTRICAL ENGINEERING for September 17th, 1908, it was announced that the London Electrobus Co. would soon put in service in London buses with top covers after the style of those employed on tram-cars. On Saturday last a trial run was made with the first of these 'buses in the Strand and other main thoroughfares, and as soon as the sanction of the police authorities has been obtained, the 'bus will be put into public service. The fact that the accumulators, which weigh nearly 30 cwt., are hung below the level of the wheel axles, causes the centre of gravity to be quite low, in spite of the extra weight of the cover on top. The seats on top are arranged transversely, as is usual, but with a gangway down either side instead of one in the centre. It is stated that the present takings of the company average 14d. per car mile, which means that each 'bus earns some £500 annually. There are 20 'buses now in service.

THE PARLIAMENTARY SESSION OF 1909

IN addition to the proposals, of which particulars were given in our last issue, notices have also been given of the intention to deposit the following Bills in the Parliamentary Session of 1909 :—

The promoters of the North and South Shields Electric Railway, which was authorised in 1902, seek an extension of time granted by their original and subsequent acts for the completion of work and the acquisition of land. Powers to raise new capital are also asked for.

An extension of time will also be sought by the promoters of the South-Western and Isle of Wight Junction Railway for a proposed electrically-operated railway connecting the mainland of Hampshire with the Isle of Wight, which was authorised in 1901. A similar application will be made with regard to the Preston, Chorley, and Horwich tramways, which were authorised in 1903.

New tramways are proposed in a Bill by the Keighley Corporation.

Electric Lighting Provisional Orders will be applied for by the Coast Development Corporation for supply in Walton-on-Naze; Southampton Corporation, for the parishes of North and South Stoneham; Stourbridge Urban District Council; Aldershot Gas and Water Co. (Camberley); Christey Bros., Ltd. (Holsworthy); Biddulph Gas. Co.; Wells Gas Co.

Tramways Provisional Orders will be applied for by the Northampton Corporation and the Bolton Corporation.

LONDON TRAFFIC

THE Prime Minister, on Thursday afternoon, received a deputation from the London County Council respecting the traffic of London. The deputation was introduced by Mr. R. A. Robinson, Chairman of the London County Council, who was followed by the Hon. W. R. Peel, who urged upon the Government the necessity for taking into consideration the question of the traffic in the whole of the area of greater London. At present, although the traffic had increased to 1,280 millions from 259 millions in 1881, there was no co-ordination between the large number of different companies and authorities, who were all competing with each other. The views of the London County Council were that, having a tramway undertaking of their own, they preferred the creation of an Advisory Board upon the lines recommended by the Royal Commission on London Traffic, in 1905. In his reply Mr. Asquith first of all pointed out that he was not a free agent in this matter, the subject being one which closely concerned the Board of Trade and the Local Government Board. At the same time he confessed that the question had not greatly occupied his own attention. He gathered from the deputation that insuperable objections were foreseen to any proposal that the London County Council should deal with the question on the lines laid down by the Royal Commission, and he further gathered that any authority which might be created by the Government should not exercise executive functions and still less coercive functions; in fact, the authority recommended would be a kind of intelligence department on this particular question. Of course it was clear that the authority might make suggestions to the Government, but he thought there were strong objections to setting up another authority in London if it could be possibly avoided. London suffered rather from a superfluity of authorities in this connection, but at the same time he was greatly struck with the want of co-ordination as regards routes and competing forms of traffic. For the present, however, he did not think he could do more than promise to most carefully consider all the points brought forward by the deputation.

The Trackless Trolley System in Germany.—In the reports prepared by the Dundee and Manchester Tramways Committees on the trackless trolley system, abstracts of which were published in ELECTRICAL ENGINEERING for July 30th and October 1st respectively, descriptions were given of the cars and equipment in the German town of Mulhausen. This is the latest example of the system, and the following notes from the *Mulhausen Tagblatt* regarding the working and proposed extension of the line are of interest. On a certain Sunday in October last, 1,434 passengers were carried, and the receipts amounted to over £10, which works out at just over one shilling per car mile. The current consumption amounted to 1·42 kw. hrs. for the 200 car miles run, as measured at the power station. The line losses amounted to 3·9 kw. hrs. This gives a total consumption of 710 watts per car mile. Each car carries twenty passengers, and weighs 54 cwt. unloaded. The total length of line working at present is two miles, and the cars run every twelve minutes on week-days, and every six minutes on Sunday afternoons, when a large number of passengers are carried to the Zoological Gardens. An extension of over six miles of route is to be made soon. On one portion of the proposed route the gradient is as much as 9·2 per cent., or 1 in 12·2.

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LONDON ELECTRIC POWER BILLS

BOTH the London Electric Supply and the London (Westminster and Kensington) Electric Supply Bills have now been passed by Sir Luke White's Committee of the House of Commons, and reported for third reading. The following account gives briefly the contents of the Bills as they have now been reconstituted in consequence of the decisions of the Committee, and affords a clearer idea of the cumulative effect of the various decisions than if we were to give them piecemeal in the sometimes contradictory and confusing form in which they were given during the Committee proceedings. Special attention may be drawn to the report of the London County Council upon the London Electric Supply Bill.

London Electric Supply Bill.

This Bill now provides that the authorised undertakers within the County of London, or any two or more of them, with the approval of the Board of Trade, may enter into and carry into effect agreements for mutual assistance both with regard to the giving and taking of a supply, and of the management and working of their generating stations or undertakings generally. Mains may be carried through the districts of intervening authorities, the protection afforded to such authorities being that they may call for a supply of electrical energy upon the same terms as those agreed between the undertakings linked up by the mains running through the intervening district. A maximum price has been inserted in the Bill for power supply at the rate of £6 15s. per kw. per annum of maximum demand, plus 0·5d. per unit where the maximum demand is not less than 2 kw. The companies supplying upon these terms may demand a contract for seven years, the consumer agreeing to pay an annual sum of not less than 20 per cent. upon the capital outlay respecting the supply.

The clause authorising the supply of energy for haulage, traction, &c., stipulates that energy shall not be supplied under this section for use in the London Docks, St. Katherine Dock, or the Regent's Canal Dock, in the Metropolitan Borough of Stepney, to any dock within the Metropolitan Borough of Poplar or to the Victoria Dock, which is in West Ham, without the consents of the respective local authorities.

Clauses are also inserted for the protection of the railway companies, Metropolitan Water Board, &c., and special reference may be made to the clause for the protection of the Royal palaces, parks, &c. This gives the engineer to the Commissioners of Works authority to inspect any generating station, and if in his opinion proper precautions are not being adopted for the consumption of smoke and for reasonably preventing the evolution of oxides of sulphur, and generally for the prevention of nuisance in relation to Royal palaces, parks, &c., the undertakers may be called upon to remedy this defect.

The clause constituting the London County Council the purchasing authority in lieu of the Borough Councils, is given in full below :—

(1) From and after the passing of this Act every power to purchase any Undertaking or any part of any Undertaking of a Supply Company which but for this section would have been exercisable by a local authority in any part of the Administrative County of London under the provisions of Section 2 of "The Electric Lighting Act, 1888," shall be and is hereby transferred to the London County Council (in this Section called "the Council"), and shall, subject to the provisions of this Section, be exercisable by the Council in lieu of and in substitution for the local authority, and the Council shall also be empowered to purchase all the Undertakings (or parts of Undertakings) in the said County of all the London Electric Supply Companies not purchasable by a local authority.

Provided that the Council shall give not less than three years' notice of their intention to exercise such power and that from and after such purchase all powers now vested in the London Electric Supply Companies in regard to the Undertakings (or parts of Undertakings) so purchased shall vest in and be exercisable by the Council in lieu of and in substitution for the said Companies and shall cease to be exercisable by the said Companies.

(2) The Council shall not give notice of their intention to purchase nor shall they purchase the Undertaking or any part of the Undertaking of a Supply Company unless they shall at the same time give notice of their intention to purchase and shall purchase upon the terms hereinafter defined all the Undertakings or parts of Undertakings of all the London Electric Supply Companies which the Council are in pursuance of this Section empowered to purchase.

(3) The Undertakings of the several London Electric Supply Companies shall if purchased by the Council be paid for upon such terms if not agreed upon as an Arbitrator may determine to be equitable having regard to all the circumstances of the case, including the date at which the Undertaking or part of the Undertaking became or would become purchasable, and in fixing such terms the Arbitrator shall in no case award less than the price which would have been payable to the Company under and in accordance with the provisions of Section 2 of "The Electric Lighting Act, 1888," if the local authority had exercised the powers of purchase under that Section, taking into consideration the date at which such purchase might take place or have taken place, and in the case of the City Undertaking of the Charing Cross, West End, and City Electricity Supply Co., Ltd., less than the price which would have been payable to that Company under and in accordance with the provisions of "the City of London Electric Lighting Order, 1899."

(4) The date at which the Council may proceed to purchase the undertakings of the London Electric Supply Companies in pursuance of any such notice as aforesaid shall be the twenty-sixth day of August one thousand nine hundred and thirty-one, and if the Council shall not have served notice as aforesaid for purchase at that date, they may, upon given notice as aforesaid, purchase such Undertakings at the expiration of any subsequent period of ten years.

(5) After the passing of this Act the Undertaking (except Undertakings or parts of Undertakings used wholly for the supply of electricity outside the Administrative County of London) of the London Electric Supply Companies shall cease to be purchasable otherwise than in accordance with the provisions of this Section.

The purchase money may be paid in stock to the extent of one-half, the remainder to be paid in cash.

Clause 24 stipulates that the County Council shall advance to the Company during the three years' notice the necessary sums for developing the undertakings during that period upon a rate of interest which the Treasury may determine, in default of agreement. The expenditure of any capital during this period is to be subject to the consent of the Board of Trade, and will be deducted from the price payable to the Companies when the actual purchase takes place.

Further clauses preserve the rights which the Corporation of London, the Camberwell Borough Council, and the Lambeth Borough Council now have of purchasing the Companies in their areas prior to 1931.

London (Westminster & Kensington) Electricity Supply Bill

This Bill, although carrying out the same objects as the London Electric Supply Bill, differs somewhat in its clauses, mainly owing to a technical difficulty which prevented an instruction being moved in the House constituting the London County Council the purchasing authority in lieu of the local authorities concerned. Instead, an instruction was moved binding the Companies concerned in the promotion not to oppose any legislation to this effect in the future. Thus, although the London County Council is definitely constituted the purchasing authority of nine of the London Companies in 1931, the question of purchase in the present Companies areas is held open for future legislation. Further, one or two of the Companies of the previous Bill supply in the areas affected by this Bill; thus, some of the Companies in Westminster, for instance, are now purchasable, if the Bills go forward, by the London County Council, and, as matters stand at present, the remainder will fall into the hands of the Westminster City Council unless Parliamentary powers are given to the County Council to be substituted for the Westminster City Council. Beyond these matters, the two Bills are identical, with the exception of certain verbal alterations necessary owing to the altered conditions in the areas supplied by the two sets of companies.

Needless to say, many amendments were asked for by various opponents of the Bills, but the Committee, having laid down, so to speak, a certain policy in dealing with them, refused to depart from it, although it must be said that the attitude taken up at times was somewhat inconsistent.

L.C.C. Report on the London Electric Supply Bill.

As the result of the decisions of Sir Luke White's Committee, the Parliamentary Committee of the London County Council has issued a further report, in which they condemn the attitude of the House of Commons Committee towards the Council.

Dealing first with the instruction, constituting the London County Council the purchasing authority, the Committee state that the first question to be dealt with arose in regard to the interpretation of the words "on equitable terms" contained

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in the instruction. It was contended on behalf of the companies that the House of Commons in passing the instruction had contemplated the safeguarding of the companies interests, and in support of this view reference was made to a certain interview which took place between representatives of the companies and the President of the Board of Trade. The Committee were previously unaware that any such exchange of views had taken place, and for the Council it was pointed out that not only was the companies' contention contrary to the Council's interpretation of the instruction of the House, but that the speech of the President in the House of Commons in the debate on the instruction strongly supported the Council's view that the instruction contemplated safeguards for local authorities whose rights might be affected. The paragraph in the speech is as follows:—"In the opinion of the Government the consolidated rights should be vested in the London County Council, after giving to the local authorities full opportunity to be heard in the interest of their ratepayers and their local claims to be fully appraised and adjusted." The local authorities supported the Council's view of the matter, and some discussion ensued, during which counsel for the Council (Mr. Freeman, K.C.) objected to any reference to the interview with the President on the ground that, if any views were held by the President other than those which could be gathered from his speech in the House, they should be placed before the Select Committee in the regular way by a representative of the Board of Trade. In the result, however, the chairman gave his ruling on the point in the following terms:—"The equitable terms can only have referred to the companies themselves as between the companies and the London County Council," and he added that this was the view of the Committee. This decision had a most important bearing on the subsequent proceedings of the Committee. The companies thereupon produced their clauses to give effect to the instruction.

The local authorities supported the Council's method of giving effect to the instruction of the House, but the companies most strongly objected thereto, and although the very onerous character of the companies' proposals was explained to the Committee, including the fact that whilst leaving the terms of purchase absolutely indefinite they departed entirely from the general law laid down in the Electric Lighting Act, 1888, the Committee decided to adopt the purchase clause proposed by Mr. Balfour Browne, K.C. (for the companies), with an alteration from ten years to three years, as the time of notice. (This clause is given in full above.)

The Committee also adopted, in face of the Council's strong objection, the proposal of the companies to require the Council to finance them during the years immediately before purchase. An obligation of this kind is, so far as the Committee are aware, entirely unprecedented. There would be no reasonable objection to an enabling power of this nature being given to the Council to advance money on agreed terms, but the clause put forward by the promoters makes it incumbent on the Council to lend money to meet the demands of the companies for any expenditure which the Board of Trade may decide to be reasonable. A proposal such as this, the report points out, which compels a local authority to lend an indefinite amount of money without full and adequate security for the payment of interest and principal is a very serious one, and should be opposed. The Committee disallowed a proposal to compel the Council to purchase the Willesden station of the Metropolitan Electric Supply Co., and preserved to local authorities their special powers of purchase exercisable before 1931.

The decisions of the Committee result, therefore, in the obligation being placed on the Council to purchase all the undertakings at the same time if it purchases any; the companies to have three years' notice instead of practically no fixed term of notice as at present; and the method of arriving at the purchase price of the undertakings is left entirely open to the arbitrator, with the reservation that the companies are in no case to receive less than the price which would have been payable under section 2 of the Act of 1888, and in the case of the City undertaking of the Charing Cross Company, that company is to receive a price not less than a price arrived at upon the basis of the very special terms above set out.

In view of the enormous financial transaction which would be involved in the carrying out of the purchase of the companies at one and the same time, the Council asked the right to discharge the purchase money by the issue of stock. The Committee, however, refused to allow the Council to discharge the purchase price wholly by the issue of stock, and reserved to the companies the right to the payment of one-half of the purchase money in cash. Further, the Committee declined to insert any power to enable local authorities to re-purchase distribution works from the Council, a matter to which the Council has attached considerable importance, particularly in view of the magnitude of the work which would be involved in carrying on the whole of the undertakings if purchased by the Council.

With regard to the amendments submitted by the Council as to the carrying out of street works and of its property, the Committee inserted some of the amendments desired, but in two important particulars at the instance of the local authorities, led by counsel for the City of Westminster, declined to insert the amendments desired, and also refused to allow the Council to have such protection in regard to the companies' operations as had previously been accepted by the companies. In this decision the Committee not only entirely depart from the established practice as embodied in the provisional orders relating to London electric supply, but refuse to the Council such rights as in the Bill they have allowed to the Middlesex County Council.

The Council will receive with deep regret the conclusions above set out. The Committee state they had hoped that the proceedings before the Committee would have resulted in the passing of a Bill dealing in a satisfactory way, not only with the question of linking up, but also with the difficulties of the question of purchase, which have so long been foreseen. As the Bill now stands, there will be little, if any, difference of opinion that in the interests of the public the present position of purchase, unsatisfactory though it may be, is preferable to the extraordinary departure contemplated in the Bill from the recognised principles governing the matter. It would be a matter for regret, however, if the present opportunity of removing some of the difficulties in connection with the supply of electricity in London by the Bill is to be entirely lost, and the Committee think the Council should endeavour to obtain therein such amendments as may make it compatible with the public interest. The Committee therefore point out that every endeavour should be made during the progress of the Bill to secure the following amendments:—(1) That the undertakings of the companies shall be purchasable under the provisions of section 2 of the Electric Lighting Act, 1888, except in the case of the undertaking of the Charing Cross Company within the area of the City of London. (2) That, in the case of this last-mentioned undertaking, it shall be purchasable on Electric Lighting Act terms, plus a consideration in respect of the loss which the company may sustain by reason of purchase taking place in 1931 instead of 1941. (3) That an enabling power for the Council to advance capital to the companies after notice of purchase has been given shall be substituted for the obligatory power now in the Bill. (4) That the Council should be entitled to discharge three-fourths and not merely one-half of the purchase money by the issue of stock. (5) That the Council and the local authorities may be empowered to agree as to the purchase by such local authorities from the Council of so much of the distributing systems of the undertakings purchased by the Council as may be within their districts. (6) That the usual powers for the Council with regard to street works be inserted in the Bill.

The following recommendation is attached to the Report:—That the Parliamentary Committee be authorised to take all steps necessary to secure that the amendments desired on behalf of the Council shall be inserted in the London Electric Supply Bill, and to prevent the Bill from passing into law in its present form.

In this connection we may point out that Mr. Rupert Guinness, Mr. Acland Allen, Mr. Walter Guinness, Mr. A. C. Morton, and Mr. B. Cooper have given notice of their intention to move the rejection of both Bills on third reading.

DEPUTATION TO BOARD OF TRADE.

On Thursday a deputation representing fifteen Metropolitan Borough Councils and thirteen local authorities owning electricity undertakings outside the County of London waited upon the President of the Board of Trade. The proceedings were private, but an official report has been published. The deputation was introduced by the Hon. Claude Hay, M.P., who stated that the deputation had two objects in view—namely, to ask the President to assist in the passing of the later stages of the London Electric Supply Bill, and also to reintroduce into Parliament the Electric Supply Bill, which was introduced by the Board of Trade in 1906, and in several subsequent sessions, so as to enable undertakings to give and take supplies of electricity in bulk.

Mr. Winston Churchill, in reply, said that he was pleased to find that at last there seemed to be some general agreement on the question of the necessity for improving the conditions of the electrical supply in and near London. On the question as to the advisability of undertakings being allowed to link up their systems there could be no doubt. He referred with satisfaction to the action of Sir Luke White's Select Committee in having inserted in the London Electric Supply Bill provisions consolidating the powers of purchase in the hands of the London County Council, and for enabling local authorities, as well as companies, to link up by mutual agreement. At the same time, it was of importance in the public interest that the companies should not be entitled to make any claim, on their undertakings being purchased, in respect of goodwill or other similar considerations. The Bill now before the House of Commons related to the County of London only, and it would be necessary for the Board of Trade to supplement that scheme, if it became law, by reintroducing the Bill referred to by the deputation, which would facilitate the linking-up of undertakings outside the Metropolis with the linked-up system created by the Bill now before Parliament.

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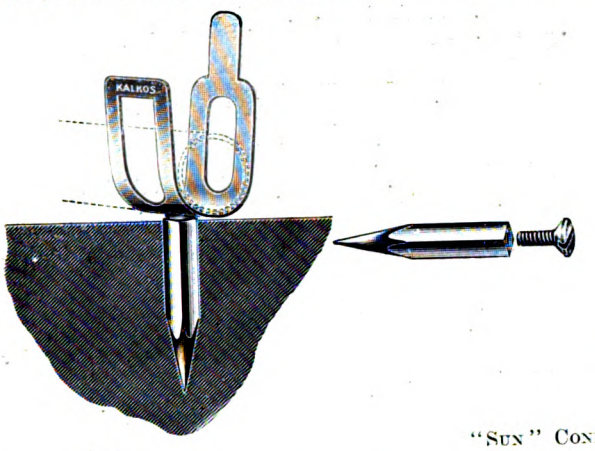
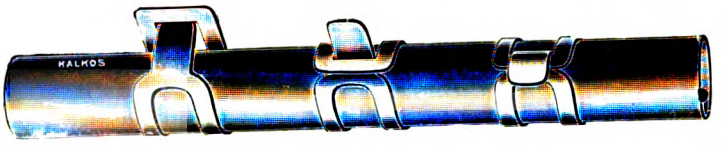
CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

CLIPS FOR FIXING CONDUIT.—The Sun Electrical Co., Ltd., of 118-120 Charing Cross-road, London, W.C., have sent us a leaflet relating to a neat "buckle" clip for fixing conduit, and they have also sent us a sample. The clip is of tinned brass, and its shape and the method of using it are clearly

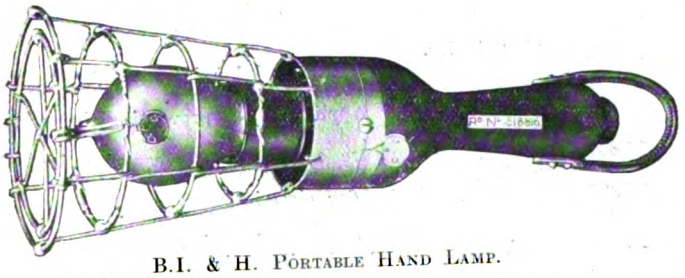




"Sun" Conduit Clip and Dowel Pin.

seen in the accompanying illustrations. Where the tubes are to be fitted to wooden surfaces, a small wooden screw may be used in place of the dowel pin and screw seen in the first illustration; but for use on brick or hard walls, the steel dowel pin and metal screw shown form a very convenient method of fixing. The pin is simply driven into the wall by a few blows with the hammer, and the clip is fixed to it by the screw, the dowel pin being tapped to take this. When the clip is placed round the tube and the tongue bent back, as seen in the second illustration, a very firm hold is obtained. The prices of the clips and dowel pins are extremely moderate.

PORTABLE HAND LAMP.—A leaflet from British Insulated & Helsby Cables contains particulars of the new form of hand lamp illustrated. This lamp was designed from the results of



B.I. & H. Portable Hand Lamp.

experience contained in the report of Mr. G. Scott Ram, H.M. electrical inspector of factories (see Electrical Engineering, July 23rd, page 137), and embodies all his recommendations. The principal features are: high insulation between brass lampholder and cage; first-rate mechanical construction throughout; screws fixing cage provided with wire holes for sealing, and cage fitted with a hinged lid, which may be sealed to prevent removal of lamp; substantial polished hard wood handle, with hole suitable for workshop flexible, edge rounded to prevent injury to flexible, and provision made for binding braiding to handle.

ARC LAMPS.—The new show card issued by the Gilbert Arc Lamp Co., of Chingford, with its quiet and harmonious colouring and simple, straightforward design, is a relief compared to many so-called "artistic" productions. It also partakes of the nature of a price list as well as an advertisement, and contains well-arranged particulars, as well as prices and illustrations of the company's well-known enclosed and flame arc lamps. Copies will be sent to any electrical contractors mentioning Electrical Engineering.

DYNAMOS AND MOTORS.—We have received a copy of the latest catalogue of Messrs. Morris-Hawkins, Ltd., of Dagenham, Essex, which relates to their standard lines of direct- and alternating-current dynamos and motors. The outputs listed vary from ¼ to 100 h.p., with a wide selection of speeds, but the firm manufactures machines up to outputs of 250 h.p. Variable-speed motors and machines for dealing with heavy overloads for short intervals are fitted with interpoles. Besides the standard lines of protected, enclosed ventilated, and totally enclosed machines, the catalogue contains particulars of back-geared motors, worm reduction gears for transmitting from 1 to 20 h.p. and with ratios of from 10 : 1 to 60 : 1, motor starters, balancer sets, and two- and three-phase motors. Messrs. Morris-Hawkins ask us to mention the fact that the works are under entirely new management, and that they can give prompt delivery of all machines up to 30 h.p., which are supplied under full guarantee for twelve months.

ELECTRIC CRANES.—A new catalogue of hand and electric cranes has been issued by Messrs. Adamson, Ramsbottom & Co., Ltd., of Birkenhead. A considerable number of illustrations of cranes, capstans, &c., of various types are included, which serve to give an idea of the large range covered by the productions of the firm of this class. A glance at these illustrations shows evidences of care in the designs, and the endeavour has been to produce patterns suitable for everyday hard usage, in which complications are avoided as much as possible.

ELECTRIC SUPPLY.—An attractive pamphlet is being issued by the South Metropolitan Electric Light & Power Co., giving a short historical sketch of methods of lighting leading up to the great possibilities of the tungsten lamp, which should be very useful in stimulating interest in electric lighting and spreading the knowledge of the fact that expense can no longer be urged as an argument against its adoption.

HEATING AND COOKING APPLIANCES, GLASS SHADES.—Two recent leaflets, copies of which will be sent to anyone mentioning Electrical Engineering, have been issued during the week by Messrs. Johnson & Phillips, Ltd. One deals with heating and cooking apparatus, and comprises lamp radiators, kettles, saucepans, urns, plate warmers, &c., while in the other are listed some of the simpler patterns of glass shades for incandescent lamps.

THREE-PHASE MOTORS.—Two well arranged lists are to hand from Mr. G. Wütrich, of Oswaldestre House, Norfolk Street, Strand, who represents the British Department of the Oerlikon Co. These deal with three-phase squirrel cage induction motors, and together cover a range from ⅛ to 85 h.p. for any voltage between 110 and 500 volts at 50 cycles.

BOOK REVIEWED

British and Foreign Hardware Trades. Guide to the Engineering, Steel, and 394 pages. 11 ins. by 7½ ins. (London: Adolphe Francis.) 10s.

This directory forms one of the series of guides to various trades published since 1877 by Mr. Alexander Lamb, and is being produced in precisely the same style by the present publishers. The book is divided into four sections, the first and larger comprising machinery, tools, metals, minerals, railway plant, &c.; the second, electricity, telegraphy, "galvanism," &c.; the third, ordnance, arms, ammunition, &c.; and the fourth, ships, boats, and their tackle, &c. The headings of the various sections are printed in English, French, German, and Spanish, in order to render the sphere of influence of the book practically international, but we are sorry to say that the translations into other languages of the subject-matter headings show a complete lack of acquaintance with foreign technical terms, especially as regards the German in the electrical section. This could easily be remedied in a future edition. Arc lamps, for example, are never called *Elektriches arc lampen* in German, but invariably *Bogenlampen*.

King's College Engineering Society.—The fifteenth annual dinner was held at the Trocadero, London, on Saturday, Sir W. H. Preece, K.C.B., F.R.S., presiding.

Electric Power for Madrid.—There are a number of small steam generating stations in and around Madrid, but several schemes are on foot for supplying cheap power generated at water-power stations. A company, called the Hidroelectrica Espanola, with a capital of £475,000, has been established, and has acquired water-power to the value of 42,000 h.p. on the rivers Jucar and Tagus. A power station with a capacity of 24,000 h.p. will be commenced shortly. Some 8,000 h.p. will be transmitted to Madrid, and 4,000 h.p. to Valencia. Another company has acquired a fall yielding from 8,000 to 18,000 h.p. in Guadalajara, some 44 miles from Madrid.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Nov. 26th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

1907 Patents

17,743. **Electrolytic Deposition on Vitreous Surfaces.** Q. Marino. In order to render a vitreous, porcelain, or earthenware surface conductive for electrolytically depositing a metal on it, it is, according to this invention, first roughened, and a solution, in hydrofluoric acid, of the substance obtained by mixing cuprous oxide with nitrate of silver is then applied to the surface. By dusting the wet surface with powdered copper and zinc, the silver and copper fluorides are reduced, and a thin conducting film of silver and copper is obtained. This film is then polished. Three claims.

23,988. **Tungsten Compound.** F. Harrison and C. H. Dorman. This specification describes an organic compound of tungsten, which is obtained by reducing tungstic acid at a temperature of about 400° to 500° C. in the presence of hydrogen and an organic vapour such as alcohol. The product consists of 97 to 98 per cent. tungsten, 2·5 to 1·0 per cent. carbon, and 0·4 to 1·5 per cent. hydrogen; it is a conductor of electricity and heat. The same product can be obtained by boiling finely divided tungsten powder with alcohol. Four claims.

24,283. **Welding of Aluminium.** M. U. Schoop. An improvement in processes of welding aluminium, which consists in using a flux produced by adding fluorides of calcium, potassium, or boron to a mixture of chlorides of alkali metals. One claim.

24,343. **Electric Signal Lamps.** C. W. Cox and The Edison & Swan United Electric Light Co., Ltd. When electric lamps are employed for signalling at sea by means of flashes of short and long duration, the speed of signalling is limited on account of the time taken by the filament to come to full brilliancy and to cool down respectively. If a shutter is employed, the inertia of the shutter causes similar trouble. To increase the speed of signalling, the use of a vacuum tube is proposed in the present specification, and a self-contained weather-proof lamp, consisting of one or more vacuum tubes, and a transformer for raising the low potential supply voltage to the necessary high potential, is described. Six claims, four figures.

24,404. **Electromagnetic Coupling.** The Sunderand Forge & Engineering Co., Ltd., and W. Blair. An electromagnetic clutch or coupling for insertion between the driving motor and the gear or winding drum of electric cranes, hoists, and winches is described in this specification. It consists of a short-circuited armature mounted on the shaft of the driving motor, and a field system fixed to the winding drum or driving gear. The field system is separately excited from any available source; by varying the strength of the field, the pull of the clutch can be varied. Further, by reducing the strength of the field, the load can be lowered, although the driving motor is running in the opposite direction. Two claims, one figure.

25,842. **Automatic Transformer Switch.** J. T. Irwin, W. E. Robson, and J. L. Cook. This specification covers an automatic switch for auto-transformers. The switch in the primary circuit of the transformer is closed by a solenoid in series with the secondary circuit, one terminal of the secondary circuit being connected to the primary circuit on the supply side of the primary switch. On closing the secondary circuit, a small current flows through the solenoid and closes the primary circuit. The switch can be opened by gravity or by any other method. Three claims, three figures.

1908 Patents

3,049. **Cable Connector.** H. D. How and W. W. Partington. This invention relates to an improved form of cable connector which consists of a metal tube split longitudinally into two halves, the ends being tapered and screw-threaded for the reception of nuts. On tightening up the nuts, the two halves of the tube grip the cable and give a good electrical and mechanical joint. One claim, two figures.

6,605. **Lamp Globe Gallery.** A. Morrison. A lamp globe gallery, in which the usual screws are replaced by spring buffers, is described in this specification. The pins, which bear against the glass, can move backwards against the springs, and expansion of the glass is thus permitted. One claim, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

20,223, "Z" Electric Lamp Syndicate (*Zerning*). Manufacture of filaments.
22,131, British Thomson-Houston Co. (*Allgemeine Elektricitäts Ges.*). Motor control.
23,450, Schattner & Amberton. Prepayment electricity meters.
24,729, Taylor. Brakes for tramway vehicles.
24,894, Slaughter & Harrison. Electrical measuring instruments.
25,109, Mortier. Ventilating-fans.
25,202, Barbary. Apparatus for ozonising liquids.
25,309, Felten & Guilleaume Lahmeyerwerke Akt.-Ges. Dynamo-electrical machines.
25,345, Winterburn. Permanent way of tramways.
25,589, Reinhardt & Johnson. Ceiling rose.
25,815, Collings & Hirst. Lamps and fittings.
25,953, Turner. Switches.
26,098, Davies & Davies. Brakes for railway vehicles.
27,171, Ewart. Electric water-heating apparatus.
28,132, Tate. Storage battery plates.
28,483, Stevens. Field magnets for obtaining rapid excitation.

1908 Patents

762, Mallman. Steam turbines.
1,203, Wyndham. Telegraphic transmission of photographs.
1,503, Chamberlain & Hookham, Ltd., & Holden. Electricity meters.
1,918, Parsons. Turbines.
2,074, Chaudoir. Electrically-controlled lifts, hoists, and cranes.
2,103, Cutler, Wardle, & Co., & Wardle. Electric incandescent lamps.
2,197, Moore. Lamp suspender.
2,498, Burt. Magnetic separators.
4,608, Suter. Holders for electric lamps.
4,844, Scheller. Apparatus for determining the damping and frequency of electric oscillations.
4,867, One Year Electric Clock Co., Grundke, & Lazarus. Automatic electric winding apparatus for clocks.
5,017, Harrison (*Electric Railway Improvement Co.*). Electrodes for welding, soldering, or brazing.
5,416, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Filaments for electric lamps.
5,691, Schürch & Himmel. Continuous or alternating current generators.
5,708, Showell & Harris. Shades for electric lamps.
5,859, Taylor. Alternating current relays.
9,077, Lake (*Schröder*). Armouring for insulated conductors.
9,648, Barbezat. Steam and gas turbine.
11,512, Siemens Bros. Dynamo Works, Payne, & Schupp. Motor starter.
12,275, Eastman & Warne. Electrical heating-apparatus.
12,644, Girdlestone & Thorkelin. Arc lamps.
13,930, Barker (*Walker*). Appliances for preventing the creeping of railway rails.
14,850, Trenzen. Manuacture of plastic masses of oxide of tungsten.
15,994, Frauenlob. Shades for electric lamps.
16,096, Siemens & Halske Akt.-Ges. Telephone installations.
16,272, Belin. Apparatus for reproducing pictures at a distance.
17,493, Wolhaupter. Insulated railway joints.
18,458, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Electric heating devices.
18,461, British Thomson-Houston Co. (*General Electric Co., U.S.A.*). Commutating poles.
18,880, Stephens. Manufacture of magnetos.
19,889, Siemens-Schuckertwerke Ges. Repulsion motors.
21,468, Allgemeine Elektricitäts Ges. Rotary pumps.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

5,040, Planchon. Metallic filaments for electric lamps.
9,876, De Sainte-Claire. Variable-speed gear for electric automobiles.
9,877, De Sainte-Claire. Variable-speed gears.
23,007, MacGahan. Manufacture of electric conductors.
23,602, Hallock. Controlling devices for motors.
23,716, Livingston & Smith. Man-holes of conduit systems.
24,259, Christensen. Lightning conductor.

Expiring Patent

The following patent expires during the current week after a life of fourteen years:—

23,581 of December 4th, 1894. **Electrically Controlled Steam Whistle.** W. P. Thompson (*G. J. Schoeffel*). An electrically operated steam whistle, in which the hand and electric operating devices do not interfere with each other, although acting on the same valve. An electromagnet embodied in the whistle case opens an auxiliary valve, which admits steam to a small cylinder. The piston in this cylinder operates the whistle valve.

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LOCAL NOTES

ABERDEEN: *Electrical Exhibition.*—Arrangements are to be made for holding a local electrical exhibition in February or March next.

ACTON: *The Supply from the Metropolitan Co.*—A special meeting of the Council has been held to consider the revised terms offered by the Metropolitan Electric Supply Co. to the Council as a result of a conference between the two parties. The new terms offered by the company are as follows:—"In lieu of the method of charges provided for in the agreement, the company will, during the years 1909 and 1910, accept payment for all energy supplied at the rate of £5 per KW. per annum of the maximum demand in each year, plus one-third of a penny per unit, provided that (1) electricity be again used for street lighting to the extent of not less than 110,000 units per annum; (2) proper sums be credited to the Electricity Department for any services rendered in connection with the sewage or other departments of the Council's works; and (3) the total payment to be made to the Council be not less than £4,200 per annum. The previous reduction made by the company represented a saving to the Council which during the 12 months ended June 30th last amounted to about £650. The effect of the proposed further reduction would, it is estimated, increase the saving to about £1,000 on the basis of the current year's business." In the result, a motion was carried:—"That the further consideration of the Metropolitan Electric Supply Co.'s proposals be postponed, and that the clerk enter into negotiations with the company for the latter to work the undertaking.

AUSTRALIA: *Tenders for Telephones.*—The *Melbourne Age* states that tenders are being invited from Australian firms only for 10,000 wall telephones, and that it is possible the order may be extended to 30,000 telephones, spread over a term of years, if it is seen that it is possible to establish this new branch of industry in Australia.

BARNSTAPLE: *Independent Report upon Electrical Undertaking.*—Mr. W. H. Trentham, Consulting Engineer of London, has been asked to visit Barnstaple, and to report upon the condition and working of the electricity undertaking at a fee of ten guineas.

BELFAST: *Expenses of Delegates.*—At the weekly meeting of the Tramways and Electrical Committee on Monday, Mr. Andrew Nance, the manager, reported that he had been in communication with the Municipal Tramways Association in regard to the surcharges recently made by the Local Government Board respecting the payments of the expenses of delegates to the meetings of that association. The organisation had taken the matter up, and had received a letter from the Local Government Board, in which it was pointed out that the surcharges in question would be remitted, but that at the same time there was no statutory enactment which authorised payments such as these from the rates, that Belfast was the only place in Ireland where tramways were owned by the municipality, and that if the Corporation wish to defray such expenditure out of the rates they must seek legislative authority. The manager added that the association still had the subject under their consideration.

BEXLEY: *Lighting and Tramways Undertaking.*—The Borough Accountant, in reference to the revenue account for the financial year to March 31st of the lighting and tramways undertakings, states that whereas the income was sufficient to meet all maintenance and working expenses and interest on loans, it was insufficient to provide for the whole of the amount payable to the sinking fund. A charge under this head has therefore been made upon the general district rate, and this has been approved by the Council.

BIRKDALE: *Electric Supply.*—The Clerk to the Ainsdale Council is in communication with the Birkdale District Electric Supply Co., with a view to the company applying for an Electric Lighting Provisional Order for Ainsdale.

BRIDGEND: *Taking Over of Power Station.*—The power station in Bridgend of the South Wales Electrical Power Distribution Co. was formally taken over by the Urban District Council last week. An estimated profit and loss account for the first year shows a deficit of £41, but certain economies which are contemplated in coal and water will, it is anticipated, easily transfer this into a profit for subsequent years.

BRIGHOUSE: *Agreement with Power Co.*—The agreement with the Yorkshire Electric Power Co., under which a supply of electrical energy in bulk will be given to the company, has now been sealed by the Council, although there was opposition to it by the Socialist members of the Council. The agreement will continue in force for 14 years, with the right of revising prices on the part of the Council at the end of the first seven years.

BRIGHTON: *Electric Tramways to Hove.*—The local papers report that the proposal by some private promoters to electrify the old Shoreham horse trams, and bring a line along Cromwell Road to connect with the Brighton Corporation system is not to be proceeded with for the present. The promoters in question appear to have changed their views as to the exact route to be followed, and will not apply for Parliamentary powers in the ensuing session, but will in all probability bring forward a revised scheme next year. Incidentally, it may be mentioned that the Hove Ratepayers' Alliance last week passed a resolution unanimously opposing the proposed scheme. As a matter of fact, the Alliance had appointed a sub-committee with a view to resisting the scheme, which, it was thought, was to be proceeded with this session.

Electric Heating and Cooking.—Mr. John Christie, the engineer and manager of the electrical undertaking, has reported having received from the Reason Manufacturing Co. an offer to provide and maintain suitable radiators at quarterly rentals of 4s. and 5s. respectively, according to the class of radiator selected, the Council to collect the money on on their behalf. Mr. Christie considered the proposal an excellent one, and pointed out that any other manufacturers or contractors who came forward with a similar scheme would also receive the same treatment. The Electricity Committee have agreed to the proposition.

CANADA: *Supply to Montreal.*—The Montreal Light, Heat & Power Co. have just put its new plant upon the Soulanges Canal into operation. The total capacity of the new plant, which is situated about 30 miles from the city, is 15,000 h.p.

CARDIFF: *Tramwaymen's Grievances.*—A deputation has waited upon the Tramways and Electric Lighting Committee regarding the action of Mr. Arthur Ellis, the Tramways Manager, in ordering tramwaymen who do Sunday duty to stand off one day of the ensuing week. It is contended that under an old agreement a fifty-four-hour week was guaranteed to the men, and that this was not to include Sunday work. The view of the men has been adopted by the Council.

CLYDEBANK: *Tramway Inspection.*—The tramways to the east of the Forth and Clyde Canal have been inspected by the Board of Trade.

DONCASTER: *Street Lighting.*—A proposal to light certain streets by gas has been rejected in favour of the use of electricity.

ENNISKILLEN: *Electric Lighting.*—The Council have received a number of offers from various firms for the installation of an electric supply installation.

EPSOM: *Electricity Undertaking.*—For the half-year ending September 30th, the receipts of the electricity undertaking amounted to £2,294, and the expenditure to £1,135. The receipts were £120 above, and the expenditure £136 below, the estimates. For the corresponding period last year the receipts were £1,910, and the expenditure £1,175.

FALKIRK: *Condition of Electricity Undertaking.*—A committee has been appointed to inquire into, and report upon, the working of the electricity undertaking.

FOLKESTONE: *The Tramway Bill.*—The Folkestone Chamber of Commerce has passed a resolution urging the Corporation to oppose the Bill of the National Electric Construction Co., which proposes to substitute overhead wires for the surface contact system originally proposed.

GLASGOW: *Proposed Tramway Extension.*—A deputation has waited upon the Extensions Sub-Committee of the Corporation Tramways Committee in opposition to the proposal to construct a tramway in University Avenue.

GOOLE: *Electric Lighting Order Revoked.*—The Board of Trade have revoked the Goole Electric Lighting Order, 1901.

HOUNSLOW: *Street Lighting.*—At the last meeting of the Council it was moved that in view of the Local Government Board inspector's remarks at the recent inquiry, the work in regard to the conversion of certain street gas lamps into electric lamps be postponed until after the inspector's report had been received. This was negatived, however.

INDIA: *Simla Water Power Scheme.*—The *Indian Trade Journal* of November 5th states that arrangements have been made for beginning work on the Simla water power electric scheme, and it is hoped to have 700 horse-power available early in 1911. The remaining 1,300 horse-power, for which the scheme provides, will be supplied when the demand for it arises. The site is some 14 miles from Simla, where the Nautikhud stream will be taken by a 6 by 3 ft. flume 12,000 ft. long into a tunnel 1,000 ft. long, and thence by a 550-ft. drop into the Sutlej river, where the turbines will be placed.

KIRKCALDY: *Tramway to Dysart.*—A sub-committee has under consideration a proposed extension of the tramway system to Dysart.

LONDON: *London County Council: Highgate Hill Tramways.*—In connection with the Highgate Hill cable tramway, further Parliamentary powers will have to be sought in relation to certain street widenings, which it is estimated will cost £10,500. Difficulties have arisen between the St. Pancras Borough Council and the County Council in regard to the cost of these widenings, the St. Pancras Council contending that as they are necessitated solely for the purpose of the tramway, the whole cost should fall upon the County Council finances. On the other hand, the Islington Borough Council, who are also interested as a road authority, have agreed to bear part of the street widenings in question.

London County Council Tramways.—In connection with the laying of cable ducts required for the reconstruction of the

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Loughborough Junction to Norwood tramways, the Highways Committee of the County Council report that the Post Office authorities have applied for permission to lay a cast-iron pipe in the same trench as the Council's ducts. This has been agreed to on the understanding that the Post Office authorities pay a proportion of the cost of opening the ground and filling in and reconstructing the surface according to the number of pipes or ducts laid by the Council and the Post Office respectively, and, further, that, where it is necessary for the Council ducts to be laid at a lower depth, owing to the presence of the Post Office pipes, the Post Office shall pay the full cost of the excavation involved.

Deptford: Tramways.—In connection with the tramways in the borough, the London County Council will undertake the widening of Queen's Road, New Cross Gate, at an estimated cost of £25,500, the Borough Council paying one-third.

Poplar: Lighting of Blackwall Tunnel.—For the lighting of Blackwall Tunnel, the L.C.C. is to take, on agreement for five years, a supply on the following terms:—Maximum load not to exceed 55 kilowatts; minimum number of units per annum, 301,000; price per unit, 0·885d. The Committee are advised that this rate will be profitable to the Borough Council, in view of the exceptional load factor of 60 to 70 per cent.

Electrolytic Disinfectant.—The agents for the manufacturers of the Council's electrolytic disinfectant plant recently submitted samples of fluid similar to that made in Poplar to Dr. Klein, the bacteriologist to the L.G.B., and he has reported that one ounce of the fluid to 150 ounces of water (or one ounce in nearly one gallon of water) would kill cholera germs in 2½ mins., and the fluid in the same proportion would kill typhoid fever germs.

Stepney: G.B. System.—In a report by the Works Committee, the remark in the report of the Traffic Branch of the Board of Trade to the effect that the introduction of the G.B. Surface Contact system in the Mile End Road became necessary owing to the refusal of the Council to consent to overhead construction, and to the impossibility of using the conduit system in the roadway in question, is taken exception to. The Works Committee emphatically deny that it is impossible to use the conduit system for the reason stated—namely, the existence of the railway tunnel—and state that the entire responsibility for the adoption of the G.B. Surface Contact system rests with the London County Council.

MANCHESTER: *Telegraph Poles.*—There is considerable opposition to a request by the Postmaster-General for permission to erect a number of telegraph poles in certain streets of the city. On a previous occasion the Highways Committee gave its consent to the Post Office authorities for the erection of 55 poles in certain back streets and passages, but when the proposition came before the Council, it was rejected by a large majority. It is now suggested that the proposed poles should serve the double purpose of carrying telegraph wires as well as the wires for a system of fire alarms. The Watch Committee, however, objects to any fire-alarm wires being overhead.

Damages for Tramcar Accident.—Damages to the extent of £200 have been awarded to a passenger on a Corporation tramcar, who was injured through the car coming into collision with a baker's cart in Gorton Lane in April of this year. It is a curious fact that neither the car nor the baker's cart was damaged, but the passenger in question is alleged to have been thrown violently against a portion of the interior of the car, injuring his back, which has resulted in his being confined to bed ever since the accident.

NEWCASTLE: *Chairmanship of Tramways Committee.*—Sir Joseph Baxter Ellis, who had announced his intention of resigning the chairmanship of the Tramways Committee, has decided to remain in that position, it having been brought to his notice that his resignation was construed into a desire to quit a sinking ship. In making his announcement, Sir Joseph gave some particulars of the undertaking. At the present time the total capital expenditure was £1,174,745, and in addition to paying interest on capital, they had repaid loans to the extent of £201,680, whilst their reserve and renewals fund amounted to £75,650. Over and above all this, the sum of £12,000 has been contributed to the relief of rates.

NEWPORT (Mon.): *Halfpenny Tram Fares.*—A report by Mr. H. Collings Bishop, the City Electrical Engineer and Tramways Manager, on the question of halfpenny fares is distinctly unfavourable to the proposal.

NUNEATON: *Tramways.*—The scheme for providing electric tramways in Nuneaton is developing at the hands of private promoters, who announce that local capital will not be required. It is stated that a feasible scheme will be well received by the inhabitants.

ROCHDALE: *Tramway Supply.*—The Tramways Committee have asked the Electricity Sub-Committee to consider the question of reducing the price charged to the tramways undertaking. The Electricity Sub-Committee have reported that, from information regarding sixty-nine other towns, they gather that in forty-three of them the charges for tramway energy are higher than those in Rochdale. The present price in Rochdale is 1·13d. per unit, whilst the highest price mentioned in the list of towns referred to is 2·7d., and the lowest 0·62d. The Electricity Sub-Committee cannot see their way to recommend a reduction in the price now charged, but offer to forgo the sum of £236 which is paid by the Tramways Committee annually to the Electricity Department for establishment charges.

SOUTHEND: *Tramways to Hadleigh.*—The Corporation has replied to the Hadleigh Council that they cannot see their way to extend their tramway system into this district upon the basis of terms proposed by the Hadleigh Council.

ST. PETERSBURG: *Tramway Undertaking.*—It is stated that an offer has been made by a British Syndicate to purchase the municipal tramway system for £1,350,000. The offer is viewed favourably.

WALLASEY: *Tramways to Birkenhead.*—A proposal is under consideration for linking up Wallasey with Birkenhead, but whether it will be put into effect depends largely upon the attitude taken up by the local authorities concerned.

WEMBLEY: *Electric Lighting.*—The Council have received a communication from the North Metropolitan Electrical Power Distribution Co. that they cannot give any definite information as to the date of commencing work under the Wembley Electric Order.

WEYMOUTH: *Trackless Trolley System.*—Owing to the large amount of street widenings which will be necessary for the introduction of electric tramways, the trackless trolley system is being considered, as a substitute for the Great Western Railway Co.'s petrol omnibuses which now run in Weymouth.

New Generating Plant.—A 300-kw. steam turbine has been added to the generating plant in the power-house. The machine in question has been supplied by the Brush Electrical Engineering Co.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ALGERIA.—Information has been received at the Board of Trade to the effect that tenders are invited by the Bône Municipal Authorities up to January 15th for—(1) the construction and working of a central electric power station; and (2) the construction and working of an electric tramway. Copies of the projects, specifications, and notices (in French), together with a plan of Bône, may be seen by British firms on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

ARGENTINE.—A decree has been issued authorising the Cia. del Ferrocarril Bahia Blanca y Noroeste to supply electric energy from their own works for lighting and power purposes in the town of Bahia Blanca. The company is granted rebate of duty up to 20,000 pesos for machinery and materials which it may be necessary to import for the extension of the works and the installation of apparatus, &c., in the town.

CANARY ISLANDS.—The steam tramway at Las Palmas has been sold to a Spanish Bank. The new proprietors intend to employ electric traction, and to erect a large power house, to reconstruct the roadway, and to purchase new rolling stock adapted to the new system of traction. It is, moreover, intended to extend the line to the town of Santa Brigida (5,000 inhabitants), situated in the mountains nine miles to the south-west of Las Palmas. The length of the present line is about four miles.

CARDIFF.—Tenders are invited for the supply, delivery, and erection of a 2,500 k.v.a. turbo-alternator, complete with surface-condensing plant and motor-driven auxiliaries. Particulars from the City Electrical Engineer and Manager, and tenders by December 18th (see an advertisement this week).

LONDON: *Hammersmith.*—The Council has taken up a loan of £10,000, payable in 20 years, for electrical purposes, and an application is to be made for a second loan of £9,085.

SHEFFIELD.—New plant to the extent of £7,000 is to be installed in the Kelham Island power station.

SOUTH AFRICA.—The *Cape Times* states that the Port Elizabeth Town Council has been authorised to raise a loan of £25,000 for the purpose of extending the electric lighting system of the town.

WALTHAMSTOW.—Tenders are to be invited by the Council for a supply of cable for the period ending March 31st, 1910.

Miscellaneous

AUSTRALIA.—The Melbourne City Council invite tenders for the supply of 33,000 incandescent electric lamps. Tenders by December 15th to McIlwraith, McEacharn & Company Proprietary, Ltd., Billiter Square Buildings, London, E.C.

AUSTRIA.—An expenditure of £250,000 is contemplated upon the development of the telephone service in Austria.

BAKU.—Tenders are invited, not later than January 24th, by the Municipal Council for the construction and working of a municipal tramway. It is proposed that the term of the con-

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cession should be 42 years, and that the Council shall have the right to purchase the undertaking at the end of 22 years. The concessionaires must advance the Council £95,000 at 5 per cent., which will be redeemed during the term of the concession.

BIRMINGHAM.—Tenders are invited for the supply and delivery of various sizes of electric motors. Particulars from the City Electrical Engineer, and tenders by December 29th (see an advertisement this week).

EDINBURGH.—The Edinburgh and District Tramways Co. invite tenders for stores during 1909, including electric light supplies. Tenders to the Manager, 1 South Charlotte Street, Edinburgh, by December 7th.

LONDON: *London County Council.*—It is proposed to construct the authorised single line of tramways in Amherst Road between Mare Street and Dalston Lane, and in Dalston Lane between Amherst Road and Mare Street, in connection with the reconstruction of the Hackney Road to Stamford Hill tramways, for which arrangements will shortly be made. The cost of the work is estimated as follows: Track work, including special work, £5,400; rails, **£1,100.**

LOWESTOFT.—The Local Government Board has sanctioned a loan of £1,000 for free wiring purposes.

POWELL DUFFRYN STEAM COAL CO.—Tenders are invited for the supply of stores from January 1st, 1909, including india-rubber, asbestos, &c., steam tubes and fittings, and electrical goods. Tenders to the Directors of the Company, 101 Leadenhall Street, London, E.C., by December 7th.

RUSSIA.—The Perm Municipal Council invite offers for the construction of tramways.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Alterations and additions to motor-bus garage, Redcliffe Road, East Ham. J. H. Ashley.

N.E.—Offices, Blackhorse Lane, Walthamstow, for Peter Hooker, Ltd., Blackhorse Road, Walthamstow.

S.E.—Lewisham Hippodrome, Brownhill Road, Lewisham. Architect, W. L. Griffiths, Lincoln Chambers, Portsmouth Street, W.C.

Curing-house, Channel Row, Bermondsey. Builder, W. J. Dixon, 3 Blue Anchor Lane, S.E.

Enlargement of Sorting Office, Southwark. H.M. Office of Works, Storey's Gate, S.W.

W.—Additions to Empire Theatre, Leicester Square. Architect, F. T. Verity, 7 Sackville Street, W.

W.C.—Wesleyan hall, Great Queen Street, Holborn. Architects, Gordon & Gunton, Finsbury House, Blomfield Street, E.C.

PROVINCES.

BATH.—Additions City Technical College (£8,000). Architect, A. M. Green, 5 Princes Buildings.

BEDFORD.—Additions to workhouse. Architect, H. Young, 35 Maitland Road, Bedford.

BLACKHEATH (BIRMINGHAM).—Library (£1,730). Builder, W. Copper, 7 West Street.

BLACKPOOL.—Post office (£16,760). Builders, R. Neill & Sons, Broughton Lane, and Neill Street, Manchester.

BRISTOL.—St. Ambrose Church (£12,000). Architects, A. W. & V. Gough, 23 Bridge Street.

School for the Blind (£14,000). Architect, E. Gabriel, Orchard Street, Bristol, and 42 Old Broad Street, E.C.

School, Alexandra Park (£9,000). Architects, Rodway & Demming, 28 Baldwin Street.

School, Kingsdown (£7,500). Architect, W. Skinner, Edinburgh Chambers.

BURSLEM.—Technical Institute (£9,000). Surveyor, F. Bettany, Burslem Town Council.

CARDIFF.—Dock offices, Bute Dock (£20,000). Architect, E. W. M. Corbett, Bute Estate Office, Castle Street.

New premises for Cardiff Laundry Co. Architect, E. W. M. Corbett, Bute Estate Office, Castle Street.

Co-operative wholesale premises, St. Mary Street. Architect, F. Harris, Balloon Street, Manchester.

CHELMSFORD.—New Council school, Trinity Road. T. Dixon, Town Clerk, Chelmsford.

CHILVERS COTON (Warwickshire).—Council school (£8,419) for Nuneaton Education Committee. Architect, E. E. Shepherd, Nuneaton. Builders, G. Smith & Son, Chilvers Coton.

COVENTRY.—New schools (3,000 places). F. Horner, Secretary to Education Committee.

CROYDON.—Dyeing and cleaning works, Waddon Marsh Lane. Architect, R. G. Ellis, Clarendon Road.

ERITH (Kent).—Alterations to public offices (£675). Surveyor, H. Hind, Erith Urban District Council.

GLASGOW.—Tramway depôt at Newlandsfield. Surveyor, A. B. McDonald, Town Council.

GREAT YARMOUTH.—Offices for Great Yarmouth Port and Haven Commissioners at South Quay. Architects, Olley & Haward, Queen Street.

HANLEY (STAFFORD).—New premises, Market Square, for M. Huntbach & Co., Ltd., Drapers, Hanley.

HASLINGDEN.—Extension to secondary day school (£6,000). W. Musgrove, Secretary, Education Authority.

HULL.—Premises, Holderness Road (£795). Architect, A. Easton, 7 Land-of-Green-Ginger.

LEICESTER.—Additions to Town Hall. Architect, F. Hames, 14 Gray's Inn Square, W.C.

County school. Architects, A. E. & T. Sawday, 6 Market Place.

Premises for Stamford, Spalding & Boston Bank. Architects, Stockdale, Harrison & Son, 7 St. Martins East.

NORTHAMPTON.—School, Billings Road, (£20,000). Architect, H. Norman, 4 Wood Hill, Northampton.

NORWICH.—Residence, Unthank Road (£967). Architects, Morgan & Buckingham, 1 Upper King Street. Builders, G. E. Hawes & Son, Duke Street.

Pavilion at Isolation Hospital, Bowthorpe Road (£2,797). A. E. Collins, City Engineer, Guildhall. Builders, T. Gill & Son, Rupert Street.

NOTTINGHAM.—Additions to lunatic asylum. Lewis, City Architect, City Hall.

READING.—Enlargement of Royal Berks Hospital (£20,000). Clerk to the Governors.

SALFORD.—Boys' department at Wellington Street School. Architect, Mr. Broadbent, c/o Town Council.

UPTON VALLEY (TORQUAY).—Secondary School (£12,000). Educational Secretary, S. H. N. Lane, Torquay Town Council.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Victorian Postmaster-General's department has accepted the following tenders: British Insulated & Helsby Cables, Ltd., Melbourne, 11 miles 52-pair telephone cable, at £246 per mile; 5 miles 208-pair telephone cable, at £535 per mile; 1½ miles 260-pair telephone cable, at £630 per mile. W. T. Henley's Telegraph Works Co., Ltd., Melbourne: 5 miles 26-pair telephone cable, at £147 5s. per mile; 12 miles 78-pair telephone cable, at £313 10s. per mile. Western Electric Co. (Aust.), Ltd., Sydney, 3 miles 156-pair telephone cable, at £402 per mile; 80,000 paper sleeves, at 2s. 6d. per thousand, £10.

BELFAST.—The tender of the British Insulated & Helsby Cables, Ltd., for trolley wire has been accepted.

DOVER.—The tender of the British Westinghouse Electric & Manufacturing Co. for an alternator at £533 has been accepted, subject to the sanction of the Local Government Board to a loan.

ERITH.—The tender of Messrs. Beadle Bros. for the supply of coal for the electricity undertaking, at 14s. 9d. per ton, has been accepted.

GLASGOW.—The Corporation has accepted the following tenders in connection with the tramway undertaking: Lead-covered and single-core cables, British Insulated & Helsby Cables, Ltd.; plumbers' fittings, John Glendinning & Sons; trolley poles, Mountain & Gibson, Ltd.; car brake chains, Weldless Chains, Ltd.

LEYTON.—The quotation of the Underfeed Boiler Co. to fit the second Stirling boiler with a mechanical stoker similar to the one already installed has been accepted by the Town Council at £417.

LONDON: *London County Council.*—The Stores Committee have accepted the tenders of the following for annual supplies:—Electric fittings, globes, and shades, Baxter & Caunter, estimated value of goods to be supplied, £53; G. Braulik, £31; the City Glass Co., £6; Dorman & Smith, £27; Elliott Bros., £57; Falk, Stadelmann & Co., Ltd., £14; the General Electric Co., Ltd., £50; A. P. Lundberg & Sons, £13; W. McGeoch & Co., Ltd., £95; Nettlefold & Sons, schedule of prices; Siemens Bros. & Co., Ltd., £40 (quantities not given for certain items); Smith Bros., £14; G. Straus & Co., Ltd., £16; Taylor & Co., £4; Verity's, Ltd., £7; W. White & Co., £48. Electric insulating materials, Baxter & Caunter, £1; British Electrical & Manufacturing Co., £184; British Insulated & Helsby Cables, Ltd., £17; British Westinghouse Electric & Manufacturing Co., Ltd., £7; W. Geipel & Co., £40; the General Electric Co., Ltd., £34; James North Hardy & Son, £163; D. Jaroslaw, £7; the Micanite & Insulators Co., Ltd., £96; G. Schultz & Co., £276; Siemens Bros. & Co., Ltd., £23; Taylor & Co., £12; A. Terry, £176; Verity's, Ltd., schedule of prices. Electric cables and wires, Callender's Cable & Construction Co., Ltd., £172; Hooper's Telegraph & India Rubber Works, Ltd., schedule of prices; Western Electric Co., £2,961.

London County Council.—The following tenders have been received for the execution of the roadwork and platelaying, exclusive of the supply of rails and special trackwork, in connection with the reconstruction, on the underground conduit system of electric traction, of the existing tramways from Prince of Wales Road, *via* Fortess Road and Junction Road, to the Archway Tavern, Highgate: John Mowlem & Co., Ltd., West-

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minster, S.W. (accepted), £31,223; Dick, Kerr & Co., Ltd., Cannon-street, E.C., £31,493; A. M. Coles, Paddington, W., £33,128. The chief engineer's estimate, comparable with the tenders, is £32,771. A provisional sum of £2,500 is included in each of the tenders for alterations of pipes, mains, &c., the cost of which works cannot be more accurately estimated beforehand, and a similar sum is also included for any other contingencies which may arise.

Poplar.—The Borough Council have received the following tenders for the supply of steam, feed, and blow-down piping in connection with the erection of the new boiler at the electricity works:—E. Le Bas & Co. (accepted), £303; Babcock & Wilcox, £338; J. Spencer & Co., £357; Wilson & Co., £389; Stewarts & Lloyd, £444.

SALFORD.—The Electricity Committee have accepted the tender of Balcke & Co., at £12,344 for the supply and erection of water-cooling plant at the electricity works. The tender of B. Thomas for the electric lighting of Seedley Baths, at £459, has been accepted. The Tramways Committee have accepted the following tenders:—A. G. Brown, impregnating plant, £75; Hulse & Co., Ltd., car-wheel lathe, £626; Witter & Son, Ltd., automatic sprinkler installation, £1,495.

STOKE-ON-TRENT.—The tender of Messrs. Davis, Perrett & Co. for an oil eliminator has been accepted at £170.

WALTHAMSTOW.—The Council have accepted the undermentioned tenders for arc lamp carbons for the period ending March 31st, 1910:—The Sloan Electrical Co., Conradty carbons for 10 ampere lamps; Geipel & Lange, Conradty carbons for five ampere lamps and ordinary carbons; Siemens Bros., Ltd., and The Sloan Electrical Co., flame arc carbons.

WATFORD.—The Electric Lighting and Power Committee have recommended the Council to accept the following tenders, subject to the sanction of the Local Government Board for a loan: Turbo-alternator, British Thomson-Houston Co., £2,400; condensing plant, Isaac Storey & Sons, £966; switchboard panel, British Thomson-Houston Co., £86 10s.; economiser No. 2, E. Green & Sons, £402; fan engine, Ashworth & Parker, Ltd., £188; building flues and foundations, L. R. Ensor, £496. The Committee have recommended that the tender of Messrs. Ferranti, Ltd., for meters be accepted.

YORK.—The Electricity Committee have accepted the tender of Messrs. G. Barnitt & Co. for engineers' stores, and of Messrs. Hardy & Holgate for general stores during 1909.

APPOINTMENTS AND PERSONAL NOTES

Mr. G. C. Jefferyes, of the Inverness Post Office Engineering staff, has been appointed sectional engineer at Dundee.

Mr. J. Sarginson, at present employed as station foreman at the Liverpool Tramways Electric Power and Lighting Department at a salary of £220 per annum, is to be appointed assistant superintending engineer of stations at a salary of £250 per annum.

The Willesden Urban District Council have appointed Messrs. J. C. Johnson and J. D. Ravenscroft charge engineers to fill two vacancies.

A junior meters assistant is required by the Birmingham Corporation. Salary, £100 per annum (see an advertisement this week).

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Son, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £66 to £66 7s. 6d. per ton (last week, £66 10s. to £67 per ton).

ADAMS MANUFACTURING CO.—An exhibition of "Igranic" electric motor controlling apparatus is now being held at the premises of the Adams Manufacturing Co.'s agent, Mr. David Alexander, 43 Mains Street, Waterloo Street, Glasgow. The exhibition closes on the 12th inst.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Amalgamated Radio-Telegraph Co. is to be wound up voluntarily. Mr. F. W. Pixley and Mr. H. Allen have been appointed liquidators.

Telegraph Traffic.—The submarine cable between Oran and Tangier was restored to working order on the 25th ult., and on the following day the cable between Zanzibar and Mombassa was also repaired. The Russian Government notified on November 26th that codes must be produced when sending or receiving telegrams in code. On the same day, no doubt owing to the political unrest, the land lines in Hayti were closed, and telegrams can now only be accepted for the coast stations, viz., Cape Haiti, Mole St. Nicholas, and Port au Prince, all of these places being cable stations. The land line *via* Batoum also suffered interruption on November 27th between Castamouni and Samsoun, while the El Arich route became inoperative between Lattaquie and Beyrouth, and between Alep and Beyrouth on the 29th ult. On November 30th the cable between Medan and Oleleh was again in working order.

COMPANIES' MEETINGS AND REPORTS

AMAZON TELEGRAPH CO.—At the annual meeting on Tuesday, the report and accounts, given in our last issue, were adopted.

BERLIN ELECTRICITY WORKS.—The report for the year 1907–8 shows that the undertaking is steadily developing. The number of consumers has been increased by 2,543, and the connected kilowatt by 17,538, or over 13 per cent. These figures are somewhat larger than the corresponding figures for the previous year. The payment to the City of Berlin amounts to approximately £250,000, of which £116,000 is the royalty of 10 per cent. which is due, and £134,000 is in the form of dividend. The gross profits for the year amounted to £733,000, which, after allowing for the above royalty, depreciation, and renewals fund, and other charges, leaves a net profit of approximately £362,000. Of this £18,000 is assigned to the reserve fund; £22,500 to the payment of dividends of 4½ per cent. on preference shares; £173,000 to the payment of an 11 per cent. dividend on ordinary shares; £134,000 to the City of Berlin, as above mentioned; and the remainder to the pension funds, bonuses, directors' fees, &c. An amount of £64,000 is carried forward.

GENEVA TRAMWAYS CO. (1906).—At the annual meeting held in London last week, the report and accounts given in our last issue were adopted. The chairman, the Hon. A. G. Brand, stated that negotiations were in progress with regard to a supply of power by the Geneva municipality, which it was hoped would be at such a price as to counterbalance the increased expenses of working the lines which had been brought about mainly by the increase of wages, &c.

ISLE OF THANET ELECTRIC TRAMWAYS & LIGHTING CO.—At the annual meeting on Thursday, the report and accounts given in our last issue were adopted. Considerable discussion took place concerning the affairs of the company, and it was eventually decided to appoint a committee of four shareholders to confer with the Board both with regard to the best means of raising new capital, and also concerning the affairs of the company generally.

LANCASHIRE POWER CONSTRUCTION CO.—At an extraordinary general meeting held in London on Friday, a resolution was passed authorising the raising of £150,000 for the completion of undertakings which have been commenced in various parts of Lancashire. The stock is to be offered upon favourable terms to the present shareholders.

SIEMENS-SCHUCKERT WERKE. G.m.b.H., BERLIN.—The report for the past year shows a net profit of £510,000 after extensive writings off, which is slightly larger than the corresponding figure for the previous year. Of this amount £450,000 will be absorbed in dividends, £40,000 will be paid out as bonuses, and £17,500 will be set aside for the management fund. The remaining sum will be carried forward. It is stated that the orders which have been received during the present business year do not materially exceed those of the same period last year. Among the tenders which have been accepted are two for the electrical equipment of two ships for the German Navy, now being built at Geestemünde and Hamburg respectively.

SINGAPORE ELECTRIC TRAMWAYS.—At the ordinary general meeting held last week, the report and accounts given in our last issue were adopted. Sir Frank A. Swettenham, chairman of the company, who presided, stated that when the tramways were first opened in 1905, regular provision was made for two classes of passengers. It was found, however, that the patronage given to the first class accommodation was insufficient to warrant the continued provision of it, and subsequently one class was substituted for two. During the past year, however, the General Manager has given further attention to the question, and has introduced a limited service of first class accommodation by reserving the two first seats on certain of the cars for first class passengers. With regard to the depression in trade in Singapore referred to in the accounts, the chairman stated that although this still continues, the Governor of the Colony had recently expressed the opinion that the worst had been reached, and that they might look for improvements in trade which must favourably affect the tramway business.

WELDLESS STEEL TUBE CO.—At the annual meeting on Tuesday, the report and accounts, given in our last issue, were adopted.

NEW PUBLICATIONS

Science Abstracts. November. Section A, Physics. Section B, Electrical Engineering. (London: E. & F. N. Spon, Ltd.) 1s. 6d. each.

"National Electric Light Association. Proceedings of Thirty-first Convention at Chicago, 1908." (New York: The Association.)

Wireless Telegraphy.—The Paris correspondent of *The Times* states that a Bill for putting into force the decisions of the Berlin Wireless Telegraph Conference of 1906 has been laid before the French Chamber.

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MISCELLANEOUS CITY NOTES

BRUCE PEEBLES & CO.—The joint liquidators have issued a circular stating that the scheme of arrangement, outlined in our issue for November 19th, has now been sanctioned by the Courts, owing to the fact that no appeal against it had been lodged during the 14 days allowed for this purpose. The first directors of the new company are: Mr. Charles H. M'Euen, of Callenders Cable & Construction Co., Ltd.; Mr. B. M. Mountain, of Mountain & Gibson, Ltd.; Mr. Alexander Mackenzie, of Mackenzie & Moncur, Ltd.; Mr. F. E. Andrews, of Brush Electrical Engineering Co., Ltd.; Mr. C. J. Shiells, chartered accountant, Edinburgh; and Mr. A. W. Tait, chartered accountant, London.

COMPANIES TO BE STRUCK OFF REGISTER.—The following companies will be struck off the register at the expiration of three months, unless cause is shown to the contrary:—Hemsworth Electricity Supply Co. Home Counties' Electricity Supply Co., Hyde Electrical Manufacturing Co., and the Irish Electrical Agency.

MEXICAN LIGHT, HEAT, & POWER CO.—The annual meeting has been postponed until December 30th.

SOUTH WALES ELECTRICAL POWER DISTRIBUTION CO.—The *Stock Exchange Gazette* states that there is good reason to believe that the anticipations indulged in at the commencement of this year regarding the outlook for this company will prove to have been fulfilled when the accounts for December 31st next come to be made up. The profit and loss account, it is believed, has at length been established on a basis which represents at least a fair approximation to equilibrium between revenue and expenditure, whilst the general outlook is decidedly favourable. It would seem, therefore, that the extraordinary efforts of those who some eighteen months ago rescued the undertaking from a position which promised to become fatal, may now be regarded as having justified the attitude taken up by them at a critical period in the history of the concern.

Siemens Stafford Engineering Society.—The first annual conversazione of this society was held on Friday, November 20th, in the large hall of the Siemens Institute. The major portion of the staff of Messrs. Siemens Bros. Dynamo Works, Ltd., and a large number of local residents were present. A large number of scientific and engineering exhibits were arranged, and popular scientific lectures were delivered by Messrs. Catterson-Smith, Hey, and Pollard. Among the other attractions were a short vocal concert, and a sketch by the Siemens' Amateur Dramatic Society. Selections were given by the Siemens' Institute Orchestra during the evening.

OFFICIAL ANNOUNCEMENTS AND SMALL ADVERTISEMENTS.

Official Advertisements are charged at the rate of **9d.** per line (column width).

Small Prepaid Advertisements of Situations Vacant and Wanted, Plant for Sale or Wanted, &c., are inserted at the rate of **1/-** for the first 12 words and 1d. per word afterwards. Three insertions for the price of two. Advertisements can be received up till Wednesday morning first post.

Letters should be addressed to The Kilowatt Publishing Co., Ltd., 203-6, Temple Chambers, London, E.C.

TENDERS INVITED.

CITY OF BIRMINGHAM.

ELECTRIC SUPPLY DEPARTMENT.

To Contractors for Electrical Apparatus.

TENDERS are invited for the SUPPLY and DELIVERY of various sizes of ELECTRIC MOTORS required by the ELECTRIC SUPPLY COMMITTEE.

Applications for General Conditions, Specification, and form of Tender to be made at the office of the City Electrical Engineer, Mr. R. A. Chattock, M.I.E.E., 14, Dale End, Birmingham.

Before obtaining the General Conditions and Specification it will be necessary to deposit the sum of One Guinea, for which a receipt will be given. The amount of deposit will be returned after the Committee's decision, provided that the contractor shall have sent in a *bona fide* tender, and shall not have withdrawn the same.

The Electric Supply Committee does not bind itself to accept the lowest or any tender, nor will the Committee pay any cost in tendering.

All workpeople engaged on any part of the work, whether sub-let or otherwise, shall not be paid less than the minimum standard rate of wages current in the district in which the work or works may be constructed or executed, and no work shall be sub-let to persons not paying at least the minimum standard rate of wages in the said district. The tender of any person or firm paying to their workpeople less than the minimum standard rate of wages current in the district will not be accepted.

Tenders to be sent in under seal, addressed to the City Electrical Engineer, at the Electric Supply Department, Dale End, Birmingham, and endorsed on the outside "Tender for Electric Motors," not later than 12 o'clock noon on TUESDAY, December 29th, 1908.

R. A. CHATTOCK, M.I.E.E.,
City Electrical Engineer and Manager.

14, Dale End,
Birmingham.
December 3rd, 1908.

APPOINTMENT FILLED.

APPLICANTS for position of Installation Assistant at Belfast are thanked, and will please note that the position has now been filled.

APPOINTMENT VACANT.

WANTED, an Engineer having a practical acquaintance with modern electrical developments. Such engineers are in demand, and command large salaries. You can qualify at home, under experts, and by a unique system. Prospectus free, The British Correspondence School of Electrical Engineering. Dept. M., 36, Maiden Lane, Strand, London.

TENDERS INVITED.

CITY OF CARDIFF.

THE CARDIFF CORPORATION are prepared to receive Tenders for the supply, delivery and erection at their Generating Station for the following:—

1-2500 K.V.A. TURBO-ALTERNATOR

complete . . . with surface Condensing Plant and Motor Driven Auxiliaries.

Specifications and form of Tender may be obtained from Mr. Arthur Ellis, City Electrical Engineer and Manager, Central Offices, The Hayes, Cardiff, on payment of a Deposit Fee of One Guinea, which sum will be refunded on receipt of a *bona fide* tender.

The successful Contractor will be required to enter into the usual form of Agreement, a copy of which can be seen at my Office.

Sealed Tenders endorsed Turbo-Alternator to be delivered at my office on or before 10 a.m. Friday the 18th inst.

J. L. WHEATLEY,
Town Clerk.

City Hall, Cardiff.
1st December, 1908.

APPOINTMENTS VACANT.

CITY OF BIRMINGHAM.

ELECTRIC SUPPLY DEPARTMENT.

Appointment of Junior Meters Assistant.

APPLICATIONS are invited for the above post. Applicants must have had thorough training in the testing of Alternating Current Meters and be familiar with the best known makes; they must also be experienced in the connecting up of 3-phase 3-wire Meters on 5,000 volt Circuits.

Salary, £100 per Annum.

Applications must be accompanied by recent testimonials and forwarded to the undersigned not later than Tuesday the 15th inst.

R. A. CHATTOCK, M.I.E.E.,
City Electrical Engineer and Manager.

14, Dale End,
Birmingham.
December 3rd, 1908.

BOROUGH ENGINEER.—Electrical Engineer in Midlands has vacancy for premium pupil; lighting power and traction. Box, A 61, Electrical Engineering, 203, Temple Chambers, London.

For Stock and Share List see page 746.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5⅞*	10½—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10	+⅛
Do. 6% Cum. Second Pref.	10	6	6%	10⅛—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½%	102—106	+1
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	4⅞*	4⅜—4⅞	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—98	
Brompton & Kensington E. S. Co.,Ld.	5	10	5⅞*	8⅛—8⅜	+¾
Do. 7% Cum. Pref.	5	7	7%	7⅞—8¼	+⅛
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101 xd	−1
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	4⅜—4⅝	+⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4⅛—4⅜	+⅛
Do. 4% Deb. Red	Stock	4	4%	97—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3⅞—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	4—4⅛	+1
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	+1
City of London Elec. Lt. Co., Ltd.	10	6	6%	10—10½	+⅜
Do. 6% Cum. Pref.	10	6	6%	12½—13	
Do. 5% Deb. Red	Stock	5	5%	123—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—103	
Cty of Durham E. P. Dis. Co.	5	2	—	2⅝—3	
Do. 5% Pref.	5	5	5%	3⅝—4	
County of London Elect. Sup. Co. Ld.	10	5	—	8½—9	+⅜
Do. 6% Cum. Pref.	10	6	6%	10⅝—11¼	+¼
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	97—100	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	⅛—⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	62—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4⅜—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6¼—6¾	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E.L.Co.	5	10	4%	7½—8¼	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N't'ng Hill E.L. Cos. Db.Rd.	Stock	4	4%	97—100	
London Electric Supply Corporation	3	2½	—	1⅝—1¾	+⅛
Do. 6% Pref.	5	6	6%	4⅜—5¼	+¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	91—94	+1
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	5⅜—5⅞	+⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4¼—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—110	+1
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply..	5	8	2½%	4¾—5⅛	
Do. (fully paid)	5	8	2½%	4¾—5⅛	
Do. 5% Pref. Do.	5	5	2½%	5⅛—5¼	
Do. Do.	5	5	2½%	5—5⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅜—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅝—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5%*	8¾—9¼	+1
Do. 7% Non-Cum. Pref.	5	7	7%	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½%	87—91	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅞—1¼	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2¾	+⅛
South Metropolitan E. L. & P. Co.	1	2½	—	¾—⅞	+⅛
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅜	+1/16
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	+1
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8½—9	+⅛
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5⅜	+⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3%*	64—66	−1
Do. 4% Preferred	Stock	4	4%	84—86	−2
Do. Deferred	Stock	2	—	49—51	−2
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	86—88	
City and South London Cons.	Stock	4½	1½%	31—32	−1⅛
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1895	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—109	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	
Gt. Northern, Piccadilly & Brompton	10	4	2½%*	7⅜—8¼	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	½%	35—36	−1½
Do. 3½% Preference	Stock	3½	3½%	85—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	76—78	
Metropolitan District	Stock	—	—	12½—13	
Do. 6% Perp. Deb.	Stock	6	6%	123—126	
Do. 4% Deb.	Stock	4	4%	80—83	
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—27	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	93—94	+⅛
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅞—1⅛	
Do. 5% Cum. Pref.	1	5	—	⅞—1⅛	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅜	
Do. 6% Cum. Pref.	10	6	6%	3⅝—4⅛	+⅛
Do. 5% Perp. Deb.	Stock	5	5%	91—96	+1
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅝—3⅝	−¼
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼% On a/c of arrears	⅞—1⅛ xd	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Street Tramways Co.	4	4/6	2½%	⅜—⅞	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	67—72	−3
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	5%	¼—⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	+1
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	95—100	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	2½%	¼—⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	1½%*	4⅜—5	−⅛
Do. 6% Cum. Pref.	10	6	6%	10—11	+½
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	81—85	+1
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	2⅜—3¼	−⅛
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*		
Do. 6% Pref. Ord.	Stock	6	6%*		
Do. Def. Ord.	Stock	1	—	58—61	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	102—103	−½
Direct Spanish Telegraph Co. Ltd.	5	4	4%	17⅞—17⅝	−⅛
Do. 10% Cum. Pref.	5	10	10%	8⅞—9½	−1⅛
Do. 4½% Debs.	50	4½	4½%	8—8½	
Direct United States Cable Co. Ltd.	20	4½	4½%	8—9	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—103	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	13—13½	−½
Do. do. (Mauritius Sub.)	25	4	4%	101—103	
Eastern Ext. Australasia & China	10	7	5%	100—102	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	99½—101½	
Eastern Telegraph Co.	Stock	7	2½%*	11⅝—11⅞	−⅛
Do. 3½% Pref.	Stock	3½	3½%*	101—103	
Do. 4% Mort. Deb.	Stock	4	4%	130—135	−3
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	83½—85½	−½
Indo-European Telegraph Co. Ltd.	25	18	2½%*	103½—105½	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	30—32	
National Telephone Co., Ltd., Pref.	Stock	6	6%	55—58	−1
Do. Deferred	Stock	6	6%*	⅝—¾	
Do. 6% Cum. 1st Pref.	10	6	6%	108½—110½	−½
Do. 6% Cum. 2nd Pref.	10	6	6%	116½—118½	−½
Do. 5% 3rd Pref.	5	5	2½%	10¼—11¼	
Do 3½% Deb. Red	Stock	3½	3½%	10¼—11¼	
Do. 4% Deb. Red.	Stock	4	4%	5⅞—5⅞	
Western Telegraph Co., Ltd.	10	7	6%*	98—100	
Do. 4% Deb.	Stock	4	4%	101—103	
				12⅝—13⅛	−⅛
				102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	7%	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	10%*	3⅛—4⅛	+1/16
Do. 6% Pref.	1	6	6%	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¼—6⅝	
Do. 6% Cum. Pref.	5	6	—	6—6⅛	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	—	
Do. 6% Pref.	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	68—73	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	49—53	−1
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10¼	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅝	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107⅝—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	¾—1⅛	−1/16
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1¼—1⅜	+5/32
Do. 6% Cum. Pref.	1	6	6%	1⅞—1⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅜—½	
Do. do. (fully paid)	5	4/2	2/6*	1½—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	—	1—1⅛	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	6¾—7¼	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	10¾—11⅜	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	5—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—107xd	−2
I. R. & G. P. Co., Ltd.	10	10	2½%*	16⅝—17⅝	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	31½—33½	
Do. 4% Deb. Bds. Red	100	4	4%	101½—103½	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—½	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72 xd	−2

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ELECTRICAL ENGINEERING

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The Engineering Journal of the Electrical Industry

Published every Thursday. Price **1d.**

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Canada. 8s. 8d. per Annum.

Other Colonies and Abroad. 13s. per Annum.

Small prepaid Advertisements for Situations Vacant and Wanted, Articles for Sale and Wanted, &c., are inserted at the rate of One Penny per word, minimum One Shilling, three insertions for the price of two.

Official Notices and Technical College Announcements are inserted at the rate of Ninepence per line (column width).

Other Advertisement Rates on Application

Latest Time for Receiving

Letters for Insertion, *Tuesday first post.*

Small Advertisements and Official Announcements *Wednesday first post.*

Displayed Advertisements, *Tuesday first post.*

Corrections in Standing Advertisements, *Monday first post.*

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Binding Cases for Vol. III. may be obtained, price 2s. each, post free 2s. 4d. Readers can have their volumes bound by their own bookseller; or they may send their numbers to us, carriage paid (with the reader's name and address), and a remittance of 4s. 6d. under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

The new mountain railway near Bozen in the Tyrol, known as the Rittnerbahn, has some unusual and interesting features. It is partly a rack railway, and, whereas locomotives with shunt-wound continuous-current motors are used to take the cars up and down the steep gradient, the cars, which are equipped with ordinary series-wound traction motors, run by themselves on the horizontal portions of the line. The rack portion is on the Strub system. When descending the gradient, the locomotive motors return energy to the line. Power for working the railway is supplied over a three-phase line from a water-power station some twenty miles away, and is converted to continuous-current at 750 volts in a sub-station about half-way along the line. (Page 751.)

The report of the Committee appointed by the Municipal Tramways Association at the suggestion of Colonel Yorke, of the Board of Trade, has now been issued independently from that of the Committee of the Tramways and Light Railways Association, of which an abstract was published on page 647 of Electrical Engineering, of November 12th. Although in some way there is divergence in the points of view taken in the two reports, the final conclusions do not conflict. Both committees emphasise the importance of the human element, recommending the more thorough training of drivers, and realise the dangers of rails not properly cleaned; but while the Municipal Committee incline to the view that an ideal brake could be designed to meet all conditions, the report of the Tramways and Light Railways Association favours the consideration of each case separately. (Page 753.)

A letter appears in the Correspondence columns, calling attention to the organisation of opposition to the Miners' Eight Hours Bill by the Coal Consumers' Defence League.—Mr. A. M. Taylor contributes a communication relating to the use of storage batteries for the improvement of load factor, and criticises some of the statements in Mr. Lackie's recent Presidential address to the Glasgow Local Section of the Institution of Electrical Engineers.—A correspondent asks for the name of a manufacturer of glass boxes for storage batteries. (Page 755.)

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A REVIEW appears in this issue of "High Speed Dynamo Electric Machinery," by Messrs. H. M. Hobart and A. G. Ellis. (Page 756.)

A VERY exhaustive Paper on transformers was read last week before the Manchester Local Section of the Institution of Electrical Engineers by Messrs. A. P. M. Fleming and K. M. Faye-Hansen, of the British Westinghouse Co. In the first part of the Paper, which was mainly theoretical, comparisons were drawn between the various forms of the core and shell patterns, the influence of size and magnetic property of core material upon efficiency was considered, and the theoretically most economical ratio between copper and iron losses under various conditions of load factor and price per unit was discussed. The latter part of the Paper dealt with a number of interesting practical points in connection with methods of cooling, insulation and mechanical construction of transformers. In the discussion which followed some further advantages of particular types were mentioned, and the influence on design and cost of the introduction of improved magnetic material was spoken of. It was pointed out that its advantages were not so marked in the case of low frequencies, as the rating in these cases was apt to be limited by the no-load current. (Page 757.)

AMONG the novelties described in short articles in this issue are a simple pattern of auto-transformers for metal filament lamps, an ingeniously designed reduction gear for motors, and an alternating-current lift controller. A notice is also given of a very complete exhibit of insulating materials at the recent Marseilles Electrical Exhibition. (Pages 761 and 762.)

THE Verein Deutscher Ingenieure, corresponding to the British Institution of Civil Engineers, has presented a memorial to the German Reichstag, in which an urgent appeal is made to reject the proposals of the Government relating to the taxation of electricity and gas. (Page 762.)

THE Board of Trade has refused to sanction the proposed transfer of the Bath Municipal Electricity Undertaking to the Bath and District Electric Supply Co. (Page 763.)

THE latest form of the Geipel "Rapidity" steam trap differs in some respects from the older design. A special self-adjustable pattern is made to the requirements of the Admiralty. (Page 763.)

A CONFERENCE is to be arranged between the promoters of the Holywood Tramways and the Belfast Corporation with regard to mutual running powers.—The petition of the Hove Corporation to the Board of Trade for a reduction in the prices now charged for electricity supply by the Company has been rejected.—The overhead tramway system of the London County Council from Brixton Road to Denmark Hill has been completed, and a through service is being maintained over the conduit system.—The Marylebone Borough Council have adopted the scheme of street lighting by Osram lamps given in our last issue. The cost is estimated at £8,650 compared with £8,818 now paid for gas.—The Malvern Council has decided not to consent to the introduction of the trackless trolley system.—The National Electric Construction Co. propose to use the overhead system on the tramway extension to Paignton, and have hinted to the Torquay Corporation their desire to substitute the trolley system for the Dolter surface contact system now in use.—The Electrical Committee of the West Ham Corporation again advise that the special contracts for power should not be produced as required by the Local Government Board Inspector, and the Town Clerk has been instructed to take the necessary steps for the protection of the Corporation's interests in the matter.—A conference of West London local authorities has been held in reference to the condition of the London United Tramways Co. track, and Sir Clifton Robinson has been invited to attend an adjourned conference on Monday next. (Page 765.)

Two 3,000-kw. turbo-generators are required by the Bradford Corporation.—The London County Council has sanctioned loans for electrical purposes as follows! Hampstead, £5,900; Stepney, £9,500.—The Woolwich Borough Council has completed a loan of £2,625 for electrical purposes.—A Local Government Board inquiry was held at Carlisle last week (£1,000), and inquiries are to be held as follows: Hereford (£8,000); Maidenhead (£3,500).—An application is to be made by the Birmingham Corporation for £92,000 for tramway purposes.—A loan of £12,400 has been sanctioned to the Liverpool Corporation for tramway purposes. (Page 766.)

THE report of the India Rubber, Gutta Percha and Telegraph Works Co. for the year to September 30th shows a balance available for dividend of £89,480. A dividend of 10 per cent. for the year is declared, and the balance of £51,980 is carried forward.—After meeting all charges, the accounts of the Manx Electric Railway Co. show a balance of £1,050 for the year to September 30th, which sum is carried forward. No dividend is paid on the ordinary shares.—Applications have been invited by the London Electrobus Co. for an issue of £40,000 6 per cent. convertible first mortgage debenture stock, and by the Monterey Light and Power Co. to an issue of £1,000,000 5 per cent. first mortgage debenture stock.—Statements have been issued by the board of directors of the Mexican Light and Power Co., and also by the committee of shareholders with regard to the proposed lease of the undertaking to the Mexico Tramways Co. (Page 768.)

THE annual dinner of the Birmingham Local Section of the Institution of Electrical Engineers took place last Wednesday. (Page 771.)

AMONG the specifications published by the Patent Office on Thursday last is one by the "Z" Electric Lamp Syndicate, in which a process for the manufacture of tungsten filaments is described. Means for dimming the lamps on a circuit controlled by an electrolytic prepayment meter, when the amount paid for has been consumed, is patented by E. Schattner and R. Amberton, and a field system for the dynamos of petrol-electric vehicles is described in a specification by W. A. Stevens. The British Thomson-Houston Co. have a patent for a modification in the known process of manufacturing metallised carbon filaments, and a specification by Siemens Bros. Dynamo Works, B. G. Payne and E. Schupp, relates to a type of motor-starter in which a step-by-step motion is obtained by means of a balance-wheel. Patents relating to heating apparatus, such as electric flat-irons, have been obtained by W. E. Eastman and A. Warne, and by the British Thomson-Houston Co. respectively. An application for amendment to a specification relating to electric power transmission systems for vehicles has been made by E. W. Hart and W. P. Durtnall. Among the expiring patents this week is one by Dr. Carl Kellner relating to electrolytic apparatus. Short abstracts of the above specifications are given in our Patent Record. (Page 772.)

THE Municipal Tramways Association has promptly followed the Tramways and Light Railways Association with the Report of its Committee on Tramway Brakes, and, from the abstract printed elsewhere, it will be found that there is no clashing between the general conclusions of the two committees. There is, however, some difference in the points of view adopted. The earlier report made a very thorough examination of the brakes available, their advantages and disadvantages, from which an intelligent choice can be made to suit given conditions; that now under discus-

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sion rather looks forward to an ideal standard brake applicable to all conditions, and sets out what it should do. These two views are complementary, not contradictory. One matter in which the reports agree is the emphasis they give to speed control on gradients. the value of the track brake for such purposes, the importance of clean rails, and, failing the prevention of greasy rails, the importance of sanding apparatus. The municipal report rather suggests that greasy rails should be abolished altogether—an ideal condition very difficult and expensive to realise, whilst road materials, general traffic, and British weather, remain as they are. A distinctively municipal view is expressed in the first six proposals of our abstract, dealing with the breaking of regulations, working steep gradients, the employment of unfit men, insufficiently tested brakes, and insufficient inspection of braking equipments in the depôts. Reading these paragraphs an outsider will take them as reflecting seriously upon the competence either of the inspecting officers of the Board of Trade, whose duty it is to make safety regulations for every line, or that of the managers, whose duty it is to see that the regulations are strictly observed by a competent staff; and it is strange that a committee of tramway managers should have published such views. Reading between the lines, we believe that the true meaning is that many municipal managers are seriously interfered with in these respects by their committees, and the paragraphs mentioned are an appeal for the protection of the managers from such interference by an outside power. On either reading the publication appears ill-advised. The Municipal Tramways Association should be strong enough to protect its own managerial members, by means less disquieting to the public. The technical considerations are inspired throughout by striving after ideals, *e.g.*, that one gear should be used for all purposes, and that any failure or accident should cause an actual application of the brake. How this holds good in the case of the driver losing his head, or to wheel-skidding on greasy rails, is not obvious. It is easy to say what an ideal brake should do, but until it exists, it is more to the purpose to show how to make the best use of what there is, and it is here that the report seems to us most defective. Of a piece with the idealism mentioned is the suggestion that there should be a standard brake equipment applicable to all systems. To load a car designed, say, for the level roads of Southport with the braking equipment needed in hilly Halifax is not good engineering, from either the operating or the commercial point of view; nor can we agree that the quick-acting brake needed in the traffic of London or Manchester is required for inter-urban lines. The due fitting of braking equipment to the conditions is as essential as the due fitting of motor equipment, and the question of cost seems to have been forgotten. The recommendations that we can most heartily endorse are those of greater attention to rail cleaning, the use of track brakes for controlling speed on gradients, and the selection, training, and control of employees. The first and last are, or should be, in the hands of tramway managers themselves. The "practical result of the Committee's deliberations" is that a brake is desirable which has certainly not yet been invented, and which will do certain things that are truly rather difficult of attainment. The most important practical result of the Committee's investigations, in our view, on the other hand, is that given by the tests of track brake blocks, which show a remarkably high value for serrated cast-iron blocks. If this result is confirmed by further tests, the terrors of the greasy rail will be very materially diminished. The number and details of the tests tabulated and in diagram form appended to the report, show great industry on the part of the Committee, both as observers and compilers. Fortunately, they supplement those of the Tramways and Light Railways Association Report, and, taken together, the two sets form a mine of information representing the whole of our present knowledge on the subject, and showing where further research is required. It now devolves upon the Board of Trade to issue a set of regulations based upon the results of the investigations made by the two Committees.

The paper read by Messrs. A. P. M. Fleming and K. M. Faye-Hansen last week before the Manchester Local Section of the Institution of Electrical Engineers was a valuable contribution to the literature of the transformer, although, from the point of view of a Paper to be discussed in its entirety at a single evening meeting, perhaps it covered rather too much ground. The comparison of the different varieties of the shell and core pattern of transformer was interesting and thorough, although the final result, that there is little to choose between them, is a little disappointing. One of the most important points affecting the future of transformer design touched on was the tremendous influence which the introduction of alloy steels with low hysteresis quality is having on the size, and therefore the cost, of transformers of given output and efficiency; or, to put it in another way, on the efficiency of transformers of a given size and output. It is to be hoped, however, that these new brands of transformer plate, excellent though their hysteresis constant may be when new, will prove "non-ageing" in the sense of their hysteresis loop not increasing as time goes on, due to the prolonged heating to which the transformer is subjected on load, for it was certainly found in the early investigations of the subject by Ewing and others that the better the initial magnetic properties of the materials then obtainable, the worse was their lasting quality, so that often it paid better in the long run not to employ material which gave the best figure in the hysteresis tester. It was seen in the Paper, and more emphatically brought out in the discussion, that the advantage is not so high in the case of low-frequency transformers, as the limiting consideration is often the no-load current, and this calls more for a steel of exceptionally high permeability than low hysteresis. If the combination of the three qualities of low hysteresis, high permeability, and good non-ageing properties can be obtained, then the steel-maker will have conferred a lasting benefit on the transformer manufacturer, and indirectly on the station engineer.

It will be seen from an article which we publish on another page that the two great engineering societies in Germany, corresponding approximately to our Institutions of Civil and Electrical Engineers, are vigorously opposing the tax which the German Government proposes to put upon electrical energy. This is hardly to be wondered at. The proposal is to collect a tax of

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5 per cent. of the selling price on all electrical energy generated, whether used for lighting or power, and the fact that the gas industry is to be burdened by a similar tax does not in any way justify this remarkable method of collecting revenue for the State. Although at times hard things may have been said in this country with regard to German competition in our electrical industry, there can be no electrical engineers who will not sympathise with the efforts made by their brethren in Germany to resist this imposition. It has been pointed out that the results of such a tax would be almost ruinous not only to the electricity supply industry, but to others. Firms generating their own electricity are to be taxed as well as supply companies and corporations, and in those cases where the cost of energy is an important factor in production, it is easily seen that the effect will be great. Thus it is predicted that, if the Bill is passed, a number of electrochemical manufacturers will be driven to move their works out of Germany, and a large iron-works which has an electric power station in connection with its blast furnaces estimates that the tax upon their output, including the tax of from 3·6d. to 6d. upon their electric lamps, will amount to no less than £2,670 per annum, or 1 per cent. of its share capital. The electric power industry has, in Germany as in this country, won its way largely by small savings in the costs per h.p.-hour, and in many cases the increased cost of 5 per cent. will prevent power-users from adopting electric driving in favour of steam or oil-driven plants. An increase of 5 per cent. in the cost of generation would, for instance, prevent a number of textile mills from adopting electric driving in place of steam driving, and there are numerous small works in which the same thing applies. Glow-lamps, it is proposed, should be taxed to the extent of 2·4d. for each lamp between 25 and 60 watts, 3·6d. from 60 to 100 watts, and 6d. above 100 watts; while gas mantles are to be let off with 1·2d. each, and a tax of 1s. per kg. is to be placed on arc-lamp carbons. The Government itself estimates that the revenue derived from the tax on electrical energy would be £870,000 a year, and on electric lamps and arc-lamp carbons £650,000. The creation of such a burden upon a growing industry upon which thousands depend for their livelihood would bring about disastrous consequences.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, DECEMBER 10TH.

Royal Society.

4.30 p.m. Meeting at Burlington House, Piccadilly, London. Among the Papers down for reading are the following: (1) "Electrolytes and Colloids; the Physical State of Gluten," by Prof. T. B. Wood and W. B. Hardy, F.R.S.; (2) "On the Specific Heats of Air and CO_2 at Atmospheric Pressure by the Continuous Electric Method at 20° and 100° C," by W. F. G. Swann; (3) "Potential Gradient in Glow Discharges from a Point to a Plane," by J. W. Bispham.

Mining Institute of Scotland.

6 p.m. Meeting at 92 Cadzow Street, Hamilton, N.B., when the discussion on the following Paper will be taken: "Experiments with Two Electrically-driven Pumps," by J. L. Galloway.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster. Paper to be read: "Output and Economy Limits of Dynamo Electric Machinery," by J. C. Macfarlane and H. Burge. Time permitting, the following Paper will be read: "Commercial Electric Heating," by John Roberts.

FRIDAY, DECEMBER 11TH.

Northampton Institute Engineering Society.

5.45 p.m. Meeting at the Institute, St. John Street, Clerkenwell, London. Paper to be read: "Instrument Transformers," by R. E. Dickinson.

Physical Society.

7 p.m. to 10 p.m. Annual Exhibition of Electrical, Optical, and Other Physical Apparatus in the Physical Laboratory, Imperial College of Science, South Kensington.

SATURDAY, DECEMBER 12TH.

Institution of Electrical Engineers: Manchester Students' Section.

Visit to the Heysham-Morecambe single-phase railway of the Midland Railway Co.

Birmingham and District Electric Club.

7 p.m. Annual Meeting at the Colonnade Hotel, New Street, Birmingham, when the officers for the ensuing session will be elected.

TUESDAY, DECEMBER 15TH.

Finsbury Technical College Old Students' Association.

7 for 7.30 p.m. Third annual dinner at the Criterion Restaurant, Piccadilly Circus, London, Mr. P. V. McMahon in the Chair.

Institution of Electrical Engineers: Manchester Local Section.

7.30 p.m. Meeting at the University. Paper to be read: "The Electrical Discharge and the Manufacture of Nitrogen Compounds," by W. Cramp.

Faraday Society.

8 p.m. Meeting at the Institution of Electrical Engineers, 92 Victoria Street, London. Agenda: (1) "The Redetermination of the Electrolytic Potentials of Silver and Thallium," by F. J. Brislee; (2) "The Heats of Combustion of Aluminium, Calcium, and Magnesium," by F. E. Weston and H. R. Ellis; (3) "The Formation of Graphite by the Interaction of Magnesium Powder and Carbonates," by H. R. Ellis; (4) "Colloidal Barium Sulphate," by E. Feilmann.

WEDNESDAY, DECEMBER 16TH.

Institution of Electrical Engineers: Birmingham Local Section.

7.30 p.m. Meeting at the University. Paper to be read: "On the Use of Transformers as Choking Coils and Applications to the Testing of Alternators," by J. D. Coales. Mr. S. P. Smith will also reply to the discussion on his Paper, "The Testing of Alternators."

Junior Institution of Engineers.

7.30 p.m. Meeting at the Royal United Service Institution, Whitehall. Paper to be read: "Motor Omnibuses," by E. F. Boult.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Meeting at 92 Victoria Street, Westminster, London. Paper to be read: "Auto-transformers and Metallic Filament Lamps," by G. H. Stevens.

THURSDAY, DECEMBER 17TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read: "The Electric Discharge and the Production of Nitric Acid," by W. Cramp and B. Hoyle.

Rugby Engineering Society.

8 p.m. Ordinary meeting. Paper to be read: "The Utilisation of Exhaust Steam with Low-pressure Turbines," by E. Halliwell.

FRIDAY, DECEMBER 18TH.

Electro-harmonic Society.

8 p.m. Smoking Concert at Holborn Restaurant (King's Hall).

Institution of Engineers and Shipbuilders in Scotland.

8 p.m. Meeting at 39 Elmbank Crescent, Glasgow. Paper to be read: "Standardisation and its Relation to the Trade of the Country," by Sir John Wolfe-Barry, K.C.B., F.R.S.

Telegraph Traffic.—The Hanekin route was restored on the 3rd inst., and repair work on the line between Bagdad and Bassorah and *via* El Arich was also completed on the 1st inst. The submarine cable between Cotonon and Grand Bassam was again working on the 5th inst., after an interruption which occurred on October 28th last. Communication with Venezuela is interrupted, and the cables between Port Arthur and Chefoo, Pontianak, and Saigon and Dakar Conakry are all still down. Communication with Tauris has been interrupted since August 17th last.

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A NEW MOUNTAIN RAILWAY IN TYROL

THE beautiful Province of Tyrol was one of the few parts of Austria which as lately as 1902 was without an electric railway. In the year 1903, however, a short mountain railway, partly on the cable system, was constructed up the Mendel pass; and this was followed by several short railways, such as the single-phase line in the Stubai valley. Subsequently, the Hungerburg and the Virgl mountain lines were opened, and finally, the Rittner line described in this article was opened last year. The Hungerburg and Virgl railways are both short electrically-driven cable railways; the former is worked with continuous current at 440 volts, and the latter with three-phase current at 3,000 volts. The Stubai single-phase line was opened in 1904; it is about 11 miles in length, and works with a line voltage of 2,500 volts. Six other railways are now being built, and when these are completed, the total length of electrically-equipped track in Tyrol will be 105 miles, including the tramways of Innsbruck and Meran. The railways under construction include four 750-volt continuous-current railways, and a local line between Innsbruck and Hall which is to operate at 1,000 volts continuous current.

The more interesting features of the Rittner line were recently described in *Elektrische Kraftbetriebe und Bahnen*. The line is situated to the north-east of the town of Bozen, between the valleys of the Eisak and Talfer, and runs up the side of the Rittnerberg, and along the plateau on top. This plateau is some 3,000 ft. above the level of the town of Bozen, and a magnificent panorama of the surrounding mountainous Dolomite district is obtained. The line which is single-track throughout, is nearly eight miles long, and about two and a half miles of this is constructed on the rack principle. A view of a portion of this section is shown in Fig. 1. Power is supplied to the trains in the form of continuous current at 750 volts, by means of a double overhead contact wire. In order to take advantage of the possibility of recovering energy when the trains descend the rack portion of the line, the motor-cars, which are equipped with the usual continuous-

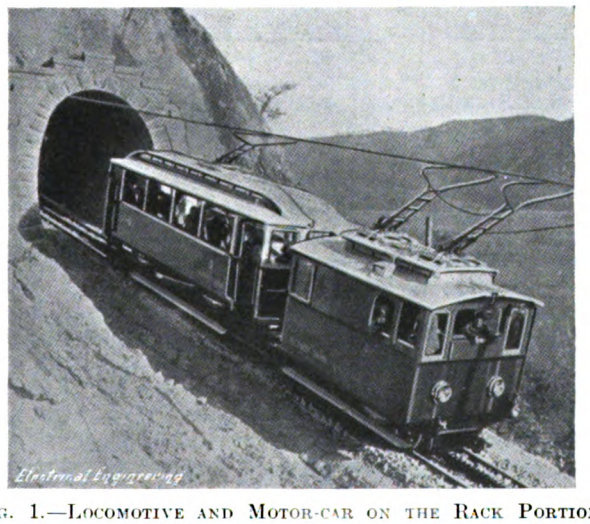

FIG. 1.—LOCOMOTIVE AND MOTOR-CAR ON THE RACK PORTION OF THE LINE.

current series traction motors, are taken up and down the rack by locomotives provided with shunt motors. When the locomotives descend the rack, the shunt motors act as generators and return energy to the line. On the level portions of the track, the motor-cars run by themselves.

Power for the railway is supplied from a water-power station in the Etsch valley, from which works the towns of Bozen and Meran are supplied with light and power. The sub-station for the railway is situated half-way along the rack portion about 22 miles from the works, and power is supplied in the form of three-phase alternating current at 46 cycles and 10,000 volts along an underground cable laid alongside the track. This cable not only supplies power for the railway, but also carries the supply for the towns of Bozen and Gries, and is in all over 30 miles long. The three-phase supply might have been applied direct to the working of the railway,

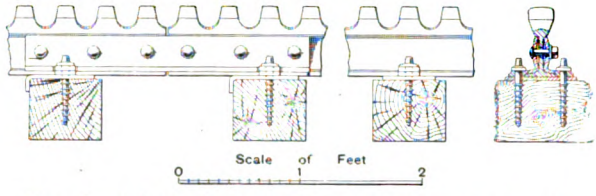

FIG. 2.—"STRUB" RACK RAIL, SHOWING METHOD OF ATTACHMENT TO SLEEPERS.

but a continuous-current system was chosen, partly on account of the necessity of two independent contact wires in the former case. As the energy is obtained from a water-power station, the losses incidental to the continuous current converting and distribution system were not of great importance; moreover, by the use of a buffer-battery, and regenerative working on the rack portion, the demand at the alternating-current side of the sub-station is kept comparatively steady during the day, and a better power-factor is obtained than would be possible with a direct three-phase system. Although regenerative working is possible with three-phase motors, the speed of descent depends on the frequency of the line, and for this reason in some of those rack railways in which three-phase motors are used, as, for example, the Jungfrau railway, the energy is not returned to the line, but is dissipated in water-cooled resistances. In the present case, by varying the excitation of the shunt motors, a useful regenerative effect can be obtained at any speed.

In the sub-station, the three-phase current is transformed down from 10,000 volts to 3,000 volts by means of a 300 k.v.a. transformer, and is then supplied at this pressure to the 325 h.p. motor of the converting set. This is a squirrel-cage induction motor, and was chosen in preference to a synchronous machine on the ground of simplicity. It is run up from the continuous-current side by means of the battery. The continuous-current machine, which is coupled to the motor with a flexible coupling, generates at 750 volts; and as the speed is comparatively high, namely 960 r.p.m., it is provided with commutating poles. A leather coupling, although it necessitates the use of four bearings, facilitates the removal of the generator armature and the substitution of a spare armature. The full-load efficiency of the set is given as 89 per cent., with a power factor of 0·92 and a slip of 1·2 per cent. As mentioned above, a battery is connected to the system to take the peaks in the load. This battery consists of 364 cells, and has a capacity of 296 ampere-hours on a one-hour rating, or 352 ampere-hours on a two-hour rating. A booster set is provided for charging the battery; the motor of this set is a three-phase induction motor, and is supplied from a transformer which also supplies the station lighting. To start this set, a low voltage obtained from a special tapping on the secondary of the transformer is impressed on the stator winding of the induction motor.

The track has some features of interest; the first portion, some half a mile in length, runs through the streets of Bozen, and is practically level, but in the next two and a half miles a difference in height of nearly 3,000 ft. is surmounted, the maximum gradient being just over 25 per cent. The remaining five miles

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is practically level again, the maximum gradient being only 4·5 per cent. On the two-and-a-half mile steep portion, the track consists of Vignoles rails, weighing 45 lb. per yard, and the rack is on the Strub system, as shown in Fig. 2. The rack is laid in lengths of 13 ft., and the rails in lengths of 40 ft. Iron sleepers, which are usual on this class of railway, have in this case not been used, sleepers of larch being employed. The whole line is single track, and a turn-out is provided in the middle of the rack portion, notwithstanding the necessity for rack points entailed, as no suitable position for a turn-out could be found on the line. The trains each consist of a locomotive and a motor-car capable of carrying sixty passengers, and in the season these are run at intervals of one hour. There are never more than two trains on the rack portion at the same time. The contact wire is in duplicate, and is supported by means of a simple form of bow-spring suspension from wooden side poles. As the rails are used as a return circuit, the joints are bonded.

The rolling-stock comprises three rack locomotives, two of which are always in service, while the third is held in reserve; four motor-cars, three of which are generally in service; two passenger trailer cars; and four goods trailer cars. The locomotives, a longitudinal and transverse section of one of which is shown in Fig. 3, are each fitted with two 150 h.p. shunt-wound continuous-current motors, and can develop a continuous output of 300 h.p. at a speed of about four miles per hour, and a drawbar pull of some 27,500 lb. On account of the strain on the rack, and in order to improve the stability of the locomotive, two toothed driving wheels are used, each one being driven by a motor through double-reduction gearing with a total ratio of 14·73 to 1. The spur wheel axles are connected to the side wheel axles by connecting rods, and consequently the pitch diameter of the spur wheel must be exactly equal to the running diameter of the side wheels if no slipping is to occur. The tyres have been found to wear very little, however. As shown in Fig. 2, the rack rail is wedge-shape in section in the Strub system, in which a gripping device is provided to prevent all possibility of the pinion mounting the rack. This is shown on the extreme right of the longitudinal section of Fig. 3. An unusual feature in the arrangement is the interposition of a spring between the grip and the locomotive frame. The motors are not coupled direct to the spur-wheel gear, but drive through a coupling which is capable of slipping when the torque of the motor exceeds a certain amount. The use of such a slipping coupling is rendered necessary on account of the fact that if a motor were to short-circuit when the locomotive was descending the rack, the sudden braking effect would put too great a strain on the teeth of the spur wheels if the motors were rigidly fixed to the wheels. The locomotive is provided with two hand brakes, which work by means of four blocks on corrugated pulleys on each of the spur-wheel axles; the arrangement of the brake mechanism can be seen in Fig. 3. No brakes on the side wheels are required, since they are coupled to the spur-wheel axles. On each armature axle is an automatic brake which comes into action when a certain speed is exceeded, or can be worked by hand. So long as the contact wire is alive, the locomotive can be braked by regenerating also.

The electrical equipment of each locomotive comprises, as already mentioned, two shunt motors, with a continuous rating of 150 h.p. each. These motors, which weigh about 2·8 tons each, are four-pole machines fitted with commutating poles, and run at 750 r.p.m. The distribution of the load between the two motors is adjusted partly by altering the position of the brushes. Speed variation is obtained by means of a shunt resistance interlocked with the starting controller. The electrical equipment of each motor-car consists of two 45 h.p. series traction motors with the usual series-parallel control. The four-axle cars weigh 21 tons empty, and have a seating capacity of 58, and the locomotive weighs about 16·3 tons, so that the train-weight per seat amounts to 1,400 lb. The motor-cars have also pinions to engage with the rack, but these are merely for braking purposes, and are not motor-driven. The whole of the electrical equipment was supplied by the A.E.G. Union Elektrizitätsgesellschaft, of Vienna; the track was laid by a local firm; and the locomotives, with the exception of the electrical equipment, were supplied by the Schweizerische Lokomotivfabrik, of Winterthur.

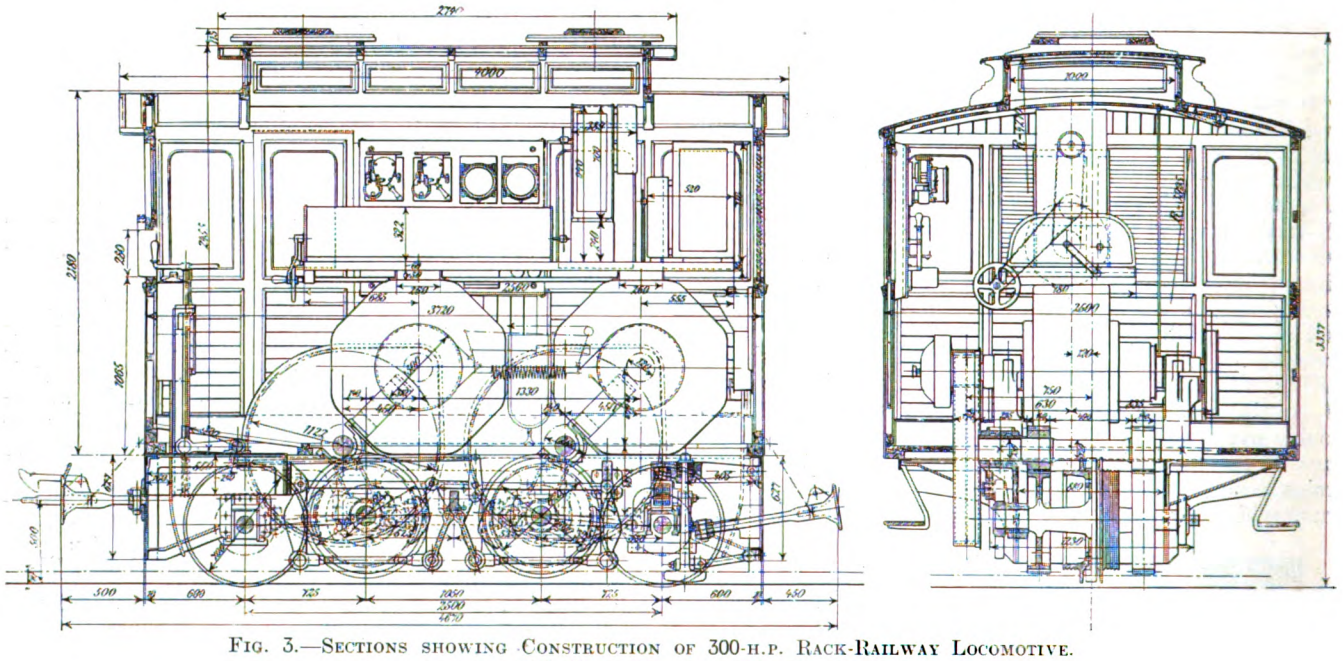

Fig. 3.—Sections showing Construction of 300-h.p. Rack-Railway Locomotive.
(All dimensions in millimetres.)

Institution of Mining Engineers.—The Council, having transferred the headquarters of the Institution from Newcastle-upon-Tyne to London, have taken chambers on the first floor of Albany Buildings, 39 Victoria Street, Westminster, S.W. All communications should be sent to the hon. secretary at that address in future.

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REPORT OF THE COMMITTEE ON TRAMWAY BRAKES

Appointed by the Municipal Tramway Association

On page 647 of Electrical Engineering of November 12th, we gave an abstract of the Report of the Committee appointed by the Tramways and Light Railways Association to consider the subject of tramway brakes, as the outcome of certain suggestions by Colonel H. A. Yorke, contained in a Board of Trade report on the Highgate tramway accident of June, 1906. In response to these suggestions, a special committee was also formed by the Municipal Tramways Association to report on the subject independently. At the conference presided over by Colonel Yorke in October it was suggested by him that the two reports should be published together as one book, but on consideration, the arrangement was not found feasible. The report of the committee of the Municipal Tramways Association has now been issued, and, together with the illustrated descriptions of the various brakes investigated, fills a volume of about 100 pages.

The Committee consisted of the following members:

The then President, Mr. J. M. McElroy, General Manager, Manchester Corporation Tramways; the then Vice-President, Mr. J. Aldworth, General Manager, Nottingham Corporation Tramways; Mr. P. Fisher, General Manager, Dundee Corporation Tramways; Mr. J. B. Hamilton, General Manager, Leeds Corporation Tramways; Mr. H. Mozley, General Manager, Burnley Corporation Tramways; Mr. C. J. Spencer, General Manager, Bradford Corporation Tramways; Mr. A. R. Fearnley, General Manager, Sheffield Corporation Tramways (Hon. Secretary).

The report is prefaced by a number of extracts from Board of Trade reports on tramway accidents, and the Committee submit that the general conclusion to be deduced from this evidence is that the accidents, taken as a whole, have been due rather to the failure of the human element than to the failure of the brakes, and they think they are justified in going so far as to say that, with reasonable skill and care, the ordinary brake equipments which have been approved by the Board of Trade have, generally speaking, shown themselves equal to the work they have been called upon to perform. Taking all the tramway accidents which have called for local inquiry by the Board of Trade during the past six years, the Committee find that the fatalities in connection with such accidents, if compared with the total number of passengers carried, work out at one per 182,875,000. The Committee, however, fully realise that these accidents having taken place, a natural duty devolves on tramway operators to carefully consider means whereby the risk in future may be reduced, and, with this object in view, the Committee, in addition to considering the brake problem, have gone fully into the whole question of tramway accidents, with a view of indicating the directions in which improvements may be effected so as to secure greater safety to the travelling public. In considering the question, the Committee have given consideration to what they believe may be the causes which are likely to result or have resulted in runaway cars, and submit the following as embracing their views on the subject:—

The careless or thoughtless breaking or ignoring of important regulations. In dealing with this point, the Committee believe that the non-observance of regulations is the most common cause of all accidents on gradients, and it may be safely asserted that danger from this source will never be absolutely eliminated. Strict discipline, close inspection, and the framing of reasonable and sound regulations will undoubtedly reduce the risk to a minimum, and, in considering this point, the Committee are strongly of opinion that in all cases it is essential that power should be placed in the hands of some responsible person to see that such regulations, which are made from time to time for securing the safety of the public, are strictly enforced.

The growing tendency to construct and work tramways on very steep gradients and the running of cars on these gradients at too high a speed. The small margin of safety in working gradients of one in nine or steeper under ordinary street conditions is so important as to cause responsible persons to hesitate before recommending their construction. It is not too much to say that the safe operation of a gradient of one in nine or steeper depends absolutely on the surface of the rails being kept clean and free from grease; also on the fixing of low maximum speeds for gradients of this character, and careful supervision to ensure that these speeds are never exceeded.

The employment of men who are not from various causes fit for their positions, and the insufficient amount of training and testing of men in charge of cars. Experience has shown that the best tramcar drivers are taken from certain types and classes of men. On practically all systems, drivers are selected from employees in the Tramways Department, whose experience, either on the rear of a car as a conductor, or as a depôt employee, is such as to fit them for the position of driver. No man ought to be appointed a driver of an electric tramcar who has not first passed a careful medical examination. A rigid and careful examination as to fitness in handling a car should be made by a responsible officer, after the man has been thoroughly trained in his duties. The supervision of the training of drivers should, where practicable, be done by one man, in order to secure uniformity. Periodical testing (medical and practical) of men is a necessity of safety.

The danger of adopting new forms of brakes without the fullest knowledge as to their action under all conceivable conditions of service. The greatest care should be exercised by tramway operators in adopting any new form of brake without adequate trial and experience. Theoretical considerations alone are not sufficient for the purpose of determining the efficiency or otherwise of any new form of brake.

The disregard of the absolute necessity of constant and careful inspection in the depôts of all brakes and equipments generally and the danger of allowing cars which have exhibited defects to remain in service on the road when they should have been sent to the depôt.

The running of cars on long gradients without suitable track brakes. The Regulations of the Board of Trade require that on tramway systems with gradients of 1 in 15 or less track brakes should be fitted on all cars. There are, however, conditions due to curves, traffic, &c., which necessitate the adoption of track brakes on long gradients of less than 1 in 15.

Drivers of cars losing conscious control of their actions under trying and critical conditions. The Committee believe that danger from this cause will always, to some extent, exist. The cause of panic on the part of a car driver, in practically every case, is due to the occurrence of some unusual phenomenon in connection with the working of the controlling apparatus under his charge, and panic having once taken possession of a man, it is impossible to say what his actions will be. It is more than probable that they will be of a sub-conscious and automatic character, formed as a habit resulting from experience in the operation of his brakes. Assume, for example, that a man is in the habit of retarding the speed of his car by means of the ordinary hand brake, and that, in his experience, he has not had to deal with a very greasy rail. He may have been fully instructed, but one day suddenly finds that the brake does not have the usual retarding effect when applied in the ordinary way. Instinctively he applies the brake harder, with the result that he skids the car wheels. He may or may not remember that his trainer told him that under such circumstances it is necessary to release the brakes, open the sand valves, and reapply the brakes, or he may remember his training when it is too late. To reduce this risk involves the designing of a brake where the minimum of skill on the part of the driver is required, and is of such constructional design as to win the absolute confidence of the man whose duty it is to operate it.

The Committee consider that this train of thought suggests that a necessary quality in an ideal brake is that its application to the fullest possible extent does not involve its failure under any circumstances, obviously meaning that the danger resulting from skidding wheels shall not exist. Simplification of braking apparatus is desirable. All brakes, however, no matter how simple, are subject to failure of some description. Two alternative methods have been suggested for reducing the risks to a minimum, namely:

(1) To have more than one brake per vehicle each quite independent in action, so that in the event of failure of one, the other brake or brakes could be called into use; and (2) To

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have only one brake per vehicle, but so designed that in the event of failure in the ordinary method of application the brake would be automatically applied and not released.

The first method is the one which has been generally adopted, but the second method, if realisable in the fullest degree, seems desirable, and the Committee suggest that an ideal brake equipment would be one where the same gear is used for all purposes, viz., service, emergency, and coasting, and worked from a single lever by the driver; the only difference between easy service stops and quick emergency stops would be one of degree of application, and that in the event of failure or accident, the result would be the application of the brake and not its release. An ideal brake would also be one that could be operated at any time by the conductor of the car, and be equally effective whether the car was running forward or backward. It should, as far as possible, be independent of auxiliaries (sand, &c.).

It has often been stated, and generally agreed, that, inasmuch as the conditions on different systems vary, a universal type or system of brakes is not only impossible, but undesirable, and that whilst a certain type of brake may be excellent for one system, it is not necessarily good for another where the conditions are different. The Committee, however, are not prepared to admit the correctness of this view. Not many systems are so flat that they have not a gradient sufficiently steep to require special apparatus and precautions. On the other hand, all systems require quick-acting brakes to avoid street collisions with other vehicles. This being so, the Committee suggest that tramway conditions are, speaking generally, of a standard character, and are, therefore, open to standard treatment.

The following types of brake equipment have been generally adopted in this country, in accordance with the requirements of the Board of Trade, viz.:—

Wheel Brakes.—In this report the term "wheel brake" is used to mean any form of brake where the sole retarding effort is obtained by means of the application of blocks to the periphery of the car wheels. The most common arrangement is one in which the driver applies cast-iron blocks to the periphery of the wheels by means of a crank handle fixed on the car platform operating through various levers in order that the blocks may be applied with sufficient pressure. The design of this brake is practically standard. Apart from the difficulty inseparable from the principle of action, viz., the skidding wheel, it has proved an excellent piece of apparatus. The crank handle, combined with the ratchet, is a convenient and handy arrangement for the driver. The winding-up of a chain on the brake spindle, though somewhat severely criticised by Colonel Yorke, has not given much trouble in practice. Many improvements have been put on the market, and largely adopted, to facilitate the taking up of slack and the reduction of chain link wear and friction, without materially departing from the principle of winding a chain on a barrel. The Committee are unable to agree with the remarks of Colonel Yorke, in his report on the Highgate accident, relative to the question of the proper position of brake blocks on the wheels; nor are they able to agree with his observations as to the requisite amount of clearance between the blocks and the wheels, and the necessity of grinding or surfacing brake blocks in a special machine before being used. The arrangement of levers and the design of the same on most modern wheel brakes are thoroughly mechanical, and properly proportioned for the work they have to perform. Care should always be taken that adequate leverage is provided.

Electric Brakes used for Emergency Purposes.—In these brakes the regenerative action of the motors is utilised for effecting emergency stops. The objection to this type of brake is that at times of emergency the car driver, accustomed as he is to use his wheel brake for ordinary service stops, involuntarily tends to put on such brake harder; he thus locks the wheels and renders inoperative the rheostatic brake.

Track or Slipper Brakes.—On tramway systems with gradients of 1 in 15 or less the cars are, by the Board of Trade Regulations, required to be equipped with track or slipper brakes.

Mechanical Track Brakes.—The type of mechanical track brake in general use consists of two or more hard wood or cast-iron shoes, pressed against the surface of the track by means of suitable lever arrangement, worked primarily from a wheel or lever on the platform of the car. The mode of operation is generally to apply this auxiliary brake when descending steep gradients sufficiently hard to supply the necessary retarding force to balance the gravity forces. If it is required to stop the car, only a light application of the wheel brake is necessary in addition. This form of brake has proved very effective in the operation of tramways on steep gradients; it is approaching the ideal brake on account of the fact that it is not liable to failure when applied to its maximum extent, also to its non-liability to get out of order. It is simple in construction, and requires practically no skill in application. Notwithstanding the transference of weight from wheels to track shoes, its effect is to materially lessen the tendency of the skidding wheel, on account of the cleaning action of the shoe on the rail. An advantage in this type of brake is gained by multiplying the points of application, thus utilising the weight of the car at four points instead of two. As a result of experience and tests with this type of slipper brake, it has been found that on a greasy rail cast-iron blocks are more effective than wood blocks, whilst on a dry rail wood blocks are more effective than cast-iron blocks. Its main disadvantages are that it is slow in application, and its effectiveness is limited to the available weight of the car.

Magnetic Track Brakes.—A development and improvement of the rheostatic brake is the connection therewith of magnetisable metal shoes hung between the car wheels, the magnetising coils of which are in series with the car motors, and rheostat when the motors are used as generators for braking purposes. These metal brake shoes are so arranged that when magnetised they are attracted to the rails, and thus assist in the retardation of the car by the beneficial effect of the friction set up, which is directly proportional to the degree of magnetisation of the track brake shoes. Theoretically the utilisation of a magnetic brake shoe properly designed and proportioned should be excellent both for service and emergency braking; its operation is of necessity economical when compared with other forms of power brakes, as it utilises the waste energy primarily obtained from the momentum of the moving car. Further, owing to its magnetic properties, its effectiveness is not limited to the weight of the car. When the car is travelling at a speed in excess of four or five miles per hour, it is practically instantaneous in its action. Disadvantages of purely magnetic brakes are unfortunately serious. They are not simple brakes, their operation depending upon the correct working of a number of the more delicate portions of the car equipment, and are consequently liable to derangement at inopportune times. It is impossible for the driver to tell whether the brake is available for action or not until his car is under way. A serious disability in one of the earlier and well-known forms was the tendency to produce skidding when over-applied.

Combined Mechanical and Magnetic Track Brakes.—Recent developments have been in the direction of combining the best features of both the mechanical and magnetic track brakes. In some cases this has taken the form of simply fitting to the ordinary magnetic arrangement a system of levers for applying mechanical pressure to the upper portion of the track shoes. In others an ordinary mechanical track brake is supplemented by a magnetic shoe capable of moving in the track line relatively to the car frame. When this auxiliary shoe becomes magnetised its attraction to the track is utilised to produce a dragging movement which, by a system of levers, increases the downward pressure on the mechanical shoes. For coasting purposes these brakes can be applied mechanically while the car is at a standstill, before commencing the descent of a gradient, and the speed may be regulated by gradually increasing the pressure of the blocks mechanically or by magnetism. Either form of application is sufficient to control the car without the assistance of the wheel brake, thus eliminating the danger of the skidding wheel or the uncertainty of the magnetic brake acting through failure of the electrical equipment. In some cases an arrangement is provided whereby the magnetising coils of the brake shoes may be excited by utilising the line current, but in the event of the line becoming dead, or the trolley leaving the wire at a critical moment, this device would be useless.

Power for Brake Application.—The speed of application and manipulation of any brake is necessarily vital to its effectiveness. In manually operated brakes much improvement is possible in this direction, and any device that has for its object the quick taking-up of slack, and hence the quick application of the brake blocks or track shoes, would be an important improvement. This desirable result may be accomplished by the use of power for the application of the brakes. The most common form of power used for this purpose is compressed air, and the Committee are impressed with its effectiveness where they have seen it in use, although, in common with other forms of power brakes, it is more complex than a purely mechanical brake. In the United States and the Continent, air brakes are almost universally used, but so are trailer cars, and the use of these trailer cars almost compels the adoption of an air or similar brake equipment. The problem for unit vehicle control is not quite the same, as it is conceivable that manually operated brakes may be improved to achieve the results already accomplished by the power applied brakes, that is, so far as quick application and manipulation are concerned.

Run-back Preventers.—One of the most likely things to cause a car driver to be seized with panic is when, through current

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failure or other cause, his car begins to run back down a grade, and the Committee are of opinion that cars operating on gradients should be equipped with run-back preventers which should act automatically.

SUMMARY AND CONCLUSIONS.

At the root of the brake problem and the problem of the prevention of tramway accidents generally, two factors stand out prominently, and continually force themselves to the front for consideration, no matter from what standpoint the subject is approached. These are :—(1) The weakness of the human element—that ultimate element necessary for the safe operation of cars—no matter how perfect the brakes may be. (2) The greasy rail, and the consequent danger of the skidding wheel.

The Committee think they are justified in saying that the human element has been the chief cause of most serious tramway accidents, and they trust that the fullest consideration will be given by tramway authorities and the Board of Trade to the suggestion contained in this report as to the selection, training, and control of tramway employees and staff. Improvements in tramcar brakes should be largely in the direction of reducing the importance of the human element, and should follow the lines set forth by the Committee in their suggestions as to ideal braking apparatus. Control of cars by purely mechanical means without sand, &c., is possible on steep gradients at reasonable speeds on practically clean rails, but with greasy rails, such as are common in all towns, proper control is impossible without the use of (*a*) sand, &c., for increasing the adhesion, or (*b*) magnetism for increasing the downward pressure on the rails in excess of the weight of the car. The Committee feel that the safety of passengers when descending steep gradients should not depend on the safe working of a sand box and gear, and magnetic arrangements alone are as yet not sufficiently reliable to be entirely depended upon.

The brake problem therefore resolves itself largely into a question of track cleaning—the keeping of the rails free from greasy matter.

The remarkable effectiveness of track brake shoes for cleaning purposes makes that system the most reliable to adopt for safely negotiating steep gradients. The Committee find that serrated cast-iron shoes are better than smooth cast-iron, and, taking the average of track conditions—wet, dry, and greasy—cast-iron is better than wood. It will be noted on the test sheets appended to the report that on dry rails the friction coefficient of cast-iron is much lower than that of wood, therefore increased leverage may be required in the case of iron. The maximum pressure possible on track shoes without danger of derailment depends very much on the type of the track brake. With flanged blocks and with the weight of the car taken on a steady base, the downward pressure could be safely brought to a high percentage of the total weight of the car, but with track brakes where the weight is taken midway between the axles, the maximum downward pressure should not exceed 40 per cent. of the total weight of the car unloaded.

The danger of the skidding wheel, and its consequent rendering inoperative of the ordinary wheel and rheostatic brakes and the magnetic track brakes, led the Committee to consider as to whether or not it would be desirable to dispense altogether with wheel brakes, but after further deliberation they cannot recommend this course. Wheel brakes are, under clean rail conditions, most effective. They are not the only brakes which may cause skidding. The rheostatic alone, or the rheostatic in combination with the magnetic track brake may cause skidding if the coefficient of static friction between wheels and rails is low on account of the greasy state of the rails.

The practical result of the Committee's deliberations and investigations is that a brake which can be applied instantaneously either by hand or power from a single lever to both rails and wheels, is desirable, and so designed that the track shoes take the full allowed percentage of the car weight before the wheel brake comes into operation. Having regard to the average tramway conditions, this arrangement is most likely to best fulfil general requirements. Tests and experience under service conditions will show what percentage of the total weight of the car may be efficiently transferred to the track shoes, and in this connection it must be remembered that one of the most important effects of such shoes is to clean the metals. A brake of this description will practically obviate the necessity of the use of sand for braking purposes, and this is most desirable.

The Committee are quite in accord with the views expressed by Colonel Yorke as to the undesirability of an independent brake for purely emergency purposes. To avoid the danger of cars running back on gradients through failure of current, or otherwise, it is desirable that they should be fitted with automatic run-back preventers. So long as sanding apparatus is necessary for braking cars, attention should be paid to the design of the hopper and operating gear. The hopper should be of ample capacity. The gear should be of good mechanical design, and so arranged that both rails are sanded simultaneously, and that the driver should be able to apply sand at the rear end from his platform in the event of the car running backwards. The Committee are also in accord with Colonel Yorke as to the advantage, for braking purposes, of steel tyres as against chilled iron.

The report is followed by full descriptions of a number of patterns of brake and results of actual tests.

CORRESPONDENCE

COAL CONSUMING COMPANIES AND THE MINERS' EIGHT HOURS' BILL.

To the Editor of Electrical Engineering.

Sir,—During the last week many gentlemen who, for the most part, control limited companies which would suffer severely if this Bill became law, have written to me for advice as to the appropriate way in which a protest should be made by their companies to the House of Lords.

I have, consequently, prepared some suggestions for resolutions to be forwarded to the Upper House, and I shall be glad to send them to any of your readers who would like to make use of them, on hearing from them at this address.

As this Bill is likely to engage the consideration of the Lords at an early date, no time should be lost in moving. I am informed that protest resolutions of this character from business men will receive weighty consideration.

Yours faithfully,

G. E. Raine.

(*Organising Secretary, Coal Consumers' Defence League.*)

Sanctuary House, Tothill Street, Westminster, S.W.

December 2nd, 1908.

STORAGE BATTERIES FOR THE IMPROVEMENT OF LOAD FACTOR.

To the Editor of Electrical Engineering.

Sir,—In Mr. Lackie's most interesting and valuable inaugural address, he is reported to have said that the "good" storage battery has not arrived as yet. Now, sir, though we are all pining for the "ideal" storage battery, yet surely that need not debar us from using the batteries that are on the market if there is anything to be gained thereby. Mr. Lackie speaks of the figure of £80 per kilowatt of maximum demand, of which, no doubt, his steam plant and transmission and conversion plant (to his city sub-stations) would account for some £40 to £50. Is he aware that a battery big enough to take 7,000 kw. off the top of his peak could be got for some £5 per kilowatt (ex. auxiliaries)? No doubt he will reply that I have forgotten the fogs. In reply to that, I would say that a battery for a continuous five-hour discharge could be got for some £10, which would leave three and a half hours of additional peak available to deal with fogs.

If Mr. Lackie can show that his worst fog load adds an area above the 14,000-kw. line of his published diagram, integrating more than 24,500-kw. hours (7,000 × 3·5), I will then admit that Glasgow is an unfortunate (though not impossible) city in which to use batteries for lighting. But in that case I would still contend that it would pay him to put them in for power. Assuming, for example, that his summer curve, as published, is practically all "power," the above £10 battery would take up 2,500 kw. off his engine and boilers, and enable the standby losses of boilers corresponding with this output to be saved by shutting down boilers to this extent for the whole year. Mr. Lackie himself supplies the data for arriving at the annual coal saving, which is roughly 400 tons per boiler shut down. He would really be able to shut down some additional boilers above those needed for the 2,500 kw., because he would have at all times of the summer a battery standby equal to a one-hour discharge at some 7,000 kw. during the first hour of the fog, when boilers could be started up if thought desirable. So that really it might be possible to shut down boilers and engines all the year round (or nearly all) to the extent of something like 5,000 kw., with corresponding saving in coal, wages, and repairs.

The fog might last for the whole 12 hours of the day, but this would not affect the batteries, as the motor load taken up by them only integrates up to some five hours, and the remainder of the evening peak would be carried in the usual way with the steam plant. If some 10 per cent. (including interest, sinking fund, maintenance, and depreciation) on the capital cost of steam plant, and some 17½ per cent. on that of accumulator plant, are the relative annual expenses, exclusive of all savings on fixed charges introduced by the cells, and if the capital costs are in the ratio of 3 to 1 or 4 to 1, surely there is a case

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for accumulators, even in their present stage of development. But, as a matter of fact, it can be shown that the savings in fixed charges will alone much more than pay for the perpetual maintenance of the cells, so that the only question outstanding is not the existence of, but the amount of, the saving in interest on capital.

Yours faithfully,
A. M. Taylor.

12 Ashfield Road, King's Heath, Birmingham.
December 4th, 1908.

INQUIRY.

Glass Boxes for Accumulators.

To the Editor of Electrical Engineering.

Sir,—Could you put us into communication with any firm who manufacture glass boxes for storage batteries? Thanking you in anticipation of your kind reply.

Yours faithfully,
The Ronald Manufacturing Co.

Milner Works, Barnsbury Street, N.

BOOK REVIEWED

High-Speed Dynamo Electric Machinery. By Messrs. H. M. Hobart and A. G. Ellis. 497 pp. 9¼ ins. by 6 ins. 355 illustrations. (London: Chapman and Hall.) 25s.

This volume continues the series which Mr. Hobart has been engaged on for some years, dealing with electric generators and motors from the designer's and constructor's point of view. The importance of the subject of high-speed machines has rapidly developed, and, apart from such isolated Papers and descriptions as have been published in the technical Press, there has been no really comprehensive book of reference until the appearance of the one under review. The authors have been fortunate in obtaining the assistance of over a dozen firms, all well known as manufacturers of turbine sets, and the foundation of the book-data, drawings, and photographs appears to be as nearly up to date as it is possible to expect.

The first 64 pages are devoted to general considerations and design coefficients, with a chapter on materials suitable for use in the construction of high-speed machines. The figures and curves in this section are stated to be "rough but fairly representative values" for normal designs, and are interesting as indicating the authors' ideas based on the analysis of such designs as they have confidence in. On pages 46, 48, and 51 there are given three most instructive sets of curves, showing the influence of low-loss core material on the cost and heating of high-speed machines. Presumably these curves are calculated on the sheet-maker's guarantees and not on core-loss tests of actual machines, which would include losses due to building the core.

Perhaps the most important section of the work is that devoted to alternating-current generators (254 pages), in keeping with the authors' frequently expressed view that turbine speeds are more suitable for alternating- than for continuous-current generators. About 65 pages are usefully devoted to the broad considerations of design before studying the best form for the detailed designs of different sizes with their possible speeds and frequencies. The preliminary chapters deal exhaustively with the pressure regulation and with the influence of output and speed on size. The table on page 100, giving leading particulars of thirty alternators by well-known makers, with outputs of from 80 to 7,500 k.v.a., is of great interest, and would have even greater interest if the dates of manufacture had been given. Chapters VIII., IX., and X. deal respectively with the authors' designs of 400, 3,000, and 6,000 k.v.a. alternators at different speeds. The strong condemnation of two-pole designs will no doubt be accepted by most designers as more than a mere expression of opinion.

The question of excitation voltage for revolving field alternators is not dealt with specially, although it is an important one for large machines, where it is difficult to devise a satisfactory winding of such cross-section that the exciter and rotor slip-rings are of reasonable dimensions. The remaining chapters in the A.C. section deal with the construction of stators and rotors, and a few examples of existing machines are given in more or less detail. The concluding chapter analyses the stresses in the rotor.

Throughout the section on continuous-current generators the authors emphasise the fact that continuous-current machinery is not suited to turbine speeds, a fact recognised by most designers at present. It will be very interesting to read this section after a few years have elapsed, when the survival or extinction of this class of machine has determined itself. The principles of design seem to be so well understood that it would appear that nothing short of a miraculous development of special commutator brushes could make large D.C. turbo-generators successful, although something might be expected from reduced turbine speeds. As in the preceding sections, the broad considerations of design are dealt with first in a very clear and simple manner. A very large amount of work has been done by the authors in providing curves from which the preliminary dimensions of any machine may be seen at a glance. These tentative designs are not intended to be worked to, but form a valuable time-saving factor in putting the designer in possession of a mass of information in an easily digested form. Several excellent modern examples of continuous-current turbo-generators are illustrated and described, and a few pages are devoted to describing homopolar machines, which have reached a commercial stage in America. The stresses in revolving armatures are dealt with, and the important question of brushes and brush-holders is fully considered, without, however, any very definite expression of opinion as to the best type, metal, carbon, or compound.

It is impossible to review this book without a feeling of profound respect for the immense amount of personal work put into it by the authors, whose previous work entitles their opinions to the most careful consideration. The style of production of the book is uniform with the preceding volumes, but there are a good many obvious misprints. A table giving references to leading patents would have been well worth the space occupied.

A New Electric Railway in the Alps.—The construction of a new and important electric railway in the Alps has been commenced. According to *Elektrotechnik und Machinenbau*, the railway is to run from the Grisons district *viâ* the Poschiavo pass and Tirano, through Edolo to Brescia. The section Edolo Brescia is nearing completion, but the concession for the construction of the section Edolo-Tirano has not yet been granted.

London (Westminster and Kensington) Electric Supply Bill.—The Parliamentary Committee of the London County Council, in a report upon this Bill, state that the various protective provisions as to street works, &c., desired by the Council were agreed with the promoters so far as such provisions had been inserted in the London Electric Supply Bill, and Sir Luke White's Committee were urged by counsel for the Council to insert provisions which they had refused in the case of that Bill giving the Council the right to be heard on the question of the route of electric lines, and the same rights as a local authority under section 14 of the schedule to the Electric Lighting (Clauses) Act, 1899. The Councils of the City of Westminster and the Borough of St. Marylebone objected, and the Committee adhered to their decision in the case of the other Bill. The Committee think the Council should endeavour, as in the case of the London Electric Supply Bill, to obtain the amendments refused by the Select Committee as to the route of electric lines and as to powers for the Council under section 14 of the schedule to the Electric Lighting (Clauses) Act, 1899, and they recommend that all necessary steps be taken to secure the insertion in the Bill of the usual powers for the Council with regard to street works and the protection of the Council's property.

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TRANSFORMERS

Some Practical and Theoretical Considerations

Comparisons of Different Types.—The Paper on transformers by Messrs. A. P. M. Fleming and K. M. Faye-Hansen, of the British Westinghouse Co., on Tuesday of last week, before the Manchester Local Section of the Institution of Electrical Engineers, commenced with a general comparison of the rectangular and circular shell and core types indicated in Fig. 1. It was mentioned that for single-phase transformers alone the following types were used on a large scale :—Shell type with rectangular coils, as built by the Westinghouse Companies, the Siemens-Schuckert Works, &c. Circular shell type, as built by the British Electric Transformer Co. Core type, with rectangular and with round coils, as built by the Westinghouse Companies, the Allgemeine Electricitäts Gesellschaft, Johnson Phillips, and other firms.

Typical designs had been worked out for each type, and some figures were given as a comparison in the case of a 100-k.v.a 50-cycle transformer on the basis of iron-weight plus copper weight multiplied by three as giving a figure approximately proportional to the cost of actual material. From the figures given it was seen that the difference in the amount of material for the four types was very small. The rectangular shell type is in all cases (especially for high copper space factors) slightly superior to the other types, while the circular shell type for low copper space factors (*i.e.*, for high voltages) is somewhat inferior to the other types.

The Paper then passed on to comparisons on the basis of electrical performance, and iron and copper losses were worked out for all four types, both as power transformers with their maximum efficiency at full load and as lighting transformers with their maximum efficiency at two-thirds of full load. From the tables given, however, it was seen that the difference in electrical performance between the types is too small to be of importance in practice, though the difference in losses for the types is of the same order as the difference in the cost of the active material. All types are equally adaptable as power and lighting transformers.

In these comparisons all the most important electrical qualities of the transformers were taken into account, except the reactance, which together with the copper loss determines the regulation of the transformer at different power factors. This feature was accordingly considered for various concentric and interleaved arrangements of the windings, and it was finally shown that with suitably designed windings *any* regulation can be obtained with any of the above types. For the shell types it will generally not be advisable to use the single concentric winding, as the regulation at low power factors will be too bad. The double concentric winding, however, gives fairly good results, but for practical reasons this arrangement of winding is very seldom used for the rectangular shell type. For the core type the single concentric winding gives fair regulation, and the triple concentric winding very good regulation. If the interleaved winding is adopted, the core type requires a larger number of coils than the shell types for obtaining the same regulation. The possibility of obtaining any reactance for any type of transformer is also of interest from the point of view of banking of transformers of different types, for it is evident from the figures given by the authors that it is possible in any type of transformer to arrange the winding so that it will parallel with any given transformer of the same or of other type when the data regarding ratio, connections, and impedance voltage for the existing transformer are known. This is made much easier because it is possible for any given transformer and winding arrangement to alter the reactance by altering the ratio of copper to iron loss.

The important question of the relative cooling surfaces available with the different types was next gone into. From the figures given for the same typical set of transformers it was seen that as regards the cooling of the copper the core types in this respect are better than the shell types. Especially is this so in the case of the circular core type, as the surface copper to iron and iron to copper for this type of transformer to a large extent can be considered as active cooling surface without diminishing the space factors. The cooling of the copper of the rectangular core type, and still more of the rectangular shell type, can be greatly improved when the sandwich winding is adopted by spreading the coils—*i.e.*, by bending them outwards outside the iron. This increases the surface considerably without reducing the space factor, and is standard practice for Westinghouse transformers of these types. The circular shell type is, as regards the cooling of the copper, inferior to any of the others, but as regards the cooling of the iron, superior even to the rectangular shell type, as theoretically each punching has cooling ducts on both sides.

In investigating whether the assumption made in the above considerations of approximately the same copper space factor for the different types was justified figures were gone into which showed that except for the double concentric winding, where the core types will give smaller copper space factors than the others, the different types in this respect are approximately equal.

Influence of Steel Alloys of Good Magnetic Quality.—A given frame has for given space factors, &c. (*i.e.* given voltages) the same maximum efficiency, whatever its rating. If, therefore, for special reasons it is desired to obtain for a 50-k.v.a. transformer the same standard efficiencies as for the 100-k.v.a. size,

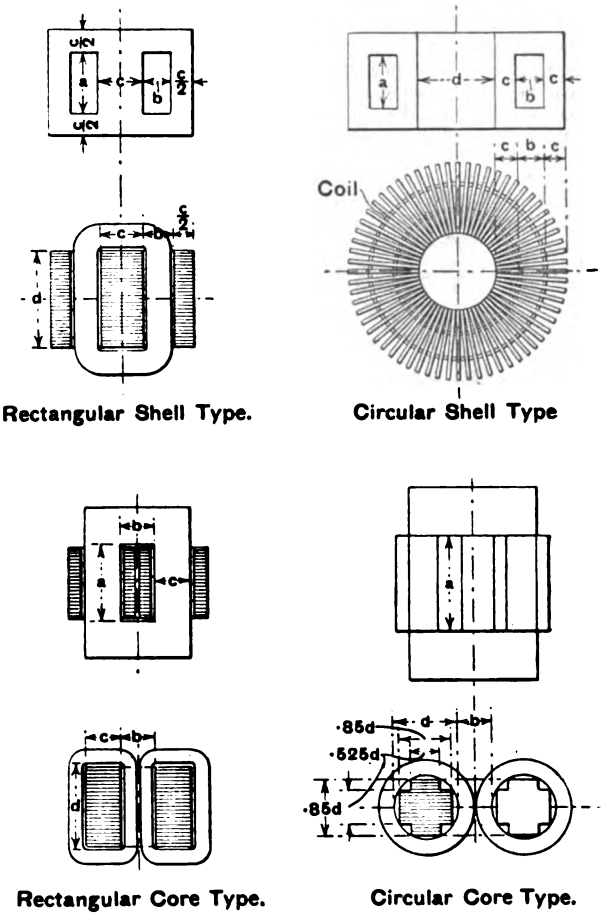

Fig. 1.—Transformer Types.

the same amount of active material will be required as for a standard 100-k.v.a. transformer. It is further seen that the demand for abnormally high efficiencies compels the manufacturers to try to use excessively high space factors, so that the insulation is cut fine and the reliability of the transformer reduced. The metallurgist has, however, assisted the manufacturer in this matter by offering alloyed iron having considerably better magnetic qualities than the material previously obtainable. If, for instance, a special alloyed iron having approximately 60 per cent. losses at the same induction and periodicity compared with ordinary iron is employed, then the same maximum efficiency can be obtained at 0·465 of the original weight. If the same efficiency is required at the same output as with ordinary iron, the product of induction and current density can be approximately 2·75 times larger than before.

The most economical ratio of copper and iron losses.—In many hand-books, &c., it is stated that the ideal condition is to obtain the maximum all-day efficiency. This, however, continue the authors, is not correct, as it is based on the assumption that the price per unit is constant, independent of the load of the generating station. It must, however, be taken into account that the iron loss goes on always, and therefore corresponds to 100 per cent. load factor, while the copper loss

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has its maximum when the load is maximum, *i.e.*, the copper loss increases the peak load, so that the unit of copper loss will cost considerably more than the unit of iron loss. To

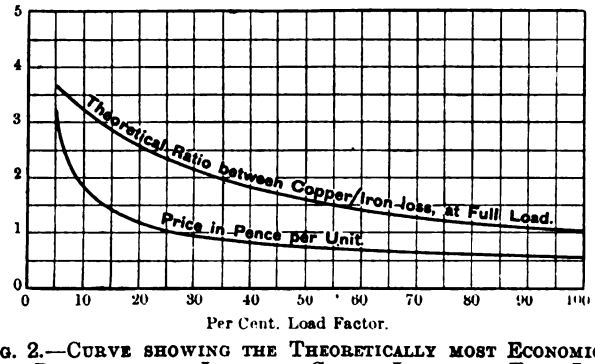


FIG. 2.—CURVE SHOWING THE THEORETICALLY MOST ECONOMICAL RATIO BETWEEN IRON AND COPPER LOSSES AT FULL LOAD FOR GIVEN LOAD FACTOR AND PRICE PER UNIT.

treat the subject mathematically in a simple manner, the authors assume that the load per day consists of full load for a time of $24 \times a$ hours, corresponding to the load factor a (the rest of the time no load at all), and that the price per unit b_a alters with the load a as per curve Fig. 2.

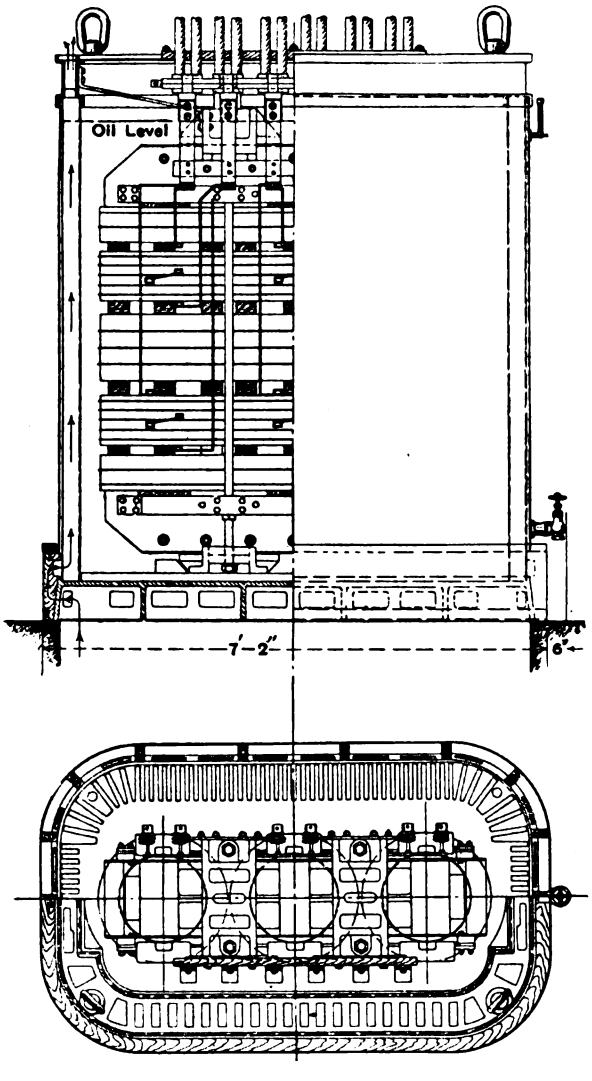
The values are given in the curve in Fig. 2.

It would, however, be good practice to make the ratio between copper loss and iron loss still smaller than according to this curve for the following reasons:—(1) The iron loss increases somewhat more slowly than proportional to the square of the induction. (2) The larger the ratio between copper and iron loss the smaller will be the wire used, whereby the copper space factor will be reduced and the losses and the price accordingly increased. (3) The smaller wire and the larger number of turns means a more expensive transformer. (4) A high copper loss means bad regulation, which will have to be compensated for by the use of cable of larger dimensions, &c.

The authors therefore recommend that for ordinary voltages the ratio between copper and iron loss at full load should not be larger than about 80 per cent. of the values given in the curve. For transformers for very high voltages and comparatively small outputs the ratio between copper and iron loss should be considerably lower.

Comparison of Methods of Cooling.—The most important practical difference between types of transformers is the method of cooling. Efficient cooling is, of course, essential to minimise the fire risk, to prevent deterioration of the insulation, ageing of the iron, and increase in copper loss.

The different methods of cooling in actual service are:—Natural draft; oil insulated self-cooling (O.I.S.C.); air blast: oil insulated air blast (see Fig. 3); and oil insulated water-cooled with cooling either internal or external.



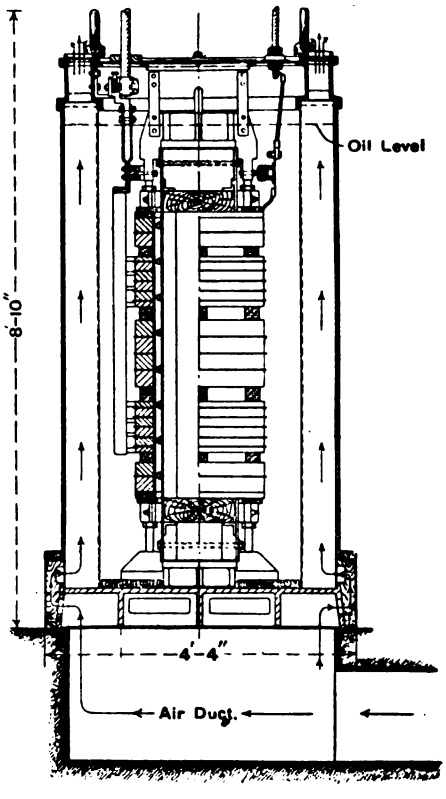


FIG. 3.—THREE-PHASE OIL-INSULATED AIR-BLAST CIRCULAR CORE TYPE TRANSFORMER FOR 1,700 K.V.A. 5,000 VOLTS, 25 CYCLES.

The iron loss is X per cent. of the full-load output of the transformer. The copper loss at full load is Y per cent. of the full output. According to a previous assumption the product of $X \times Y$ will be constant for a transformer of a given size and price.

The price for the losses $(X \times 24 \times b_{(a=1)} + Y \times 24 \times a \times b_a)$, should be a minimum. From this it follows that the most economical ratio between copper loss and iron loss is—

$$\frac{X}{Y} = \frac{b_{(a=1)}}{a \times b_a}.$$

The first two types possess the advantage of being entirely self-cooling, and do not require any auxiliary apparatus such as blowers or pumps, but practically the limits in output for which the natural draft type can be economically built are very narrow, since as the size of the transformer increases, the exposed surface per unit volume of active material decreases rapidly. The O.I.S.C. type can be built for very much greater capacities than the natural draft type, since the heat conduction between metal and oil is very much greater than between metal and air, but the natural draft type has the advantage of greater cleanliness,

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especially in case of repairs or alterations and ease of transport. On the other hand, in the O.I.S.C. type there is a greater uniformity of temperature throughout the active material, and the thermal capacity is increased, so that overloads can be carried for longer periods. Further, the O.I.S.C. type is capable of withstanding a higher temperature without injury than the natural draft type, due to the fact that the organic insulating materials being oil immersed do not deteriorate so rapidly. The scope of the natural draft transformer is also restricted by voltage considerations, whereas with the O.I.S.C. type there are no such voltage limitations owing to the high insulating and self-healing properties of the oil. Hence we find that the oil-insulated type is used for practically all really high-tension work, and in the opinion of the authors the natural draft type should be confined to very small sizes and low voltages. With the present available materials the economic limit for the O.I.S.C. type is about 1,500–2,000 k.v.a. at 50 periods.

In the remaining types the output, both from a theoretical and practical point of view, is unlimited. Of these types, the oil-insulated water-cooled can be adantageously used only where there is an abundant supply of cheap water at a low temperature. When cheap water is not available air-blast types should be used for large units. The ordinary air-blast type without oil insulation is the one that has hitherto mostly been used under such circumstances, but its safe application is limited by voltage; and further, this type is dependent on the continuity of the air supply, since if this fails the transformer would in a very short time attain a dangerous temperature. On the other hand, the oil-insulated air-blast type, as well as the oil-insulated water-cooled types, owing to the large thermal capacity of the oil, can carry their full load without injury for a considerable time should the air or water supply fail.

With regard to the safe-limiting temperature conditions for transformers, it is important to keep this down as low as possible, since the depreciation of insulation and ageing of iron depends on the temperature attained. This temperature should not for any length of time exceed about 85° C. (German Normalien 95° C., A.I.E.E., 75° C. at full load, and 90° C. at overload.

With transformers of the forced cooled type the temperature of the cooling medium (air or water) can usually be easily kept low enough, and the air temperature of the transformer chamber is of secondary importance. In the self-cooled types, however, particularly for large units, special precautions must be adopted to ensure adequate ventilation of the transformer chamber.

Insulation.—A matter not less important than temperature is that of insulation. Broadly speaking, there are two considerations to be observed which apply to all types of transformers. The external insulation usually gives very little trouble, but the insulation between the various parts of individual coils requires careful consideration. It must be remembered that during sudden changes of potential the voltage across the terminal portions of the high-tension winding may for a short time be raised to many times the normal value, so that for large transformers for really high voltages it is becoming standard practice to specially insulate the end turns, except in such cases where the necessary protection is afforded by heavily insulated choking coils arranged outside the transformer in series with the high-tension winding. In the case of oil-insulated transformers of very high voltages, say, of 100,000 and upwards, the principal insulation difficulty is not in protecting the windings, but in bringing the terminal conductors safely out of the transformer case. This problem is somewhat the same as that of insulating a high-tension cable, except that there is the added difficulty of obtaining sufficient creepage surface in the limited distance between the transformer terminals and case. A form of terminal insulation which has been latterly introduced for dealing with this problem in very high-tension transformers consists of alternating cylinders of insulation and metal foil wound on to a metal tube which constitutes one of the terminals. The consecutive layers of insulation are of similar material and thickness, and the metal foil cylinders have each approximately the same area, so that in accordance with the law for condensers of similar capacity in series, the potential gradient across the entire dielectric thus composed will be uniform. This permits an economy in the total radial thickness of material required, and prevents the greater part of the stress falling on a small thickness of insulation nearest the terminals. In laying out the windings so as to ensure the best disposition of insulation, care must be taken not to lose sight of their mechanical rigidity.

While under normal working conditions the mechanical stresses will be very small, these may become appreciable during transit and erection, and especially also after the transformer is in service in case of short-circuits on the secondary side. This point in the design of transformers has not until recently received the attention it deserves, and even in some modern designs by prominent makers no provision has been made for dealing with such stresses. It must be remembered that the electromagnetic stresses developed are proportional to the square of the current flowing, and in modern transformers having very close regulation at low power factor the current on short-circuit may be from 50 to 100 times the normal full-load current, corresponding to 2,500 to 10,000 times the normal stresses. For instance, in the case of 0·1200-k.v.a. three-phrase transformer having a close regulation, the forces tending to displace the winding were calculated to be 2·8 tons for the coil nearest to the yoke. Fig. 3 shows a construction adopted for taking care of these stresses. In this 1,700-k.v.a. transformer, which has not a specially close regulation, the forces on short-circuit are calculated to be about half this amount. It will thus be seen that the tendency for obtaining closer and closer regulation for transformers is a somewhat dangerous one, especially if the size of the power plant is such that the voltage is maintained if a short-circuit takes place on the secondary side of the transformer.

Mechanical Features.—The following comparison of the mechanical features of the various types was then given. The rectangular shell type affords a sound mechanical construction embodying a short iron circuit, easy method of building, all joints interleaved, freedom from humming, and no bolts are required through the laminations. The rectangular core type is constructed either on the same general lines as the shell type, or it may be built on lines which conform more readily to the general ideas of core-type transformers. In the latter case the cores and yokes may be interleaved or arranged with a butt joint between them, and with this type either concentric or sandwiched windings may readily be used, whereas in the former type the sandwich winding is preferable. For large sizes the circular core type construction requires the use of bolts through the laminations to ensure a really rigid mechanical construction, and is generally built with a butt joint between top yoke and cores, which affords an easier means of assembly and removal of the coils than does the shell or rectangular core type having interleaved joints. With this type either the sandwich or concentric winding may readily be used. Regarding the circular shell type the authors have had no experience in the building of the magnetic circuit, but from the appearance of the finished transformer there would seem to be some difficulty in making a really substantial mechanical job of securing the laminations. With this type probably the triple concentric or sandwiched windings are usually adopted.

Oil Tanks.—The Paper then passed on to the difficulties in the construction of oil tanks absolutely free from leakage, but stated that with suitable materials and design, and expert workmanship, leakage troubles can be satisfactorily overcome. For small sizes of transformers it is customary to use cast-iron tanks, galvanised or enamelled, so as to render them impervious to oil. For larger sizes, sides of corrugated sheet iron have been used, soldered to sheet-iron bottoms, and secured in deep grooves in top and bottom castings, or tanks of plain sheet iron having cooling ribs soldered on outside and inside. The tanks for oil-insulated water-cooled transformers are usually of plain boiler iron construction.

In conclusion, a few remarks were made on fire risk with oil-immersed transformers, a matter which is often much exaggerated.

DISCUSSION.

Mr. J. S. Peck (British Westinghouse Co.), who opened the discussion, agreed with the authors that there was very little difference between the various types of transformers as far as efficiency and weights are concerned, but there were many other considerations which influenced the decision of an engineer in the selection of a type. The possibilities of ventilating and of insulating, of supporting the coils mechanically, of quickly repairing in case of breakdown, adaptability for single-phase and poly-phase construction, for large and small sizes, &c., must all receive careful consideration. In one part of the Paper the author had stated that a high copper loss meant bad regulation, which would have to be compensated for by the use of cable of larger dimensions. There was another point in favour of close regulation, and that was the better light and higher meter readings which were obtained. Regarding fire risk with oil tanks, oil could not be burned unless it was first raised to a high temperature. With regard to the question of explosions in oil-cooled transformers, he had never thought it a very serious risk. He had made a number of tests himself, and could get small explosions inside the case, but only under very extreme conditions. Some engineers, however, insisted that their transformer cases should be explosion-proof, and many cases had to be built to stand 150 lbs. internal pressure.

Dr. C. C. Garrard expressed agreement with most of the conclusions expressed in the Paper, but criticised some of the

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methods by which they had been arrived at. For example, he had always found with the best design of transformer that the induction density was not the same right through the core. In the double concentric core type very low reactance and very good regulation could be obtained without very much subdivision, which was a great advantage from a constructional point of view. Then the number of sandwiches was kept low; and that came in more especially if earth shields had to be provided, and although these were the last things one should put in a transformer, they were sometimes specified. The great advantage of the "Berry" type of transformer is that the core is kept cool, but, as pointed out in the Paper, the winding was apt to get hot. As regards the explosion effect, what was much more dangerous in transformers was not the explosion due to the oil, but the explosive mixture which was formed, due to the varnish which is used for insulating purposes. The varnish used nowadays consisted generally of compound dissolved in benzine. If a transformer was opened after it had been in use, and not ventilated, an explosive mixture due to the benzine was often obtained.

Mr. K. VON KROGH made some remarks emphasising the important effect of the latest brands of steel alloys in rendering it possible to reduce the size of transformers of a certain output without diminishing their efficiency.

Mr. G. HARLOW spoke of some practical considerations which favoured the adoption of the rectangular shell type of transformer. As the manufacture was cheaper, more material might be put in for the same price, and correspondingly higher efficiency, or for the same efficiency a cheaper transformer could be built. Working at the same induction the shell types had only approximately 60 per cent. of the number of turns of the core type transformer. Thus the labour to be expended on winding was cheaper with the shell type, and this advantage was particularly noticeable in high-tension transformers. A further advantage of the rectangular shell transformer in connection with high-tension work was the ease with which series-parallel connections could be made. Further, the shell type transformer could be much more easily braced to withstand the forces which occur on short-circuit. Another advantage of the shell type was that there need be no bolts through the magnetic core, even in large sizes, and consequently the building of the iron circuit was much cheaper and the possibility of humming was much reduced. He then referred to the advances that have been made in transformers due to the introduction of alloyed sheet steel. These reductions in size and price were, however, not possible for transformers having a lower periodicity than approximately 30. Below this periodicity it was not possible to increase the induction as at present used in low periodicity transformers built with normal iron, owing to the excessive no-load current which results from any increase in this induction. Consequently what might be expected and was obtained in low periodicity transformers due to alloyed steel was a considerable increase in efficiency, but very little reduction in price. The rating with the alloyed steels was entirely limited by the large no-load current, resulting when inductions higher than 14,000 were used, at which induction the no-load current was approximately 10 per cent. Unfortunately the new alloyed steels were no better with regard to permeability than the steel hitherto used. Consequently, in order to still further cheapen the production of transformers having a reasonably high performance, the crying need of the transformer builder is an alloyed steel having the same losses as those recently produced but having a much higher permeability at inductions between 14,000 and 20,000 lines per square centimetre.

Mr. J. N. C. HOLROYDE wished to point out, from a user's point of view, that the troubles experienced with transformers were often due to the carelessness and ignorance of those who handled them, and not to defects in the transformers themselves, and related a number of amusing instances.

Mr. C. F. SMITH thought that the cooling qualities of the circular shell type had been rather underrated. The author had given the best relation between the copper and iron losses plotted as a curve, on a basis of the transformer load factor, with the price per unit at the station given below. It seemed to him that although the method employed by the authors for getting the theoretically correct ratio between the losses would be right if the losses exerted any appreciable influence on the output of the station, this was not the case for very small loads. Considering how small the iron losses were, he thought that the load factor which should be taken was that of the station rather than the load factor of the transformer.

Mr. A. P. M. FLEMING first replied to some of Dr. Garrard's criticisms of the data taken for the theoretical calculations. As an advantage of the circular core type of construction had been claimed the small reactance in the double concentric type of winding used with this type. In this connection he mentioned the difficulty in obtaining a really good mechanical construction for supporting the double concentric windings. The type of transformer which a company started out to build was usually the one they stuck to, as changing over from one type to another meant a large outlay, and this generally gave manufacturers a bias in favour of their particular type. In regard to earth shields, this was a matter in which all designers and manufacturers of transformers agreed with Dr. Garrard. Another very interesting point was the question of an explosive mixture formed due to the use of varnishes containing volatile matter, particularly benzine. Trouble due to this was not, he thought, very likely to occur when baking varnishes were used, which were dried at a fairly high temperature for many hours. The effect of frequency on the types did not alter the comparison already drawn, and with regard to the induction at different periodicities with transformers of, say, 40 periods and upwards, this could usually be increased, using the alloyed iron. When dealing with 25-period transformers, the price could not be reduced by using alloyed iron. In some cases, however, the efficiency could be considerably increased for a comparatively small increase in cost. In reply to Mr. Smith, the "free" iron surface in the circular shell type was smaller than in the case of the other types. It had been particularly pointed out that the cooling of the iron in this type was superior to that of the other types, due to the added cooling surface.

The "Telewriter."—The Postmaster-General has granted a licence for twenty-one years to the owners of the "Telewriter," an instrument for electrically reproducing at a distance handwriting and drawings. The "Telewriter" Syndicate is about to form a company, and will commence the establishment of public "Telewriter" exchanges in connection with the existing telegraph offices next year. The apparatus, which is already in use in several business houses, comprises a pencil used by the writer, the motion of which is resolved into two component motions. By means of two rheostats, controlled by these motions, two currents of varying strength operate magnetically on two levers attached to the receiving pencil, which reproduces completely the motion of the transmitting pencil. The Post Office has granted the use of existing telephone lines, and has undertaken to provide new lines when necessary, but will levy a royalty on the profits of the company, will charge rent for the lines, and has reserved to itself the right of buying the undertaking at fourteen years' purchase.

The Aluminium Corporation.—In the Chancery Division, on Friday, a motion for the appointment of a receiver and manager at the instance of a mortgagee to enforce a security was heard before Mr. Justice Eve. The plaintiffs were Lloyds Bank, Ltd. It appears that the bank has advanced the Corporation £26,200 under the terms of a trust deed, and that on November 26th £24,000 was due for principal, and £312 for interest. Having heard that judgment in another matter had been entered against the Corporation, and that execution was threatened, the present action was taken. During the proceedings it was stated that at the present time there are 110 tons of aluminium in stock at the company's North Wales works, and a quantity of material capable of making a profit of £2,500. The company, it was further pointed out, had favourable contracts in hand, and Mr. Justice Eve appointed Mr. Hawkins, the secretary, receiver and manager for the purpose of working out the material at the works.

Wireless Telegraphy and Telephony.—A new wireless telegraph station for the General Post Office is to be opened to-morrow by the Postmaster-General. It is situated at Bolt Head, near Kingsbridge, in South Devon, and stands some 350 ft. above the sea level. The apparatus installed is stated to be constructed partly under the Marconi patents and partly under certain patents controlled by the G.P.O. It is expected that messages from the public will be accepted for transmission early next year.

Arrangements are being made by the Admiralty for the establishment of stations on the east coast. According to the *Standard*, Ipswich and Cleethorpes have been selected as suitable sites.

The *Figaro* announces that the Minister of Marine has, in a letter to the Academy of Sciences, approved of the establishment of a service of signals from the Eiffel Tower, giving the Paris time to vessels at sea.

Regulations regarding the use of wireless telegraphy apparatus on board of foreign vessels in Norwegian waters have been issued by the Norwegian Government. These require that special permission be obtained before either wireless telegraphic or wireless telephonic communication can be employed in Norwegian waters, that the place and time of operation may be limited, and that the use of such apparatus is to cease immediately at the request of the Admiralty or authorised persons. No vessel lying in a Norwegian harbour within 5 kilometres of the nearest telegraph station may use its wireless apparatus for communication except to prevent disasters. Intercommunication between foreign warships in Norwegian harbours is allowed, however, under the conditions above mentioned. In all cases the provisions of the International Telegraph Convention must be observed.

Further experiments in wireless telephony are being carried out by Prof. Majorana in Italy. Communication was maintained last month between the Island of Laprera and the meteorological station on the Monte Mario, near Rome, a distance of 170 miles, and it is reported that on Thursday last a conversation between Rome and Trapani (Sicily), over a distance of 312 miles, was carried on.

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SMALL TRANSFORMERS FOR METAL FILAMENT LAMPS

THE accompanying illustrations show a new pattern of auto-transformer for enabling 25-volt metal filament lamps to be used on ordinary alternating current supply circuits, which has recently been placed on the market under the name of the "Fulmen" auto-transformer, by Messrs. J. L. Cateaux & Co., of 10 Bush Lane. These transformers, which are of simple mechanical design, are entirely British-made, and advantage is taken in their construction of the magnetic qualities of the

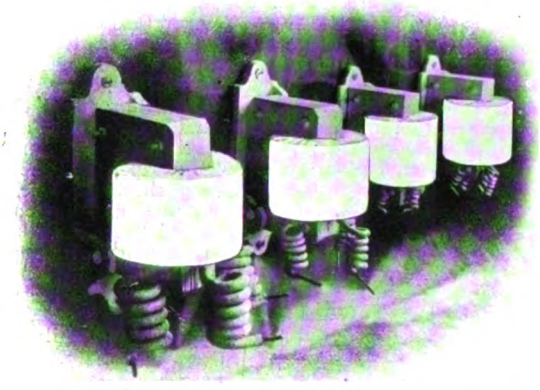


Fig. 1.—"Fulmen" Auto-transformers, House Service Pattern.

finest brands of transformer steel procurable. In their electrical design special attention has been given to efficiency, close regulation, and high insulation. In Fig. 1 is shown the house service pattern, which can be supplied either with a single pair of secondary terminals or for two or more balanced secondary circuits. With the latter arrangement a smaller transformer can usually be employed for the same number of lights, as the size is governed by the maximum out of balance load. In the case of shop lighting, office lighting, &c., where the lamps are turned on at dusk and turned off at closing time, a switch should be fitted, so that the transformer can be switched off at

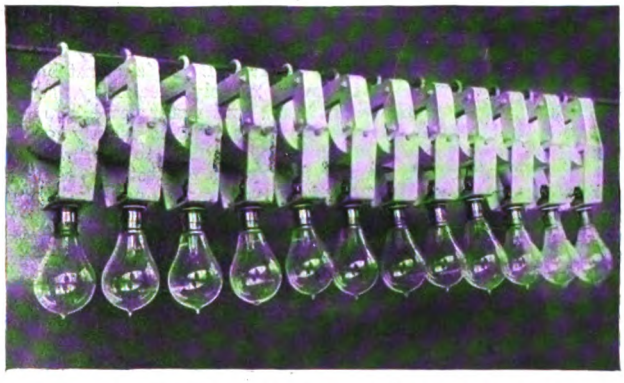


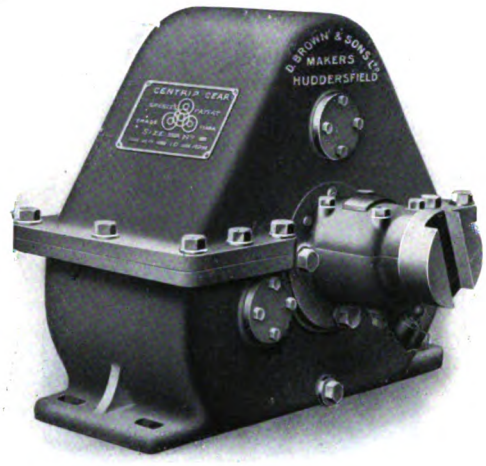
Fig. 2.—"Fulmen" Auto-transformers, Street Lighting Pattern.

closing time, and switched on again when light is required the following day; by doing this the open circuit losses will be a negligible quantity and the maximum saving in current consumption will be obtained. Fig. 2 illustrates another type of transformer which has been specially designed for street lighting purposes, and is intended to be hung inside the lantern hood. It can either be fitted with one or two lampholders.

A NEW REDUCTION GEAR FOR MOTORS

A NEW form of self-contained reduction gear for use with electric motors where speed reductions of from 10 to 1 to 20 to 1 are required has been put on the market by Messrs. David Brown & Sons, of Huddersfield, under the name of the Spence patent "Centrip" gear. This is a totally enclosed double reduction gear with straight line transmission, and consists essentially of a pinion gearing with three spur wheels, placed concentrically round it and equidistant from one another, which are keyed to shafts on each of which is also fixed a pinion which gears with a spur wheel whose axis is in line with that of the first pinion. The gears are mounted in a case which serves as an oil bath.

The primary nickel steel shaft runs in ball bearings, and is provided on its outer end with a flexible coupling to prevent any possibility of a bending strain being placed upon the shaft, and on the inner end is cut a pinion which gears with three spur wheels fixed to counter shafts placed concentrically around the primary shaft at 120° to one another. The counter shafts are placed one above, and two below, the centre line of the primary shaft, forming an equilateral triangle, and run in ball bearings. One of the wheels of these counter shafts is keyed solid, whilst the other two are bolted to fixed centres to allow adjustment. The pinions which are cut on the counter shafts gear in their



"Centrip" Reduction Gear.

turn with a spur wheel, which is keyed on the slow-speed shaft to be driven. As this wheel is equally driven by the three pinions it transmits pure torque, and therefore does not require a special bearing in the case for its shaft, the wheel being carried on the overhanging shaft of the machinery to be driven.

The enclosing gear box is in two pieces, bolted together on the centre line of the primary and slow-speed shafts; and its appearance is shown in the accompanying figure. The upper portion is readily removable, together with the counter-shaft and wheels it carries, and the lower half is provided with oil sight gauge and drain plug. A hand hole is provided for inspection and filling with oil. The gears are made in various sizes for maximum powers from 10 to 35 b.h.p.

Newcastle Showrooms of Simplex Conduits, Ltd.—A new branch establishment with extensive showrooms has been recently opened by Simplex Conduits, Ltd., at 61, 63 and 65, High Bridge, Newcastle. A special feature will be the stock of fittings suitable for the shipbuilding and colliery industries. The branch will be under the management of Mr. Alan G. Robson, who formerly conducted the business of the Eldon Electric Co., now incorporated with Simplex Conduits, Ltd. At the formal inauguration of the premises on November 12th a number of engineers well known in the North were present, and the com-

Newcastle Showroom, Simplex Conduits, Ltd.

pany, to the number of about 70, dined together at Tilley's Restaurant in the evening, with Mr. Henry Huggins in the chair. The speakers included Mr. J. E. Lloyd Barnes and Mr. Edgar Cross, and Mr. Waterhouse replied on behalf of the company. A very successful musical and humorous programme was provided. The accompanying illustration gives a view of the interior of one of the show-rooms.

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AN ALTERNATING-CURRENT LIFT CONTROLLER

MESSRS. W. GEIPEL & CO., of Vulcan Works, St. Thomas's Street, S.E., have recently put on the market a new form of "Schureman" lift controller, which has been designed for use with alternating current where the control is by a rope passing through the lift. The controller is made for two- or three-phase motors only, and is adapted for use where the lift is operated through a hand-rope passing through the cage. As will be seen from the illustration, which shows the 10 h.p. size, there is a reversing switch at the top, which is operated by the hand-rope. It has three definite positions, "up," "down," and "off" respectively; no intermediate positions are possible, so that accidental burning of the contacts is obviated. When the switch is closed, the motor starts with all resistance in circuit. This resistance, which is star connected, is cut out by short-circuiting switches operated through a cam shaft which

"SCHUREMAN" ALTERNATING-CURRENT LIFT CONTROLLER.

is actuated by a solenoid. This solenoid contains the only coil in the apparatus, and it is heavily wound with a large margin of safety. The rate at which the resistance is cut out is regulated by the adjustment of a dash-pot.

The arrangement is such that upon the failure of the supply or opening of the reversing switch by the movement of the rope, all resistance is instantly inserted, whilst it is not possible to reverse the direction of running without first inserting the resistance. The switches are of heavy construction with carbon contacts, whilst every part of the apparatus is readily renewable. The resistance material consists of German silver wound in coils, in which a large margin of capacity is provided. The sizes constructed range from 5 to 25 h.p.

P. & O. Batti Walla Society.—The second smoking concert of the season was held at the Great Eastern Hotel on Monday last, with Mr. Walter Riggs in the chair, and was very well patronised. The next informal monthly dinner will take place at the Holborn Restaurant on February 1st, 1909, as the first Monday in January was considered to be too near to the Christmas holidays.

National Telephone Company's Assessment.—An action has been pending between the National Telephone Co. and the Chorlton (Manchester) Union with regard to the assessment of the company's undertaking in that district. Hitherto in the provinces the company has been assessed at the rate of £1 per mile of wire, but the Assessment Committee of the Chorlton Union conceived the idea of assessing according to the earning capacity of the undertaking in their district, a principle that is already applied to railway and tramway lines. Upon the old basis, the assessment of the National Telephone Co.'s undertaking in Chorlton was £2,895, and under the new system this has been increased to £4,491. Originally the company opposed this, and the case was to have been heard last week at the Manchester Court of Session. The company, however, have now withdrawn the action, having, it is presumed, accepted the new principle.

INSULATING MATERIALS AT THE MARSEILLES ELECTRICAL EXHIBITION

ONE of the most complete exhibitions of insulating materials at the recent electrical exhibition at Marseilles was that of W. Weidmann, of Rapperswil, Switzerland. Among the items shown were several moulded pieces of a material composed mainly of asbestos, and intended particularly for high-tension apparatus. This material, which goes under the name of "Cornite," is said to withstand a temperature of 300° C., and under certain conditions a still higher temperature, without appreciable damage. It is also stated to be entirely non-hydroscopic; unaffected by atmospheric changes; mechanically strong, and capable of being ground and polished; and to be unaffected by continuous immersion in oil at a temperature of 70 to 80° C. Plates for preventing the spreading of arcs from circuit breakers, tramway-controller insulating plates, handles, tubes, and washers for high-tension apparatus, and other moulded articles, are made from this material. Another interesting exhibit was a selection of friction cones and pulleys of an artificial leather which, it is claimed, wears down much more uniformly than natural leather, besides being much cheaper than the latter. Press-spahn in various forms, including sheets in thicknesses varying between 0·1 mm. to 15 mm., was also to be seen. Bobbins and field-coil insulating frames of "Amianite," a vulcanised asbestos material, and a large collection of samples of insulating tapes, varnished linen for slot insulation, moulded mica pieces for commutators, and other insulating accessories, including plates made of an asbestos-cement, and specially suitable for the insulating plates of tramway and railway controllers, were also exhibited.

THE PROPOSED TAX ON ELECTRICITY IN GERMANY

IN last week's issue we gave some particulars of the opposition which is being organised in Germany amongst the representatives of the various electrical and gas interests to meet the proposals of the German Government relating to the taxation of electricity and gas. According to the current issue of the *Elektrotechnische Zeitschrift*, the Verein Deutscher Ingenieure, corresponding to the British Institution of Civil Engineers, has drafted a protest, and has submitted it to the Reichstag. The Verband Deutscher Elektrotechniker, which corresponds more or less to our Institution of Electrical Engineers, has associated itself with the movement. The protest, which concludes with an urgent appeal to the Reichstag to reject the proposals of the Government, points out the unjust and unpractical nature of the Bill, and the retarding influence it is bound to have on the commerce of the country, in that it proposes to tax what is equivalent to a raw material. It is unjust because it affects only two forms of energy, namely, electricity and gas, while poor quality furnace gas, steam and water power are free; also, because the amount of the tax depends merely on the amount of energy used without any regard to the value of the product obtained. Another serious defect is that the amount of electricity generated is taxed, and not the amount usefully applied, which in some cases may be less than 40 per cent. of that generated. The extension of the use of electricity and gas for power purposes in the mining and metal industries will certainly be retarded, and it is stated that the electrochemical works would not be able to compete with foreign works were the Bill to become law. The possible retrogression in the hygienic and social conditions of the people consequent upon a return to the earlier methods of lighting and heating is also commented upon, and it is stated that the revenue from these sources will fall considerably below that estimated owing to the reduction in the consumption of the two commodities which is certain if the Bill becomes law. Some of the almost insurmountable difficulties which will arise in the administration of the tax are then enumerated, among which are the measurement of large quantities of gas; the determination of the calorific value, which in some cases is continuously varying; the determination of the works' costs in the case of both supply stations and private plants; and the disputes that will arise on these questions between the Government officials and the industries. The necessity of a large body of expert officials conversant with the technical features of all kinds of generating plant is also emphasised, and it is claimed that this and other unforeseen expenses of administration, together with the diminished revenue as above stated, will cause the financial benefit to the State to be much outweighed by the general disadvantages to the industries concerned and the country at large.

Comparison of Natural and Induced Draught Systems.—In our account of the discussion on Mr. W. N. Y. King's Paper, on page 734 of last week's ELECTRICAL ENGINEERING, the author is reported to have placed the life of an induced draught fan outfit at about ten years. Mr. King kindly points out that this should really have been about 20 years, as he had known of actual cases of fans which had been running eight or nine years which would last in all probability as long again.

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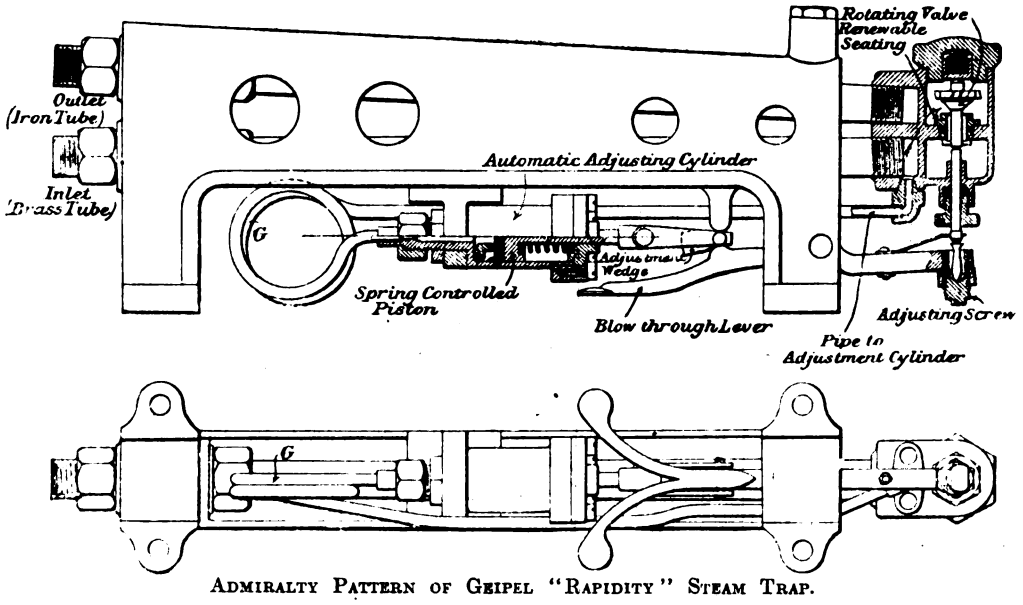
THE GEIPEL "RAPIDITY" STEAM TRAP

ALTHOUGH the Geipel steam trap for the automatic draining of steam pipes is well known in the form which has been on the market now for 10 years, the improved pattern, which was introduced this year, and which differs in some important respects from the old pattern, may not be familiar to our readers, and the following description will therefore be of interest.

The principle of the trap—namely, the contraction of a brass tube when the live steam in it is replaced by condensed steam—remains the same, and the main feature of the Geipel trap, which consisted in the multiplication of the contraction without the use of levers or cranks, is also retained in the new pattern. The point which distinguishes the new "Rapidity" trap from the old pattern is the fact that the valve is arranged so that it is held on its seat by steam pressure, instead of by means of an abutment against steam pressure as in the former pattern. There is thus no continuous strain on the expansion parts. The construction of the trap is shown in the accompanying figure.



ADMIRALTY PATTERN OF GEIPEL "RAPIDITY" STEAM TRAP.

It will be seen that the brass tube which forms the inlet, and is connected to the vessel or pipe to be drained, is at the bottom of the trap, and the iron tube which constitutes the outlet is at the top. In the valve body a passage leads from the entrance of the brass tube to the upper side of the valve, whilst the passage from the lower side connects to the iron tube; the pressure therefore comes on the top of the valve. When the trap is cold or full of water, the brass tube is contracted, so that the valve casing is accordingly pulled into its lowest position, and the valve spindle, which abuts against the lever, is in contact with the valve, and has raised it from its seat. When steam enters the brass tube, the latter expands and moves the valve casing upwards. The steam pressure closes and holds the valve tight on its seat, until water has again entered the brass tube and caused it to contract and again pull the valve casing downwards. Just as the valve opens, a rush of water takes place, which forces the valve upwards, and causes a large opening, and, therefore, a rapid discharge, whilst at the same time the rush of water catches the vanes provided on the periphery of the valve, and accordingly causes it to rotate and grind itself in at each discharge. A sharp blow through occurs at each opening until all the water is discharged, after which the valve is suddenly closed. This prolongs the life of the valve, because of the absence of that cutting action which occurs when water or steam are leaking through improperly opened valves. A lever for blowing through by hand or by foot is provided.

Although the "Rapidity" trap works with considerably greater ranges of pressure than the ordinary Geipel trap, yet, for the purposes of the Admiralty, who specify that a trap must be capable of working from atmospheric pressure up to 300 lb. per sq. in. without adjustment, Mr. Geipel has introduced a new means of automatic adjustment, which is illustrated in the figure. It consists of a cylinder, which is connected to the pressure side of the valve casing by the coiled tube *G*. The steam pressure on the piston is opposed by a helical spring, and the adjustment wedge moves outwards or inwards, according as the pressure rises or falls. This has the effect of raising the abutment by means of which the valve is opened. The higher the pressure at which the trap is to work, the higher is the position taken up by the valve casing, and the angularity of the wedge is adjusted so that it gives the precise movement required by the abutment to accommodate itself to the respective positions of the valve casing. Thus, if the steam in the pipes were at a low pressure, and consequently at a low temperature, the valve body would descend owing to the contraction of the brass pipe, and the valve spindle would strike the abutment, thus keeping the valve open and allowing steam to escape. The piston in the adjusting cylinder, however, is pushed back against the low pressure by the action of the spring, and as the wedge is pulled back, the abutment falls. It then requires a further cooling of the brass tube, caused by the collection of condensed steam in the tube, before the spindle will strike the abutment and open the valve.

Some of the advantages which are claimed for the new pattern are as follows: The range of pressure through which the trap operates without adjustment (and without the automatic adjusting device) is greater than in the former pattern; the valve seat is readily renewable, and the valve casing is easily cleaned by removing the valve and blowing through; finally, the action of the trap is intermittent and without dribbling. A demonstration of the action of the new pattern of trap was given on Friday last at the works of the makers, W. Geipel & Co., and there it was shown that a 1½-in. trap working under a pressure of 200 lb. per sq. in. could discharge one gallon of water in three and a half seconds, the valve closing directly the live steam reached the valve end of the brass tube, so that practically no steam is lost. The small surface exposed to the atmosphere ensures a very small loss due to condensation of steam in the trap itself.

London Electric Supply Bill.—A deputation of London Liberal members of Parliament waited upon the President of the Board of Trade on Thursday in reference to the terms of the London Electric Supply Bill as amended by Sir Luke White's Committee. The purchase terms now in the Bill were strongly protested against, and Mr. Churchill, it is understood, agreed to move an amendment absolutely limiting the terms of purchase to those of the Electric Lighting Act of 1882. At the time of going to press, however, no notice of this amendment had appeared in the Parliamentary papers. We are able to state, further, that in addition to a few drafting amendments, which are of no practical importance, the promoters have, since the Bill left the Committee, inserted a clause for the protection of the instruments at Greenwich Observatory.

Railway Assessment and Tramway Competition.—In the Appeal Court, on Monday, an action by the Assessment Committee of the Southwark Borough Council against the South Eastern & Chatham Railway Companies' Managing Committee was heard in respect of the basis of assessment of the companies' undertaking in Southwark. The companies claim the right to be placed upon the provisional valuation list for the purpose of assessment, their contention being that since the last quinquennial valuation the earnings of the undertaking have seriously diminished as the result of the competition by tramways, tube railways, and motor omnibuses. The case was decided against the Council in the Divisional Court, and the Appeal Court, consisting of Lord Justices Vaughan Williams, Buckley, and Kennedy, now upheld this decision. In giving judgment, Lord Justice Vaughan Williams relied upon a similar case in relation to the New River Co., in which it was laid down that if by any extraordinary or unlooked-for circumstances the value of the property assessed should be greatly increased on the one hand, or greatly decreased on the other, the then existing assessment ought not to continue, and that the taxes should be levied upon the altered state of circumstances. He thought that in this case the alteration in the circumstances of the earning capacity of the companies had been so permanent and substantial as to bring the case within this category.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907 %	Dividend Paid. 1908 %	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ltd.	10	7	5 ½*	10¼—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½*	9⅝—10	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10⅝	+⅛
Do. 4½% Debenture, Red.	Stock	4½	4½%	102—106	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	4 ½*	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—98	
Brompton & Kensington E. S. Co., Ltd.	5	10	5½*	8¼—8⅜	+⅛
Do. 7% Cum. Pref.	5	7	7%	8—8¼	−¼
Central E. S. Co., Ltd.. 4% Guar. Db.	Stock	4	4%	98—101 xd	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	4¼—4½	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—4⅝	
Do. 4% Deb. Red	Stock	4	4%	97—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3⅞—4⅜	+⅛
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3⅝—4⅜	−⅛
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
City of London Elec. Lt. Co., Ltd.	10	6	6%	0—10½	
Do. 6% Cum. Pref.	10	6	6%	12½—13	
Do. 5% Deb. Red	Stock	5	5%	123—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—103	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3½—4	
County of London Elect. Sup. Co. Ltd.	10	5	—	8½—8¾	−¼
Do. 6% Cum. Pref.	10	6	6%	10½—11	−¼
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	97—100	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	62—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¼—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6¼—9⅜	+⅛
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E.L.Co.	5	10	4% *	7⅜—8¼	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—100	
London Electric Supply Corporation	3	2½	—	1½—1⅝	+⅛
Do. 6% Pref.	5	6	6%	4¾—5¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	91—94	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	5¼—5⅜	−⅛
Do. 4½% Cum. Pref.	5	4*	4½%	4⅜—5⅛	−⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	94—97	
Newcastle-upon-Tyne Elec. Supply..	5	5	2½%	4¾—5⅛	
Do. (fully paid)	5	8	2½%	4¾—5⅛	
Do. 5% Pref. Do.	5	5	2½%	5⅛—5⅜	
Do. Do.	5	5	2½%	5—5⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½*	5¾—6½	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5% *	8⅝—9⅛	−⅛
Do. 7% Non-Cum. Pref.	5	7	7%	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½%	87—91	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅞—1⅛	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅝—3	+¼
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—¾	
Do. 7% Cum. Pref.	1	7	7%	1¾—1⅞	+⅛
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5% *	8¼—8⅜	−¼
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	−⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3% *	64—66	
Do. 4% Preferred	Stock	4	4%	84—86	
Do. Deferred	Stock	2	—	50—52	+1
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	86—88	
City and South London Cons.	Stock	4½	1½%	29½—30½	−1½
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—109	
Great Northern & City Pref. "A"	10	11¼d.	—	⅜—⅝	
Gt. Northern, Piccadilly & Brompton	10	4	2½*	7¾—8	−¼
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	1%	35½—36½	+½
Do. 3½% Preference	Stock	3½	3½%	85—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	74—77	−1
Metropolitan District	Stock	—	—	12¾—13½	+¼
Do. 6% Perp. Deb.	Stock	6	6%	123—126	
Do. 4% Deb.	Stock	4	4%	80—83	
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—27	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	92½—93½	−½
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅛—⅛	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	1½—1⅝	
Do. 6% Cum. Pref.	10	6	6%	3¾—4¼	+⅛
Do. 5% Perp. Deb.	Stock	5	5%	91—96	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	Amount of Share.	Dividend Paid. 1907 %	Dividend Paid. 1908 %	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£				
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅜—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼% On a/c of arrears	⅞—1⅛ xd	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Street Tramways Co.	4	4/6	2½%	⅜—⅝	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	67—72	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. % Cum. Pref.	1	5	5%	⅜—⅝	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	95—100	
Potteries Electric Traction Co. Ltd.	1	4	—	½—¾	
Do. 5% Cum. Pref.	1	5	2½%	½—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	1½*	4½—5	
Do. 6% Cum. Pref.	10	6	6%	10—11	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	81—85	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅝—1⅛	
Do. 6% Cum. Pref.	5	—	—	2⅜—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	58—61	
Do. 6% Pref. Ord.	Stock	6	6%*	102—103	
Do. Def. Ord.	Stock	1	—	16½—17⅛	−¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	87—89	−¼
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13—13½	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	101—103	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	100—102	
Do. do. (Mauritius Sub.)	25	4	4%	99½—101½	
Eastern Ext. Australasia & China	10	7	5%	11½—12	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½*	129—134	−1
Do. 3½% Pref.	Stock	3½	3½%	83½—85½	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	54—57	−1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6%*	116—118	−½
Do. 6% Cum. 1st Pref.	10	6	6%	10¼—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	101—103	
Western Telegraph Co., Ltd.	10	7	6%*	12⅜—13½	
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—½	
Do. 6% Cum. Pref.	1	6	7%	¼—⅜	
Babcock & Wilcox, Ord.	1	20	16%*	3⅛—4⅛	
Do. 6% Pref.	1	6	6%	1⅛—1⅜	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¾—7	+½
Do. 6% Cum. Pref.	5	6	—	6—6¾	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—¾	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	
Brush Electrical Engineering Co.	2	—	—	—	
Do. 6% Pref.	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	65—70	−3
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	49—53	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	−½
Do. 5% Cum. Pref.	5	5	5%	5½—5¾	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	1¼—1⅜	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅝—1⅞	+⅛
Do. 6% Cum. Pref.	1	6	6%	1⅞—1⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	½—¾	
Do. do (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	—	½—1⅛	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	6¾—7¼	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	11½—12¼	+½
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—107xd	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16¾—17¾	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	31—33	−½
Do. 4% Deb. Bds. Red	100	4	4%	101½—103½	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72 xd	

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PROPOSED SALE OF THE BATH ELECTRICITY UNDERTAKING

A LONG correspondence has taken place between the Board of Trade and the Bath Corporation with reference to the proposed sale of the municipal electrical undertaking to Mr. E. Schenk, representing the Bath and District Electricity Supply Co., the intention being subsequently to transfer the works to the Somerset and District Electric Power Co. The result of the correspondence, however, is that the Board of Trade has refused to proceed with the Provisional Order, for which an application had been made, to carry out the proposed transfer. Negotiations with regard to the proposed transfer had been taking place for about two years, and some surprise is expressed at this decision.

It was contemplated that the transfer should take effect as from March 31st, 1908, at which date the capital expenditure upon the undertaking was £159,423, but the purchase price, as stated in the draft deed of transfer, was £162,939, a difference of £3,516. The deed of transfer also provided that the sinking fund and reserve fund, amounting together to £36,000, should remain the property of the Corporation, thus the Corporation contemplated making a profit on the sale of £39,516. The Board of Trade regard it as contrary to practice on the transfer of an electric lighting undertaking that the undertaking should be charged with any profit accruing to the transfer, inasmuch as full price was being paid for plant which had been many years in use. Another point to which objection was taken was that the transfer was to be in perpetuity, it being pointed out that there are no powers for the Corporation to contract their successors out of the rights of purchase confered by Section 2 of the Electric Lighting Act of 1888. Even if such a clause had been passed, it would have been inoperative. The Board was also in some doubt as to the security the Corporation had in regard to the annual payments of the purchase money by the Bath and District Electric Supply Co. in the event of the works being made over by that company to the Somerset and District Electric Power Co. In spite, however, of very detailed explanations, both by the Corporation and by Mr. Schenk, the Board of Trade have refused to sanction the proposed transfer as pointed out above.

The Board of Trade is to be asked to receive a deputation from the Corporation in reference to the matter.

LOCAL NOTES

ABERDEEN: *Supply for Wireless Telegraphy.*—The agreement between the Corporation and the Admiralty for the supply of electricity to the wireless telegraph station at Stonybridge consists of nineteen clauses, and provides that the Corporation shall have completed all necessary works within six months of the execution of the agreement. The supply will be three-phase current at 100 volts, and the price 3½d. per unit, the Admiralty guaranteeing a minimum payment of £350 annually. The Admiralty will also pay £1,000 towards the cost of laying the necessary cable, and £195, which is the cost of connecting the wireless telegraph station with the power house by telephone. The agreement is for five years from March 31st, 1909, after which it is terminable by either party on three months' notice.

Overhead Wires.—Notification is given of an application by the Corporation to the Board of Trade for consent to the erection of overhead wires for electric lighting purposes in the parish of Peterculter.

AUSTRALIA: *New South Wales: Tramways.*—The report of the Chief Commissioner, Mr. T. R. Johnson, on the working of the New South Wales Government tramways for the quarter ended September 30th, 1908, states that the revenue was £248,504, an increase of £20,014 on the corresponding period of last year in the money earned, and over 3,000,000 in the number of passengers carried; the total number of passengers during the quarter was over 42,000,000. Expenditure amounted to £192,806, an increase of £4,852 on the corresponding period of the previous year. The lines, which are principally worked by electric traction, have a total length of 133½ miles. A number of extensions will shortly be opened for traffic and the construction of other lines commenced.

BELFAST: *Tramway Running Powers.*—At the weekly meeting of the Electrical and Tramways Committee on Monday, a letter was read from Messrs. M'Lean & Sons, solicitors for the promoters of the Holywood tramways, as to arranging mutual running powers over their respective systems. The committee decided to leave the matter in the hands of the manager, Mr. Andrew Nance, and the Town Clerk for conference with the promoters, and report the result.

BIRKDALE: *Street Lighting.*—The Birkdale Electric Supply Co. are carrying out an experiment in street electric lighting by means of a number of 400-c.p. and 160-c.p. Osram lamps. The experiment will extend over three months, during which time the Council will institute a comparison of the respective cost and illuminating power of gas and electric lighting.

BRADFORD: *Tramways to Brighouse.*—General satisfaction is expressed locally at the inclusion of a tramway to Bailiffe Bridge in the Corporation's Tramway Bill next session. If sanctioned, this will open up communication with Brighouse, which at present has a very inadequate direct railway service or an expensive and lengthy, although more frequent, one *via* Halifax.

CLEETHORPES: *The Electric Lighting Order.*—The main provisions of the amending electric Lighting Provisional Order, of which the Council has given notice, are to reduce the number of streets comprising the compulsory area, and to extend the time granted by the original Order of 1900 for the carrying out of the works.

COLWYN BAY: *Tramway Extensions.*—The inhabitants of Old Colwyn are much annoyed by the delay in extending the line of the Llandudno & District Electric Tramways Co. to that village. It appears that the company some time ago agreed to contribute the sum of £3,000 as the cost of the necessary road widenings which were to be carried out by the Council, but the latter require this sum to be paid down before the work is actually commenced. The company refuse to do this.

CROYDON: *Tramway Receipts.*—On the year's working, to date, there has been a decrease in the tramway receipts of £471, whilst the number of passengers carried has decreased by 82,771.

DUBLIN: *Street Lighting.*—A proposal is before the Corporation for the expenditure of £1,550 upon public electric lighting in the North Circular and Drumconda Roads.

FELIXSTOWE: *Diesel Engine Generating Set.*—With reference to the recent advertisement of the Council for a Deisel oil engine and dynamo, it was stated at the last meeting that the Chairman of the Lighting Committee and the Electrical Engineer have visited several towns, and inspected various installations of similar plant, and their general impression is that the proposed engine will be satisfactory. Particular points upon which investigation has been carried out have reference to noise, vibration, reliability, and nuisance.

GOLBORNE: *Electric Lighting Provisional Order.*—The Board of Trade have communicated with the Council with reference to the steps which are likely to be taken by the Council towards putting into effect the Electric Lighting Order of 1905, which stipulates that works in the compulsory area should be completed within two years.

HASLINGDEN: *Electricity Supply.*—Mr. H. W. Handcock (Messrs. Handcock & Dykes) has been instructed by the Council to interview the Accrington and Rawtenstall electrical engineers respecting the present and future supply of electricity for tramway purposes. Mr. Handcock will present a special report, also containing an estimate of the cost of the erection of a power station in conjunction with the new destructor works.

Electric Lighting Provisional Order.—The Town Council has decided to apply to the Board of Trade for an extension of time allowed for putting into force their Electric Lighting Order for 1899.

HESSLE: *Electric Lighting.*—Now that the Hull Corporation have powers to supply electricity outside the confines of the City, the Hessle Council have again approached them in connection with a supply in their district. The Hessle Council has an electric lighting provisional order, and a deputation is to wait upon the Hull Corporation to endeavour to arrange terms for the working of the Hessle order.

HOVE: *Electric Supply Charges.*—The petition to the Board of Trade by the Corporation for a reduction in the charges for electric supply by the Hove Electric Lighting Co. has been decided in favour of the company.

LIVERPOOL: *Proposed Power Sub-Committee.*—A proposal by Councillor Muspratt that a sub-committee should be appointed to control the production and distribution of electric power by the undertakings of the Corporation was defeated.

LLANDUDNO: *Tramway Extension.*—The Llandudno & District Electric Tramways Co. has informed the Council that it is impossible for them at present to make any statement with regard to the extension of their lines from Llandudno West Shore to Deganwy. The matter has been referred to a meeting of the whole Council in order to ascertain whether pressure can be brought upon the company to carry out their obligation with regard to this extension.

LONDON: *London County Council: Tramways.*—The traffic receipts upon the Council's tramways from April 1st to November 28th of this year amount to £1,030,712 from lines worked by electric traction, and £196,105 from lines worked by horse traction, or a total of £1,226,817. The receipts for the corresponding

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period in 1907 under the same heads were £609,399, £279,007, and £1,088,406 respectively.

London County Council: Tramways.—The overhead tramway system of the Council from Brixton Road to Denmark Hill has now been completed, and the Board of Trade inspection carried out. A through service is worked with the conduit system of the Council, and it is stated that the operation of changing over from the conduit to the overhead system, or *vice versa*, takes but a few seconds, and works very satisfactorily.

Marylebone: Street Lighting.—With regard to the proposal made by the Electric Light Committee of the Borough Council to light certain of the ordinary street lamps within the borough by means of electricity, in the place of gas lamps in use (ELECTRICAL ENGINEERING, December 3rd, page 724), the Council, at their meeting on Thursday, approved the recommendation of the Special Committee appointed to consider the matter, to accept the offer of the Electric Light Committee to light the 1,964 lamps affected in those streets where electric mains are now laid, the existing lamp standards and lanterns being utilised, at a lighting and maintenance cost of £8,650 per annum, compared with £8,818, the amount paid for gas lighting. In 1,114 single-burner lamps will be installed one 50-c.p. Tungsten lamp, 827 double, with two 40 c.p., and 23 triple, with three 40 c.p., which will give an average light 2½ per cent. greater than that now shown by photometric test to be actually obtained from the gas system at present in vogue.

Paddington: Tramways.—The Borough Council have confirmed the recommendation of its Works Committee to offer strenuous opposition to the County Council's proposal to construct a tramway from Harrow Road to Maida Vale, by way of Sutherland Avenue. It is contended that the proposed line would depreciate the value of property in Sutherland Avenue and streets adjacent thereto, and that, as it would not link up any existing tram service, it would serve no useful purpose.

MALVERN: *The Trackless Trolley System.*—The proposal by a private syndicate for the sanction of the Corporation to the introduction of the trackless trolley system has been rejected. The Streets Committee, who recommended that the proposal be not entertained, seem to have been largely influenced by the fact that it would have been necessary to instal additional generating plant to the value of £5,000 to cope with the additional load, and felt dubious as to the commercial success of the omnibus undertaking. In the event of failure, they say, they would have been left with this plant on their hands.

MIDDLESBROUGH: *Electric Supply Undertaking.*—For the six months ended September 30th, the electricity undertaking shows a profit of £539, and Mr. H. M. Taylor, the Electrical Engineer, anticipates an improvement of about £1,000 at the end of the year compared with the position last year. Although, in consequence of the strike, the revenue had decreased considerably, the profits exclusive of interest and sinking fund at the present time are £2,105 against £1,565 last year.

MIDDLESEX: *Extension of County Tramways.*—A petition has been presented to the County Council in favour of extending the tramways from Highgate through Muswell Hill into Southgate. There is, on the other hand, considerable opposition to the proposal.

OLDBURY: *Proposed Tramway.*—The Potteries Electric Traction Co. is to be asked to consider the construction of an extension of their tramways between Oldbury and Blackheath.

OLDHAM: *Tramway Finances.*—A discussion took place at Thursday's Council meeting upon the finances of the tramways department. Complaints were made that the reserve fund for renewals is not sufficient, and other criticisms were levelled at the undertaking. The Chairman of the Tramways Committee said that the Finance Committee had £29,600 for the relief of rates which really ought to have been invested in the tramway sinking fund. He also expressed the opinion that the assessment of the tramways should be reduced by at least £3,000, and that if the Committee got fair play in these matters, the tramways would undoubtedly be run at a profit.

PENMAENMAWR: *Electric Lighting Provisional Order.*—The Board of Trade have communicated with the Council as to the possibility of their taking action in the near future with regard to their electric lighting order. As a matter of fact, the period allowed for the establishment of works has now expired. In a discussion upon the matter last week, it was pointed out that the North Wales Power Co had obtained authority to supply in the district, but has not done so, and eventually the Town Clerk was instructed to prepare a report dealing with the position of the Council and the Power Company in the matter, for the information of the Board of Trade.

ROTHERHAM: *Proposed Electric Lighting Extension.*—The extension of the electric supply system to the district of Wincobank is now engaging the attention of the Electricity Committee. The Borough Electrical Engineer is to prepare alternative schemes for extending the existing mains there or erecting a new power station.

RUSSIA: *Electric Railway.*—A project, for which foreign enterprise is responsible, for connecting St. Petersburg with Finland by means of an electric railway, is under consideration. It is proposed to utilise the Imatra waterfall.

TASMANIA: *Launceston Tramways.*—According to the *Australian Mining Standard*, the Launceston Council have decided to construct tramways on the principle of the debenture system, provided the terms and conditions to be arranged with the London tramways group are satisfactory. Before finally settling the matter the fullest particulars will be placed before the citizens, and a plebiscite taken, when, if the citizens approve, the trams will be undertaken by the London tramways group. The main heads of the agreement are as follows:—(1) A price to be mutually agreed to. (2) Price to be paid to the constructing company by the Council's debentures carrying interest at a rate to be agreed upon, the debentures for the purpose of such payment to be taken at current market rates. (3) The running and maintenance to be undertaken and the profits therefrom received by the constructing company for a period of thirty years, and for a period of two years the company shall be personally responsible for the payment of the debenture interest. (4) During the period that the constructing company runs and maintains the tramways, they shall pay to the Council the interest on the debentures, and a yearly contribution as a sinking fund calculated to extinguish the capital cost within thirty years.

TORQUAY: *Trolley Tramways.*—The National Electric Construction Co. have placed a proposal before the Corporation for the use of the overhead system on the projected tramway extension to Paignton, and have asked for a concession for 42 years. The Council, whilst agreeing to the Bill, of which notice has been given, being allowed to go forward, have reserved their right of opposition to matters of detail, including the system which is to be adopted. At the meeting of the Council last week, when the matter was discussed, it was pointed out that the tramway company have intentions of converting the whole of the surface contact system in Torquay to the overhead system.

WEST HAM: *Street Lighting.*—As the existing contracts with the gas companies for street lighting will shortly expire, the Electrical Committee are to be authorised to submit an estimate in competition with the gas companies.

The L.G.B. Inquiry and Power Contracts.—The Electrical Committee have had again under consideration the L.G.B. inquiry, which was adjourned by the inspector (Mr. Hooper) because the representatives of the Council declined to give information as to the terms on which they supplied current to certain large power consumers. The committee have decided that the Council still decline to produce the contracts, and have authorised the Town Clerk to take such steps as he considers necessary to protect the Council's interests.

MIDDLESEX: *London United Tramway Co.'s Track.*—On Monday a conference was held by the local authorities through whose districts the tramways of the London United Tramway Co. run, for the purpose of considering what steps should be taken to compel the company to keep its track in a proper state of repair. After considerable discussion the following resolution was passed:—"That this conference of representatives whose districts are served by the London United Tramways, desires to call the attention of the London United Tramways to the condition of the tramway tracks, which are frequently out of repair and cause great annoyance and danger to users of the highways; that the company be urged to at once organise a proper and efficient system of repair in order that faults may be remedied as soon as possible after they develop; and that Sir J. Clifton Robinson, the managing director of the company, be invited to attend an adjourned meeting of the conference, to be held at the Council House, Hounslow, on Monday, the 14th day of December, 1908, at 4 p.m."

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ARGENTINE.—The *Review of the River Plate* states that a company is being formed to acquire an hydraulic concession on the Rio Primero, in Cordoba, and to erect a large electric power house. The capital is to be $3,000,000 m/n, and the Spanish Bank is said to be interested in the business.

The Senate of the Province of Buenos Aires have approved the Bill granting a concession for an electric light station in La Plata to Mr. A. Limousin.

CARLISLE.—A Local Government Board inquiry was held on Thursday into an application by the Corporation for sanction to borrow £1,000 for the purposes of the electrical undertaking.

DARWEN.—The Local Government Board has sanctioned the borrowing of £2,960, £460, and £637 for electrical purposes.

HEREFORD.—A Local Government Board inquiry is to be held into an application by the Corporation for sanction to borrow £8,000 for electrical purposes, which includes £2,300 excess expenditure.

INDIA.—*The Indian and Eastern Engineer* states that at a recent meeting of the Secunderabad municipality, an application was read from the Indian & Colonial Development Co. for a

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concession for supplying electric light to Secunderabad. It was resolved that general approval be given to the scheme, subject to expert criticism.

LONDON: *Hampstead.*—The Finance Committee of the London County Council recommend a loan of £5,900 for electric lighting purposes, repayable as follows:—Mains, £1,787, 30 years; plant, £1,191, 20 years; house services, £2,250, 12 years; and buildings, £672, 7 years; £35 being deducted from the amount which might be sanctioned for mains in order to make a round figure of £5,900.

Stepney.—The Finance Committee of the London County Council recommend a loan of £9,500 for electric lighting purposes, repayable in 50 years, at £3 17s. 6d. per cent. per annum.

Woolwich.—A loan of £2,625 for electric lighting purposes has been completed.

MAIDENHEAD.—An application is to be made to the Local Government Board for sanction to borrow £3,500 for the purposes of the electrical undertaking.

MANCHESTER.—The Electricity Committee invite tenders for the foundation work for 6,000-kw. turbo-generator set, pipe trench, and extensions to air filter house at the Stuart Street generating station. Particulars from the Secretary to the Department (fee £2 2s. returnable), and tenders to the Town Clerk by December 18th.

MEXICO.—The Guadalajara Electric Light & Power Co. (Mexico) intends to construct a new line of electric cables about 130 kilometres (81 miles) long, which will serve as a stand-by in case of accident. These cables will be carried on iron poles. Sub-stations will be erected every 15 kilometres (about 9 miles).

SOUTH AFRICA.—*The British and South African Export Gazette* states that a 500-kw. generator is required for the Bantjes Consolidated Mines, Ltd.

Miscellaneous

ARGENTINE.—The Government is to construct certain telegraph lines in the Pampa Central at a cost of 66,000 pesos (about £5,770).

BIRMINGHAM.—The proposals of the Tramways Committee given in our issue for November 26th, with regard to an application to the Local Government Board for sanction to borrow £92,047, for the purposes of adjusting the capital account in connection with the Corporation tramways undertaking, and for the reconstruction of a number of lines, have been sanctioned by the Corporation.

BRADFORD.—The Corporation invite tenders for the supply and erection of two 3,000-kw. turbo-generators with condensing plant, motor-driven auxiliaries, and steam exhause and circulating pipework. Particulars from Mr. T. Roles, City Electrical Engineer (fee, £2 2s. returnable), and tenders to the Town Clerk by December 23rd (see an advertisement this week).

LIVERPOOL.—The Local Government Board has sanctioned the borrowing of £12,400 for tramway extensions.

MIDDLESBROUGH.—As an experiment the Watch Committee has decided to instal arc lamps in some of the public streets.

SPAIN.—The "Gaceta de Madrid" of November 26th contains a copy of a decree authorising the Diputacion Provincial of Guipuzcoa to arrange for the installation and working, for a period of 35 years, of an inter-urban telephone system in the province. The Provincial Government will be required to pay to the State 10 per cent. of the gross receipts.

URUGUAY.—Señor Ricardo Acosta has been authorised to instal a telephone line 25 km. long from Paso de Manuel Diaz across the River Tacuarembo Grande to Estacion Dañado de Rocha.

A decree has been issued authorising the Government to undertake the working of telephone services, first in Montevideo, and afterwards in the various departments. The plans of Mr. A. R. Bennet are to be accepted for the installation of the service in Montevideo, and he is to make further investigations. Amongst these he is recommended to include the examination of the working of Strowger, Lorimer, and other automatic systems. A Chicago firm have applied for a concession for the installation, but the consideration of their application has been postponed.

A project of law authorising the Junta Economica Administrativa of Rocha to contract with Don Frederico Ribas for electric lighting works in the capital of the department has been issued.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Addition to factory of the British Ultramarine Co., Sugar House Lane, Stratford.

New ambulance and fire station at the Silvertown premises of the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.

School, Fairclough Street (968 places), St. George-in-the-East. T. J. Bailey, Architect to L.C.C. Education Committee, Victoria Embankment.

The Stepney Borough Council's Electricity Department has been asked to furnish an estimate for installing the electric light in the workhouse and infirmary.

N.—School, Shelburne Road, Islington (500 places). T. J. Bailey, Architect to L.C.C. Education Committee, Victoria Embankment.

N.W.—Alterations, Stonebridge Park Laundry, Barry Road, Stonebridge. Estate agent, S. Catling, Wembley Hill Station.

S.E.—School, Cow Lane, Rotherhithe (£14,465). T. J. Bailey, Architect to L.C.C. Education Committee. Builders, Kirk & Randall, Woolwich.

School, Sherington Road, Greenwich (500 places). T. J. Bailey, Architect, as above.

Church, Culmstock Road and Alfriston Road, Battersea. Architects, J. S. Quilter & Son, 1 and 2 Adam Street, Adelphi, W.C.

W.—Laundry at Church-path, Acton, for A. J. Smith, 176 Bollo Bridge Road, Acton.

PROVINCES.

ASTON (BIRMINGHAM).—New blocks, workhouse. Architects, Whitwell & Son, 1 Newhall Street, Birmingham.

BACUP.—Secondary School at Waterfoot (£11,500). Surveyor, W. H. Elce, Town Council.

BERKSHIRE.—Enlargement of Royal Berkshire Hospital (£20,000). Architect, C. S. Smith, 14 Bull Street, Birmingham.

BIRMINGHAM.—Roman Catholic Church. Architects, Nicol & Nicol, 117 Colmore Row.

Council School, Sladefield Road. Architects, Buckland & Farmer, Norwich Buildings, Congreve Street.

Additions, Central Library. H. E. Stilgoe, Surveyor to City Council; builders, W. & J. Webb, 256 Great King Street.

Tramway and emergency station, Miller Street. H. E. Stilgoe, Surveyor to City Council; builder, E. Crowder, 153 Farm Street.

BLACKBURN.—School (£7,218). Lewis Beard, Clerk to Education Committee.

BOURNEMOUTH.—New School (650 places). Architect, A. J. Lacey, Municipal Buildings.

BRISTOL.—Roman Catholic School, St. Nicholas (£3,000). Architect, The Very Rev. Canon Scholes, Basingstoke.

CHATHAM.—New School (£15,000). Architect, H. Dunstall, Chatham.

CHELMSFORD.—School (£20,000). Architects, C. & W. H. Pertwee, Bank Chambers, New Street, Chelmsford.

CHELTENHAM.—Residence (£2,500). Architect, T. Malvern, 21 Winchcombe Street; builder, A. Wilson, Swindon Road.

CHESTER.—Erection of Egerton Street School (£2,621). Builders, J. Mayers, Son & Co., Canal Side.

COLCHESTER.—Offices and new blocks at workhouse. Architect, C. E. Butcher, 3 Queen Street, Colchester.

DARWEN.—School (£7,218). Surveyor, R. W. Smith-Saville, Municipal Offices; builders, Lloyd & Millward, Blackburn Road, Darwen.

DROYLSDEN (ASHTON-UNDER-LYNE).—School, Fairfield Road (800 places). H. E. Clare, Clerk to Lancashire County Council, Preston.

GLOUCESTER.—Mission Hall and Sunday School, Seymour Road (£4,700). Architect, J. Fletcher Trew, County Chambers, Station Road.

Extensions to Shire Hall (£8,000). R. Phillips, late County Surveyor, Shire Hall, Gloucester.

GRANTHAM.—Secondary School, London Road. Surveyor, W. Shackleton, Town Council.

HANDSWORTH.—Isolation Hospital. Architect, T. Richardson, Town Hall, Handsworth.

HARROW.—Secondary School (£16,815). H. T Wakelam, Surveyor to Middlesex County Council.

HASLINGDEN.—A new infirmary and boiler-house is to be built at a cost of £21,048.

HEREFORD.—Additions, Free Library. Architect, J. Parker, City Hall, Hereford.

Secondary School, Cattle Market. Architect, R. Jack, County Hall, Hereford.

HOVE (BRIGHTON).—Catholic Church. Architect, B. H. Dixon, 35 East Street, Brighton.

LIVERPOOL.—The Mersey Docks and Harbour Board propose to introduce an improvement in the electric lighting arrangements at the Alfred and Morpeth Docks at an estimated cost of £960.

RUGBY.—Infectious Diseases Hospital. Architect, T. Willard, Market Chambers, Rugby.

SALISBURY.—Isolation Hospital (£8,000). Architect, H. Goodman, 13 Blagrove Street, Reading.

SHIPLEY.—The question of introducing electric lighting into the Saltaire Institute is under consideration.

SOUTHPORT.—Homœopathic Hospital. Architect, Percy Adams, 29 Woburn Place, W.C.

SWANSEA.—Glyn Vivian Art Gallery (£10,000). Surveyor, Geo. Bell, Town Council.

WATFORD.—Drill Hall, Park Avenue. Commanding Officer.

WEST HAM.—Theatre (£18,000). Architect, Bertie Crewe, 75 Shaftesbury Avenue, W.C.

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TENDERS RECEIVED AND ACCEPTED

ARGENTINE.—The *Review of the River Plate* states that the municipality of Florencio Varela has accepted the tender of Messrs. Otto Franke & Co. for an electric light station. The public lighting will consist of 40 arc lamps; price $25 per month.

BLACKBURN.—The tender of the Wigan Coal & Iron Co., Ltd., for the supply of steam and house coal to the electricity works has been accepted.

CAPE TOWN.—An order has been placed with the British Westinghouse Co. for the supply of motors from 3 to 20 h.p. during 1909.

CHATHAM.—The Council have accepted the tender of the British Thomson-Houston Co. for the following incandescent electric lamps:—8 c.p., £3 12s. per gross; 16 c.p., £3 12s. gross; 25 c.p., £3 12s. gross; 32 c.p., £4 16s. gross; and 50 c.p., £8 14s. gross.

COSTA RICA.—It is announced that a contract has been concluded between the Government of Costa Rica and a private company for the construction of an electric tramway between San José and Cartago, which are about 12 miles distant.

EAST HAM.—Messrs. Shadrack having completed the delivery of 900 tons of yard slack under their contract at 11s. 6d. per ton to the electricity undertaking, the firm offered to supply from 350 to 450 tons of this coal at 11s. per ton. This offer has been accepted.

GILLINGHAM.—The tender of the Medway Motor & Engineering Co. has been accepted for the installation of electric light at the naval ward of the Infectious Hospital.

GLASGOW.—The tender of Messrs. Allan Arthur & Ure, at £87 10s., has been accepted for relaying the cables for the electric lighting of the grounds of Ruchill Hospital.

ILFRACOMBE.—The Council has decided to accept the tender of the Gas Company for street lighting for the next five years, for the reason that this tender was £300 less than that of the Ilfracombe Electric Light & Power Co.

LONDON: *London County Council.*—The following tenders have been received for the roadwork and platelaying, exclusive of the supply of rails and special trackwork, in connection with the reconstruction on the conduit system of the existing tramways from the "Britannia," Camden Town, *via* Chalk Farm Road, Ferdinand Street, Malden Crescent, Malden Road, Southampton Road, Fleet Road, Agincourt Road, and Constantine Road, to Hampstead Heath. The tenders also contain provision for the execution of certain paving works outside the tramway tracks in connection with the widening of Southampton Road. Mr. W. Manders (recommended), £35,101; Mr. A. M. Coles, £35,737; John Mowlem & Co., Ltd., £36,343. The chief engineer's estimate was £36,444. Provisional sums, amounting to £2,800, are included in each of the tenders for alterations of pipes, mains, &c., the cost of which works cannot be more accurately estimated beforehand, and a sum of £2,000 is also included for any other contingencies which may arise.

The following tenders have been received for six fuel economisers at the Greenwich generating station:—J. Carter & Sons, £3,360; Edwin Danks & Co. (Oldbury), Ltd., £3,378; E. Green & Son, Ltd. (recommended), £3,874; Goodbrand & Co., £3,935; Roberts Bros., £3,957; A. Lowcock, Ltd., £3,960; Clay Cross Company, £3,990. The estimate of the chief officer of tramways comparable with the above-named tenders is £4,000.

The Highways Committee recommend that Messrs. Mountain & Gibson, Ltd., who have an order for six electrically-propelled stores transport vehicles for use in the tramways department, shall be allowed to sub-let as follows:—(i) to the British Westinghouse Electric & Manufacturing Co., Ltd., the electrical equipments; (ii) to Cammell Laird & Co., Ltd., the axles; (iii) to Hadfield's Steel Foundry Co., Ltd., the wheel centres; (iv) to Steel, Peech, & Tozer, Ltd., the tyres; (v) to the Tempered Spring Co., Ltd., Messrs. Sam Osborn & Co., and Messrs. Ibbotson Brothers & Co., the springs; (vi) to Messrs. William Shaw & Co., and Hadfield's Steel Foundry Co., Ltd., the steel castings; (vii) to Leys Malleable Casting Co., the malleable iron castings; (viii) to the Tutbury Engineering Company and Thornewill & Warham, Ltd., the iron castings; (ix) to Messrs. Player & Mitchell and W. S. Laycock, Ltd., the ratchet brake handles; (x) to Messrs. Player & Mitchell, Messrs. Hoskins & Sewell, and Messrs. William McGeoch & Co., the head lights, lighting fittings, and furniture.

Fulham.—The Council has accepted the tender of W. Edgar at £163 6s. 8d. for the supply of street lighting fittings in connection with the conversion of the whole of the 32-c.p. carbon filament lamps now in use in the borough to 200 volt 75 c.p. Osram lamps.

Woolwich.—The tender of the Cliver Arc Lamps, Ltd., has been accepted for the supply of carbons as follows:—(1) 12,000 pairs 18 mm. by 12 in. long, solid, for Oliver lamps, £84; (2) 40,000 pairs yellow-flame carbons with ordinary core, 7 mm. diameter by 12 in. long, 6·35 mm. by 12 in. long, for Oriflamme lamps, £110; (3) 2,000 pairs carbons, enclosed lamps, 11 mm. diameter by 12 in. long, solid, for Brockie Pell lamps, £4 10s.; (4) 2,000 pairs yellow-flame carbons with metal core for Excello lamps, 9 mm. diameter by 15 in. long, 10 mm. diameter by 15 in. long, £20 12s. 6d.; (5) 5,000 pairs ditto large, soft cores, for Johnson & Phillips lamps, 9 mm. diameter by 15 in. long, 8 mm. diameter by 15 in. long, £18 11s. 3d.; (6) 15,000 pairs yellow-flame carbons with metal core for Oriflamme alternating lamps, 7 mm. diameter by 12 in. long, £42 15s.; (7) 5,000 pairs flame carbons for Excello lamps, 8 mm. by 15 in., 9 mm. by 15 in., £45 6s. 3d. Tenders were also received from the following:—General Electric Co., Ltd., Siemens Dynamo Works, Ltd., Ship Carbons, Ltd., Brockie Pell Arc Lamp Co., Ltd., Sloan Electrical Co., Ltd.

LONGTON. The tender of Mr. J. Walters, jun., Ayshford Street, for the construction of two power-houses at the Corporation sewage farm has been accepted at £285.

SHIPLEY.—The tender of Electromotors, Ltd., at £339 for a 10-in. electrically-driven pump and switchgear at the sewage pumping station has been accepted. The following tenders for steam coal have also been accepted: Messrs. Fyfe, Kemp, & Co., 2,500 tons Bower's smudge, and 500 tons Bower's slack; Messrs. Locke & Co., 500 tons of slack; and Mr. John Wade, 500 tons of slack.

STALYBRIDGE.—The tender of Messrs. G. Robson & Co., of Sheffield, for the supply of a portable track grinder has been accepted by the Stalybridge, Hyde, Mossley, & Dukinfield Tramways & Electricity Board.

TUNSTALL.—The following tenders have been received for the installation of electric light in the Museum:—Barnett & Hyde, £13 10s.; Blackburn & Starling, £18 12s.; Evans & Son (accepted), £12 12s.

WEST HAM.—The Council have received tenders for overhauling the electric light installation at the hospital, and providing for the supply and fitting of transformers to reduce the voltage for the use of metallic filament lamps. The quotation of J. T. Halsey at £57 15s. has been conditionally accepted.

YORK.—The Electricity Committee have accepted the following tenders for stores during the coming year:—Engineer's stores, Messrs. G. Barnett & Co.; general stores, Messrs. Hardy & Holgate.

COMPANIES' MEETINGS AND REPORTS

BLACKPOOL, ST. ANNE'S & LYTHAM TRAMWAYS CO.—In this report for the year to October 31st, 1908, the directors regret that the adverse weather and bad trade caused a shrinkage in the traffic receipts as compared with the two previous years. The net receipts on the company's own lines, however, only show a decrease of £370 for the year as compared with last year, and this is considered satisfactory when compared with other tramways both in this district and throughout the country, showing as they do very much larger decreases. The agreement with the St. Anne's Urban District Council has been amended on terms mutually agreed upon between the Council and the company, and this has effected a saving to the company in its cost of electrical energy. The trustees for the debenture-holders have, upon the recommendation of the directors, intimated their intention of paying 2½ per cent. interest on account of the arrears of interest due on the debenture stock. The meeting will be held at Blackpool to-day.

BURMAH ELECTRIC TRAMWAYS & LIGHTING CO.—The report for the year ending July 31st last, from which it will be noticed that the revenue account shows a surplus of £1,676, against an adverse balance last year of £18. It is with great pleasure that the directors are able to report that the plague, which has been so destructive to traffic, seems now to have disappeared, and the receipts show some improvement. Their growth has been very gradual, as the return of the inhabitants has naturally been slow, but the improvement shown towards the end of the year has been fully maintained and tends to increase. After adding the surplus in hand, the revenue balance amounts to £5,201. In view of the fact that no provision has yet been made for depreciation, the directors propose to start a fund for this purpose by transferring thereto the sum of £5,000 out of this balance, leaving the sum of £201 to be carried forward.

INDIA RUBBER, GUTTA PERCHA & TELEGRAPH WORKS CO.—The accounts for the year to September 30th show, after provision for doubtful debts, a net profit of £52,946.

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Adding balance brought forward, and deducting £12,500 interim dividend paid in July, there remains a disposable balance of £89,480. The directors recommend a dividend of 15s. per share, free of income tax, amounting to £37,500, making, with the interim dividend paid in July, a total payment of 10 per cent. for the year, and leaving £51,980 to be carried forward. The general business of the company shows an increase compared with the results of last year in certain lines; in others, however, there has been a falling off. The electrical industry has been passing through a period of depression, from which we have not escaped. There has been little doing in submarine cable work, but the company's steamers have had occasional employment during the year and are in an efficient condition. The works at Silvertown and Persan have been maintained in their usual state of efficiency. Since the termination of the financial year the Board, under the authority granted by the special resolution of the shareholders of June 30th last, has issued 12,500 preference shares representing one-half of the amount authorised. These shares are cumulative preference of £10 each, and bear interest at the rate of 5 per cent. payable half-yearly on Jan. 1st and July 1st of each year, the first half-yearly payment falling due on July 1st, 1909. The board regret to state that the Hon. Henry Marsham died in July last. Mr. Marsham had been a member of the Board for twenty-one years and the chairman of the company for seven years. Mr. C. H. Moore and Mr. J. Y. Buchanan, the retiring directors, offer themselves for re-election. The meeting is on Tuesday.

MANX ELECTRIC RAILWAY CO.—The report and accounts for the year ended September 30th show gross receipts amounting to £33,734, and expenditure to £16,733. Adding the balance brought forward from last year, there is a sum available of £18,211. After deducting debenture interest (£9,000), interim dividend of 2¾ per cent. per annum on preference shares paid September 30th, 1908 (£3,580 10s.), and amount placed to reserve for special renewals (£1,000), there is a balance of £4,561, and after providing for balance of preference share dividend due in respect of the year ended September 30th, 1908 (£3,580 10s.), there remains a balance of £1,050 10s., which is carried forward. During the year the capital expenditure has been the sum of £299 14s. 6d., as per detailed Schedule No. 3 overleaf. The net result of the year's working has not been as favourable as last year's; bad trade has prevailed, especially in Lancashire, which has affected the spending powers of the people, and from the middle of August to the end of the season very unseasonable, rough weather was experienced in the Isle of Man, in consequence of which the arrivals in Douglas in September totalled 20,543 (or 32 per cent.) less than last year. Previous to August 15th the receipts were actually slightly ahead of last year. The passengers carried during the twelve months totalled 527,986, as compared with 546,666 during the previous twelve months. The receipts were £33,734, as against £35,345 the previous year; whilst working expenses amounted to £16,733, as compared with £16,772, and the ratio of working expenses to receipts has been 49·6 per cent. in 1908, as compared with 47·4 per cent. in 1907. The retiring director is Mr. Ernest Schenk, who, being eligible, offers himself for re-election. At the meeting on Tuesday the report and accounts were adopted.

WEST KOOTENAY POWER & LIGHT CO.—The report for the year to August 31st shows total receipts amounting to $297,670. After deducting working expenses a net profit of $193,906 is shown. After providing for interest on the recent issue of six per cent. bonds, sinking fund, and dividends on the preferred and common stock, a net balance remains of $52,069. The amount carried forward is $409,731, including the balance brought forward from the previous accounts. The demand for power is increasing, and is expected to continue to increase.

MISCELLANEOUS CITY NOTES

ANGLO-ARGENTINE TRAMWAYS CO.—A meeting will be held at Winchester House, Old Broad Street, London, on Friday, December 18th, at 2 p.m., for considering a scheme of arrangement between the company and the holders of the 6 per cent. debenture stock.

CANADIAN GENERAL ELECTRIC CO.—A dividend of 1¾ per cent. has been declared on the ordinary shares for the three months ending December 31st, being at the rate of 7 per cent. for the year. Last year a 2½ per cent. dividend was paid.

LONDON ELECTROBUS CO.—Applications have been invited this week for an issue of £40,000 6 per cent. convertible first mortgage debenture stock. The stock is secured by a first charge on the whole of the property of the company created by a trust deed in favour of the trustees for the debenture stockholders. Any portion of the stock may be redeemed by the company at any time after three years at £110 per cent. on a six months' notice. The stock is exchangeable at any time within three years for ordinary shares, but if not exchanged it is repayable on December 31st, 1919, at 110 per cent. In the prospectus it is stated that the Brighton Corporation has, since the introduction of the Electrobus, declared an intention not to renew the annual licence for petrol 'buses, and it is further stated that the introduction of an electric omnibus service is under consideration in the following, among other towns:—Glasgow, Harrogate, Cardiff, Torquay, Portsmouth, Oxford, Loughborough, Bath, Salisbury, Liverpool, Sheffield, Edinburgh, and York.

MEXICAN LIGHT & POWER CO.—A circular has been issued setting forth the reasons why the Board decided to abandon the negotiations with the Mexico Tramways Co. for an amalgamation of the two undertakings. The circular in question is a reply to those shareholders who desire that the provisions of the proposed lease should be considered, and has been issued in order to assist the shareholders to form a clear understanding of the questions at issue. The proposed lease involves a transfer to the Tramways Co. of all the properties, assets, and concessions of this company, and of the Mexican Electric Light Co., Ltd., and is irrevocable on the part of the power company, but is revocable on a six months' notice at any time by the Tramways Co. The circular also draws attention to the detailed financial proposals of the proposed lease, all of which, it is alleged, are against the interests of the shareholders of the Mexican Light & Power Co. The committee of shareholders have since issued a statement in which the other side of the question is set forth. This points out that the directors have not dealt in their circular with the question of the company's position should the lease not be entered into. The present contract with the tramways company, who are by far the Light and Power Co.'s largest customers, will expire in the ordinary course within the next three years, and there is grave reason to fear that unless some other arrangements are made, the tramways company will determine to generate its own power. Further, if the lease is not completed, the power company will have to find within the next two years a sum of upwards of $6,000,000 to pay off outstanding creditors and provide for immediate capital requirements. This sum the directors propose to find by means of fresh issues of securities and stock, and the placing of such securities and stock would surely react unfavourably upon the prices of the preference and common stocks of the company. The committee conclude that they are convinced, after careful and mature consideration, that a lease of the company's undertaking to the tramways company is in the best interests, and will conduce both to economies in working and a higher standard of efficiency in the management.

MEXICO TRAMWAYS CO.—The following have been elected to the Board of this Company: Mr. E. N. Brown, President National Railroad Co. of Mexico, and Mr. Julio Limantour, director National Railroad Co. of Mexico, National Bank of Mexico, International and Mortgage Bank of Mexico, and President National Dynamite Co.

MONTEREY LIGHT & POWER CO.—Subscriptions have been invited for an addition of £1,000,000 5 per cent. first mortgage debenture stock at 89 redeemable at par on August 1st, 1949, and secured by trust deed in favour of the British Empire Trust Co., Ltd., of London, England, and the National Trust Co., Ltd., of Toronto, Canada, as trustees, and will constitute the stock a first mortgage and charge upon:—(1) 22 miles of street railway in the city of Monterey and surrounding districts including a valuable concession from the Government. (2) The whole of the issued shares and securities of the Monterey Waterworks & Sewer Co., Ltd. (3) The whole of the issued shares of the Monterey Light & Power Co. (4) The whole of the issued shares of the Monterey Plumbing Co., Ltd. Monterey is the capital of the State of Nuevo Leon, Mexico. It has a population of about 90,000, is a great railway centre and distributing point, and is the first city in Mexico in manufacturing importance. There is at present an electric light service in Monterey supplied by the Monterey Light & Power Co.

SAO PAULO TRAMWAY, LIGHT, & POWER CO.—A quarterly dividend of 2½ per cent. has been declared.

VICTORIA FALLS POWER CO.—With reference to our recent note that an action was pending between the Victoria Falls Power Co. and the Rand Mines, Ltd., in relation to certain contracts for the supply of electric power, it is stated by the *African World* that this action has been withdrawn, and that the differences between the two parties have been overcome, with the result that the Power Co. will supply to the group of mines in question.

APPOINTMENTS AND PERSONAL NOTES

Mr. E. Elvy Robb, who was for seven and a half years Chairman of the Electricity Committee of the Tunbridge Wells Corporation, and is a past Mayor of the Borough, has been selected by the constituency of East Manchester as a prospective Unionist candidate at the next General Election.

The Electric Lighting Committee of Wimbledon Town Council received 71 applications for the position of drawing office and record assistant in the Electricity Department. Mr. David Walker, of Wimbledon, has been selected at a salary of £2 per week.

The Eastbourne Town Council have increased the salary of Mr. H. H. Bowlan, Mains Superintendent, from £2 15s. to £3 per week.

Mr. A. Forbes, who has been acting as clerk of works for the electrical work at the South-Western Hospital of the Metropolitan Asylums Board, has been appointed to take charge of the completed plant.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Son, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £65 to £65 10s. per ton (last week, £66 to £66 7s. 6d. per ton).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the Mutual Telephone Co. will be held at the offices of Messrs. F. Scott & Co., 6 Booth Street, Manchester, on January 5th, 1909, at 12 noon, for the purpose of hearing the liquidator's account of the winding up.

The last day for receiving proofs in the bankruptcy of E. P. Oliver, Electrical Engineer, carrying on business as Messrs. Newington, Priddle & Co., 50 Great Sutton Street, Goswell Road, London, E.C., is December 19th next. Mr. G. W. Chapman, Bankruptcy Buildings, Carey Street, W., is trustee.

The winding-up of the Isle of Man Tramways and Electric Power Co. has now been completed, and the liquidator has applied for his discharge.

DISSOLUTION OF PARTNERSHIP.—The partnership between E. Townsend and A. Chadwick, carrying on business as electrical and mechanical engineers at 118 Bark Street, Bolton, as Townsend, Chadwick & Co., has been dissolved.

NEW COMPANIES

BATLEY ELECTRIC CARBONISING CO.—This company was registered on November 21st, with a capital of £20,000, in £1 shares, to carry on the business of waste pullers and carbonisers carried on by S. Butterfield at Batley Carr as the "Batley Waste Pulling Co." The subscribers are S. Butterfield, Stanley Mill, Batley, and G. H. Briggs, Blindwell Ings, Ossett. Private company. The number of directors is not to be less than five nor more than eight; the first are S. Butterfield, G. H. Briggs, H. Hey, I. Holmes, and A. D. Smith. Qualification, £100. Remuneration, £5 per annum dividend. Registered office, Bradford Road, Batley.

BRITISH TUNGSTEN LAMP CO.—This company was registered on December 1st, with a capital of £12,000 in £1 shares, to adopt an agreement with the Metallfadenlampenwerk, Berlin, G.m.b.H., and the Syndicate Lamp Co., Ltd., for the purchase of the British and Colonial rights in the metal filament and metal filament lamp which belong to the said German company, and in which the Syndicate Lamp Co., Ltd., have an interest. The subscribers are L. Higginbottom, 14 Broomfield Road, Heaton Moor, engineer; R. Hilditch, 16 John Dalton Street, Manchester, solicitor; T. Dicken Jones, Eastwood, Huyton, manager; T. Walton, 36 Spring Gardens, Manchester, C.A.; T. Johnson, Latrigg, Hulmes Road, Clayton Bridge, architect; E. W. Barnaby, Cliff Cottage, Wilmslow, clerk; W. D. Cash, 21 Marlborough Avenue, Clarendon Road, Whalley Range, Manchester, clerk. Minimum cash subscription, 90 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than five; the first are A. Wenck, of Berlin; and F. C. Becker, of Purley, Surrey (representing the holders of the German shares), and L. Higginbottom, H. S. Morrison, of 52 Albemarle Road, Beckenham, and T. Johnson (representing the holders of the remaining shares). Qualification, £100. Remuneration (except managing directors), £25 each per annum. For one year from the date of incorporation, every 10 German shares confer one vote; afterwards each such share shall confer one vote. Each other share confers one vote at any time. Registered office, Canada Chambers, 36 Spring Gardens, Manchester.

CAERGWRLE AND DISTRICT ELECTRICITY SUPPLY CO.—This company was registered on November 25th, with a capital of £350, in £1 shares, to carry on at Caergwrle and elsewhere the business of an electric light and power company in all its branches. The subscribers are R. F. Allen, Mountain View, Hope, Flintshire, and H. H. Hughes, Ty-Cerig, Caergwrle. Private company. The number of directors is not to be less than five nor more than ten; the subscribers are to appoint the first. Qualification, £25. Registered by Worthington Evans, Dawnay & Co., 27 Nicholas Lane, E.C.

B. JOHNSON & SON.—This company was registered on November 26th, with a capital of £7,500 in £1 shares (5,000 6 per cent. preference), to carry on the business of mechanical, electrical, and general engineers, manufacturers of agricultural implements, steam, electrical, and other cranes, and other machinery and appliances, iron and brass founders, hardware merchants, &c. Private company. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first. Qualification, £50. Remuneration (except managing directors), £150 for first year, and £300 per annum afterwards, divisible. Registered by Lupton & Fawcett, Leeds.

THOMAS KESNOR & CO.—This company was registered on November 26th, with a capital of £8,000, in £1 shares, to adopt an agreement with H. J. Norballe, J. L. Lawson, and G. Lawson, trading as "Thos. Kesnor & Co.," and to carry on the business of electricians, engineers, manufacturers of and dealers in electrical and other machinery and apparatus, &c. The subscribers are J. L. Lawson, c/o Thos. Kesnor & Co., Armadale Road, Fulham, S.W., and W. G. Dunstall, 2 Norfolk Street, W.C. Private company. The number of directors is not to be less than two nor more than five; the first are H. J. Norball, J. L. Lawson, G. Lawson, and W. G. Dunstall. Qualification, £50 shares or stock. Remuneration, 10s. 6d. each per board meeting attended. Registered office, Armadale Road, Fulham, S.W.

MUNSTER ELECTRIC LIGHTING CO.—This company has been registered, with a capital of £2,000 in £1 shares, to acquire the business of general electricians and contractors, electric lighting contractors, &c., carried on by J. Hunter, C. H. Wright, J. O'Keeffe, E. Griffiths, and R. H. Bindless as the Munster Electric Lighting Co. No initial public issue.

NEVILLE KAYE & CO.—This company was registered on November 26th with a capital of £5,000, in £1 shares, to carry on the business of constructors, builders, erectors, and suppliers of electric, hydraulic, steam and mechanical lifts or elevators, engineers, &c., and to adopt an agreement with H. N. Kaye. The subscribers are W. S. Durrant, 25 London Lane, Mare Street, Hackney, N.E., and T. L. Henderson, 11 Victoria Street, Charlton. Private company. The number of directors is not to be less than two nor more than five; the first are G. V. Twiss, J. L. Brooks, and H. N. Kaye (managing director). Qualification, £250. Remuneration (except managing director), £25 per annum dividend. Registered office, Thanet House, 213-2 Strand, W.C.

NEWALLS INSULATION CO.—This company was registered on November 28th, with a capital of £60,000 in £1 shares, to manufacture, deal in, erect and apply materials and appliances for affording insulation or protection from or for heat, cold, light, electricity, sound, blows, vibration, air, water, fluids, gases, emanations or rays, to manufacture, deal in, and apply cork, magnesia, asbestos, silicate of cotton, lime refuse, fossil meal, charcoal, flax and other substances, to manufacture and deal in chemical products and substances, and to acquire or subscribe for shares, debts, or liabilities of Magnesia Coverings, Ltd., and the Washington Chemical Co., Ltd., and to adopt agreements (*a*) with Magnesia Coverings, Ltd., and another, and (*b*) and (*c*) with the Washington Chemical Co., Ltd. The subscribers are F. S. Newall, Castle Hill, Wylam, chemical manufacturer, and G. F. Newall, Castle Hill, Wylam, engineer. Private company. The number of directors is not to be more than five. F. S. Newall is the first. Qualification, £500. Remuneration, £100 each per annum.

NEW TRANSPORT CO.—This company was registered on November 12th, with a capital of £11,000 in 10,000 preference shares of £1 each and 20,000 deferred shares of 1s. each, to acquire from A. W. Gattie, A. G. Seaman, and H. Aldrich the benefit of certain existing inventions for improvements relating to the loading, unloading, sorting, weighing, conveying, and marshalling of goods, merchandise, chattels, books, documents, letters, and the like, and to carry on the business of mechanical, electrical, and magnetic engineers, manufacturers of apparatus, appliances, implements, and machinery, &c. The subscribers are:—H. Aldrich, St. Margaret's Burgess Hill, merchant; A. W. Gattie, 13 Ladbroke Grove, W., engineer; F. H. Preece, 27 Clement's Lane, E.C., engineer; A. G. Seaman, The Narrows, Altrincham, Cheshire, electrical engineer; G. Cose, 17 Tower Royal, E.C., solicitor; C. Ashton Denyer, 17 Tower Royal, E.C., solicitor; G. H. Griffin, Meadowlea, Datchet, Bucks, merchant Minimum cash subscription, £500. The number of directors is not to be less than two nor more than seven; the first are A. W. Gattie, A. G. Seaman, and H. Aldrich. Remuneration as fixed by the company. Registered by Cox and Lafone, 17 Tower Royal, E.C.

R. & R. SYNDICATE.—This company was registered on November 14th, with a capital of £5,000 in £1 shares, to adopt an agreement with Anti-Friction, Ltd., the Antifriction Equipment (Railways), Ltd., and the Antifriction (Foreign and Colonial) Patents Co., Ltd., to promote the new company referred to in the said agreement, &c. Private company. The number of directors is not to be less than two nor more than five. Qualification, £50. Registered by Le Brasseur & Oakley, 10 Carey Street, W.C.

T. REYNOLDS & CO.—This company was registered on November 23rd, with a capital of £10,000, in £1 shares, to adopt an agreement with T. Reynolds and to carry on the business of dealers in and manufacturers of motor-cars, motor and other cycles, gas and electrical fittings, gas engines, gas-producing plant, hardware, builders' requisites, &c. The subscribers are T. Reynolds, 19 High Street, Coventry; Ethel M. Reynolds, Woodside, Tile Hill, near Coventry; and Olive M. Reynolds, Woodside, Tile Hill, near Coventry. Private company. T. Reynolds is sole director for life, with £800 per annum and 50 per cent. of the net profit after 5 per cent. is paid on the shares. Registered by E. T. Peirson & Sons, Coventry.

SOREL LIGHT & POWER CO. (OTTAWA).—This company has been incorporated in Canada with a capital of $500,000.

SPANISH RAILWAYS CONSTRUCTION CO.—This company was registered on November 25th, with a capital of £5,000 in £1 shares, with objects as indicated by the title. Minimum cash subscription, half the shares offered to the public. The number of directors is not to be less than three nor more than 15; the subscribers are to appoint the first. Qualification, one share. Remuneration as fixed by the company.

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CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

ALTERNATORS.—Messrs. Johnson & Phillips have issued a new leaflet giving prices, sizes, and weights of alternators and accessories.

ARC AND OTHER LAMPS.—New pamphlets are to hand from the Electrical Co., Ltd., of 121 Charing Cross Road, giving illustrations of the A.E.G. "Sunshine" flame arc lamp with accessories, and an entirely new pattern of 3-ampere Nernst lamp, giving 800 to 1,000 c.p. for voltages from 200 to 250 volts. The glowers are said to have a life of 400 hours, and the whole lamp is designed to take the place of an arc lamp where great steadiness of light is essential.

HANDBOOK TO LOUGHBOROUGH.—We have received from Mr. W. H. Allen, Borough Electrical Engineer to the Loughborough Corporation, a small handbook to the town, with descriptive letterpress, a map, and 13 photographic reproductions, many of engineering interest, and including a view of interior of the generating station. This guide has been issued by the Trades' Extension Committee of the Loughborough Town Council.

METAL FILAMENT LAMPS.—A small circular of a size to accompany a letter in an ordinary envelope is being issued by the British Westinghouse Electric & Manufacturing Co., Ltd., to call attention to the economies rendered available by the adoption of Westinghouse tungsten lamps, which can be run at an efficiency of 1·2 watts per c.p. These lamps are now made in sizes from 8 to 12 c.p. at 25 volts, from 10 to 20 c.p. at 50 to 55 volts, from 30 to 100 c.p. at 100 to 125 volts, and in the 50 and 100 c.p. size for 200 to 230 volts.

METAL FILAMENT LAMPS.—A circular from the Armorduct Manufacturing Co. announces considerable reductions in prices for the firm's "Gral" metal filament lamps, and amended discounts to the trade. These new prices have been rendered possible by the completion of the extensions to the works where they are made, which have been necessitated by the enormously increased demand for these lamps.

METAL FILAMENT LAMPS.—One of Messrs. Johnson & Phillips' new series of lists, which has appeared during the week, deals with Osram lamps for voltages ranging from 25 to 260 volts.

SWITCHGEAR AND ARC LAMPS.—A new catalogue has been issued by the Universal Electrical Manufacturing Co., of 14 Station Parade, Queen's Road, Peckham, London, S.E. This consists of some twenty leaflets filed in a cover, each of which gives particulars and prices of some speciality. Lighting and traction switchboards, and also small boards for accumulator installations, are among the items listed. With regard to the former, it may be mentioned that the six main low-tension boards for the lighting and power distribution at the Franco-British Exhibition were supplied by this firm. Other leaflets deal with various patterns of knife switches, clip and switch fuses, fuse boxes, iron-clad switches and fuses, &c. Enclosed arc lamps for series burning, but without shunt coils, are listed; these have an auxiliary coil, which ensures that the lamp does not take more than its share of the pressure. A simple pattern of flame arc is also listed. The remaining leaflets relate to arc lamp accessories, street lighting brackets for metal filament lamps, switch and feeder pillars, and cable-junction and house-service boxes.

TELEPHONES AND CALLS.—Messrs. Marples, Leach & Co. have issued a pamphlet containing a description of an ingenious piece of apparatus, known as the "Adnil" vibratory generator, from which currents from ordinary dry cells or other batteries can be converted into alternating current at any pressure for ringing telephone call bells, sounding electric hooters, and other similar purposes. The apparatus, which is very compact and well thought out, combines a pair of vibrating tongue contact makers, with a small step-up transformer. With this apparatus much smaller batteries can be used than direct or ordinary trembler bells, owing to the much better efficiency of the polarised bells without contacts that can be employed. The same pamphlet contains particulars of loud-speaking telephones, hooters, bells, and other apparatus.

THREE-PHASE MOTORS.—The third instalment of a series of lists of induction motors manufactured by the Oerlikon Company is to hand from Mr. G. Wüthrich, of Oswaldestre House, who represents the British department of the firm. This consists of a pair of cards containing well-arranged particulars of three-phase enclosed ventilated squirrel-cage induction motors, ranging from 1/5 h.p. to 55 h.p. for voltages up to 500 volts at 50 cycles. The previous lists dealt with single-phase and unenclosed three-phase machines respectively. The range of sizes is very complete, and from the particulars given in the lists it is evident that the motors are very compact for their output.

ANNUAL DINNER OF THE BIRMINGHAM LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS

THE annual dinner of the Birmingham Local Section of the Institution of Electrical Engineers took place on Wednesday, December 2nd, at the Grand Hotel; the number of members and guests present was about 100, and included several representatives from the parent body.

Prof. G. Kapp (President of the Local Section) was in the Chair, and, after proposing the usual loyal toasts, he gave that of "The Institution of Electrical Engineers." In his speech he referred to the probability of the early inauguration of a system of examination of candidates for admission to the Institution, and the gathering showed warm approval of the scheme. Mr. W. M. Mordey (President of the Institution) replied to this toast, and noted with pleasure the warmth with which the proposal for the new system of admission of candidates was received. He referred to the new home of the Institution, and stated that he considered the financial risk was negligible, whilst the necessity for suitable headquarters was not open to question. Comparing our position in electrical engineering with that of Germany and the U.S.A., he was of opinion that we were well in advance of either of these two countries.

Mr. R. Kaye Gray gave the toast of the Local Section, and hoped Birmingham would soon supply a President. Prof. R. Threlfall, in reply, objected to the system of censorship of Papers by the referees in London, and gave very amusing instances of the disadvantages of this method of procedure.

Major W. A. J. O'Meara (Chief Engineer to the Post Office), in proposing the toast of "The City of Birmingham," referred to the diverse character of her manufactures, and instanced a prayer wheel captured during the Tibet Expedition, which proved to have been made in Birmingham. Mr. R. A. Chattock (Chief Electrical Engineer, Birmingham Corporation), acknowledging the toast, described the commercial lines on which the municipal undertakings were conducted, and said no friction existed between the Electric and Gas Departments.

The toast of the "Electrical Industries" was proposed by Mr. J. F. C. Snell, and responded to by Mr. M. Railing (General Electric Co.). The last toast was that of "Our Guests," proposed in a brief but witty speech by Mr. R. K. Morcom, and acknowledged by Mr. J. E. Kingsbury.

The Electron.—The November issue of the magazine conducted by the employees of the Siemens Stafford Works commences with a portrait of Mr. Alexander Siemens, a short biographical notice of whom also appears. The conclusion is published of a Paper on "High-voltage Transmission and Distribution," by Mr. C. H. N. Chamen, with a report of the discussion thereon. Several original articles are also included, together with particulars of the doings of the various societies, clubs, &c., connected with the works.

Newcastle Local Section of the Institution of Electrical Engineers.—The meeting held at Armstrong College on the 7th inst., was of a strictly informal nature, being occupied by an interesting lantern oscillograph demonstration by Prof. W. Thornton, dealing with the effects produced by the superposition of alternating and direct currents. This was followed by the showing of a series of lantern views showing oscillograph diagrams of alternating phenomena taken from commercial machines by Mr. Davis, and after a discussion which was chiefly of local interest, Mr. Carter proposed, and Mr. Stoney seconded, a resolution of thanks to Dr. Thornton.

The Reorganisation of the American Westinghouse Companies.—According to the *Electric Railway Journal* (New York), the readjustment committee of the Westinghouse Electric & Manufacturing Company, of Pittsburg, announced on November 20th that the modified or substitute plan for the readjustment of the debt of the company had been declared operative. This means that the final stage in the rehabilitation of the company has been reached, and that in all probability the company will be out of the hands of the receivers and turned over to the stockholders very soon. It is stated that counsel will now go ahead with the necessary proceedings for the termination of the receivership, the issue of the new securities, and the restoration of the business to the company, all of which will be accomplished in the near future. It has been unofficially announced that Mr. George Westinghouse will remain the president of the Westinghouse Electric & Manufacturing Co. While the merchandise creditors agreed to accept new stock in the company in payment of their $4,000,000 of claims, the stockholders contribute $6,000,000 of new capital by subscribing that amount of stock at par. The employees, besides making their contribution as stockholders, accepted salary cuts ranging from 20 per cent. to 7½ per cent. The company has been making money steadily since the receivership, and the profits are now $9,000,000. This, with the $6,000,000 cash supplied by the stock subscriptions, gives the company $15,000,000 cash working capital, in addition to which $6,000,000 debts have been funded. The total liabilities consisted of about $29,000,000 funded debt and about $15,000,000 floating debt.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Dec. 3rd, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1907 Patents

20,223, **Manufacture of Metal Filaments.** "Z" ELECTRIC LAMP SYNDICATE (*H. Zerning*). According to the process described in this specification, powdered tungsten trioxide is mixed with powdered zinc, and then the mixture is heated in an atmosphere of hydrogen. The zinc oxide formed is removed by heating with hydrochloric acid, and the remaining hydrogenous compound of tungsten is mixed with a binding agent consisting of nitro-cellulose, amylacetate, and castor oil. The liquid produced is squirted into filaments in the usual way. After the filaments have been heated in iron vessels coated with a paste of zirconium hydride and amylacetate, they are sintered by passing a current through them in the usual manner. Five claims.

23,450, **Electrolytic Prepayment Meter.** E. SCHATTNER AND R. AMBERTON. In electrolytic prepayment meters, the supply ceases when the level of the electrolyte falls below the level of one electrode. According to this invention an auxiliary electrode is connected in parallel with the above electrode, but through a resistance. The auxiliary electrode remains in the liquid after the main circuit is broken, and so the lamps are only dimmed instead of being extinguished. Two claims, one figure.

28,483, **Dynamo for Petrol Electric Systems.** W. A. STEVENS. The object of this invention is to ensure rapid excitation of the dynamos of petrol-electric systems, and consists in making the magnet poles of the dynamo of soft permeable magnetic steel and hard steel of great retentivity, alternately. Each pole is excited in the usual manner, and the action of such a machine will be normal, except that when the dynamo is running very slowly, it will not lose the whole of its excitation, and further, that the excitation will rapidly increase with an acceleration in speed, owing to the large amount of residual magnetism. Two claims, one figure.

1908 Patents

5,416, **Manufacture of Metallised Filaments.** BRITISH THOMSON-HOUSTON CO., LTD. (*General Electric Co., U.S.A.*). This invention relates to the manufacture of metallised carbon filaments, and consists in impregnating the rough filament with sodium chloride previous to carbonising. It is stated that filaments treated in this way are free from spots of high resistance, and are more uniform in cross-section. Three claims.

11,512, **Motor Starter.** SIEMENS BROS. DYNAMO WORKS, LTD., B. G. PAYNE AND E. SCHUPP. The principle of the motor starter with automatic step-by-step motion, described in ELECTRICAL ENGINEERING, October 29th, 1908, page 586, is given in this specification. The switch arm is controlled by an escapement device and an adjustable balance wheel. Six claims, three figures.

12,275, **Electric Flat-iron.** W. EASTMAN AND A. WARNE. This specification describes a flat-iron, in which the heating coils of platinoid are wound on strips of uralite and placed in slots in the heating surface, the sides of the slots being insulated with mica, which conducts heat. A steel plate covers the slots from which it is insulated with mica. The bottom of the slots are insulated with uralite, which partly prevents the heat from reaching the handle and top surfaces. Four claims, three figures.

18,458, **Heating Apparatus.** BRITISH THOMSON-HOUSTON CO., LTD. (*General Electric Co., U.S.A.*). In order to provide a more uniform heating surface in such electric heating apparatus as flat-irons, &c., and to prevent the heat from being radiated from the other surfaces; the heating resistance unit, according to this invention, is insulated from the portion of the heating surface to which it is nearest, and from the other surface, by means of air spaces in the body of the metal. Two claims, three figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

18,441, PINCKNEY. Electro-magnets.
22,868, BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). Motor control systems.
24,165, WILLIAMS. Enumeration of telephone calls.
25,361, MATTER. Railway signalling.
25,585, HOPE, SUGDEN, & GARDNER. Interlocked iron-clad switches.
25,624, WALKER. Commutating devices.
25,655, VON SEEMEN. Processes of manufacturing conducting bodies.
25,716, VENNER & GRIESBACH. Control of electric appliances.
27,611, SUMMERS, WOOTTON, HILL, & GREEN. Electrically-controlled locks and latches.
27,792, COX. Electrical switches.

1908 Patents

931, BINKO & PHŒNIX ELECTRIC HEATING CO. Coffee roasters.
1,187, THOMSON (*Kempt*). Electric railway and tramway systems.
1,696, FRANK. Electric heating apparatus.
2,927, HOWARD & COUSINS. Luminous electric heaters.
3,369, THORNTON, CLOTHIER, & A. REYROLLE & CO. Detector for indicating the existence of high voltage.
3,539, THORPE. Time-alarm signalling systems.
4,193, LYON. Controllers for electric motors.
4,964, SIEMENS BROS. & CO. & FERREIRA. Electrically-controlled railway points and signals.
5,029, JOHNSON & PHILLIPS, LTD., & PATERSON. Arc lamps.
7,302, JACOBS & INSELL. Signalling on railways.
8,101, SIEMENS BROS. & CO., & TOPLIS. Method of cooling commutators.
8,522, BERG. Turbo-generator systems.
8,558. DICKMANN. Electric alarm apparatus.
9,101, AMERICAN ELECTRICAL NOVELTY AND MANUFACTURING CO. GES. Vibration meter for wheeled vehicles.
9,237, ALLGEMEINE ELEKTRICITÄTS GES. Devices for protecting transformers, cables, &c.
9,509, MILES. Electric switches.
9,850, BOULT (*Union Switch and Signal Co.*). Electric signalling systems for railways.
10,764, TATE. Storage battery plates.
10,767, TATE. Storage battery plates.
10,768, TATE. Storage battery plates.
11,064, TIMAR & VON DREGER. Motor starters.
11,068, ROUTIN. Electro-mechanical governors for electric generators, and furnaces.
11,118, DANIELLS. Railway signalling apparatus.
12,305, WIKSTRÖM. Hand lamps for signalling.
12,880, HILLIER. Fire alarm system.
13,661, BLOXAM (*Siemens Schuckertwerke Ges.*). Fittings for electric lamps.
14,425, GRAHAM. Telephonic systems.
14,469, RAFFO & RAFFO. Means for signalling between trains on railways.
15,289, HALL. Magneto ignition machines.
15,461, NICHOLSON. Electrically-sounded horns.
17,148, FAGERLUND. Automatic ignition and extinction of lamps.
17,809, BERGMANN. Magneto igniting device.
20,288, Firm ROBERT BOSCH. Terminal for magneto-electric ignition apparatus.
21,470, ALLGEMEINE ELEKTRICITÄTS-GES. Centrifugal pumps.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

22,873, SIEMENS & HALSKE AKT.-GES. Process of producing tantalum.
24,192, CONRAD. Electric relays.
24,211, SOC. FRANÇAISE D'INCANDESCENCE PAR LE GAZ (SYSTÈME AUER). Manufacture of lamp filaments.
24,212, SOC. FRANÇAISE D'INCANDESCENCE PAR LE GAZ (SYSTÈME AUER). Manufacture of lamp filaments.
24,264, KETTLER. Manufacture of oxygen-compounds of nitrogen.
24,597, WINKLER. Transparent flexible infusible insulating media.
24,823, STEYNIS. Production of ozone.

Application for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of Dec. 2nd, 1908.

17,248, of 1905. **Electric Power Transmission Systems for Ships and Vehicles.** E. W. HART and W. P. DURTNALL seek leave to amend this specification in order to make the meaning of a certain paragraph clearer.

Expiring Patent

The following patent expires during the current week after a life of fourteen years:—

24,541, of December 17th, 1894. **Electrolytic Apparatus.** DR. CARL KELLNER. Apparatus for the electrolysis of metallic salts, in which the cathode consists of a helical channel of mercury. The mercury continually passes from the decomposing chamber to the combining chamber, and then back to the decomposing chamber to form fresh amalgam.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

THE Bolt Head wireless telegraph station of the General Post Office, which was opened on Friday last, is the first Post Office station which will give facilities for communication with ships at sea, under the provisions of the International Radio-Telegraphic Convention. Most of the apparatus installed in the station is of the latest Marconi pattern, which includes some interesting improvements on former practice. When working, both the transmitting and receiving circuits are connected to the aerial, and the same operator can receive while transmitting. This arrangement is rendered possible by the use of a small spark-gap inserted in the aerial, across which the receiving apparatus is connected. During transmission, the current surges bridge this gap which is then practically non-existent. Means are provided for automatically short-circuiting the telephone when contact is made in the transmitting circuit. A novel feature is the provision of variable couplings in the high-frequency oscillation transformers for the purpose of enabling sharper waves to be produced. The receiving apparatus includes the latest pattern of the Marconi multiple tuner. A mast, 160 feet high, supports an umbrella type aerial of stranded copper wire. (Page 777.)

THE Comptroller-General of Patents has issued an Order that two patents covering a manufacturing process, which is being carried on exclusively outside the United Kingdom, are revoked. This is the first decision under the revocation clause of the Patents and Designs Act, 1907. In order to avoid revocation the patentee would have had to show satisfactory reasons for his omission to arrange for the manufacture in this country. The Comptroller set aside the plea that the manufacture would cost more owing to higher rates of wages, and he also held that the patentee could not relieve himself from manufacturing in this country by the mere insertion of a few advertisements for buyers of the patent or licensees, and the sending round to manufacturers of a few circulars, to which no replies are received. Another point arising out of the decision is that the motives of the applicant for revocation are quite irrelevant to the issue. (Page 780.)

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Mr. J. Roberts, of Durban, in his Paper on "Commercial Electric Heating" which was taken as read last Thursday, before the Institution of Electrical Engineers, outlined a proposed system of alternating-current distribution at 800 volts, with house transformers to reduce to 50 volts for both lighting and heating purposes, and described some simply constructed cooking apparatus of his own design for use on this system. (Page 781.)

According to a report by the Highways Committee of the L.C.C., there have been 927 occasions on which the live stud indicators operated on the cars on the G.B surface-contact system in the Mile End Road; 728 of these live studs afterwards cleared themselves, 185 cleared after hammering, and 7 remained alive. (Page 782.)

The Physical Society of London held its annual exhibition of apparatus, in which a number of well-known instrument manufacturers took part, on Friday last. (Page 782.)

A Paper was read last night before the Leeds Local Section of the Institution of Electrical Engineers by Mr. J. W. Beauchamp, in which the methods of keeping records of the positions and nature of mains and services in use at Sheffield, and a proposed more complete system, were described. (Page 783.)

At the Institution of Electrical Engineers, on Thursday last, a Paper was read by Messrs. J. C. Macfarlane and H. Burge, on the present state of the design of electrical machinery, with special regard to the possible output limits at medium speeds from given core dimensions. A large number of generalisations with regard to the design of both continuous-current and alternating-current machinery were made in the Paper, and the results of these were embodied in quadrant diagrams, which expressed the output factors as functions of the core dimensions. The part of the Paper relating to continuous-current machinery concerned interpole machines only. Deep slots, and a low ratio of magnetic to electric loading were advocated in the case of continuous-current machines, and high saturation and small air-gaps in the case of alternators, as means of increasing the output. The view was also expressed that the output of induction motors could be limited by temperature rise only. In the discussion which followed the Paper, Col. R. E. Crompton referred to the disregard of the importance of the core in the early days of dynamo design, and Mr. C. C. Hawkins doubted if generalisations in the design of alternators could yet be safely made. Dr. S. P. Thompson commented on the increasing strength of armatures in relation to the strength of the field system, and suggested a means of decreasing the self-inductance of induction motor windings. The curves given for induction motors were criticised by Mr. Miles Walker, and Mr. G. G. Stoney referred to the improvement in the quality of armature iron. Mr. S. E. Glendenning emphasised the importance of good ventilation. Several written communications have been received. (Page 785.)

Mr. W. R. Cooper's Paper on electricity supply tariffs and electric heating and cooking, read recently in London before the Institution of Electrical Engineers, was further discussed in Dublin last week. The discussion turned chiefly upon systems of charging, and some difference of opinion was shown. It was also generally agreed that neither the cost nor the design of electric cooking apparatus had yet reached finality. (Page 790.)

The third reading debate upon the London Electric Power Bills took place in the House of Commons on Monday, when several important amendments were made. A Board of Trade amendment was made, stipulating that the purchase terms in 1931 should be under Section 2 of the Electric Lighting Act of 1888. Mr. Churchill also stated that a Bill would be introduced as soon as possible constituting the London County Council the purchasing authority for the West End companies in 1931, thus placing all the companies in the same position in this respect. Words were inserted in the London Electric Supply Bill authorising linking up between the West End and East End companies. A clause protecting Greenwich Observatory was inserted in the London (Westminster and Kensington) Electric Supply Bill, a similar clause being already in the London Electric Supply Bill. (Page 791.)

Under Electrochemistry and Electrometallurgy we note the methods for removal of sulphur in iron and steel metallurgy by the old methods, and in the Héroult and induction furnaces. Notes are also given upon aluminium carbide, the number of electrode furnaces employed in the iron and steel industry, and on the Papers read before the Faraday Society. (Page 792.)

Amongst the specifications published by the Patent Office on Thursday last was one by the British Thomson-Houston Co. for a method of obtaining regenerative braking with continuous-current series traction motors. A specification by Miles Walker relates to means for the prevention of sparking due to over commutation, and another by E. von Seemen concerns the manufacture of incandescing bodies of alumina and magnesia for electric lamps. The patent specification for the "Venner" time and solenoid operated main switch combination for the control of arc lamp circuits was also among those published last week. Dr. W. M. Thornton, H. W. Clothier, and A. Reyrolle & Co., Ltd., have obtained a patent for a detector for indicating the existence of high voltage, and three patents granted to A. O. Tate relate to the construction of a novel compound plate for storage batteries, which consists of alternate anode and cathode sections. Among the patents expiring during the current week is one by H. Aron, relating to an electric winding device for clock and meter mechanisms, and another by G. H. Nisbett for sealing boxes for cables. Short abstracts of the above are given in our Patent Record. (Page 793.)

A letter from a Berlin correspondent, referring to Mr. Mordey's recent Presidential Address, states that wages are higher in Germany, and that other conditions result in prices being generally higher. He contends, however, that Mr. Mordey's figures as to the output of the German stations are incorrect, owing to the omission of the outputs of large independent power stations supplying mines, ironworks, &c., and denies that the electrical manufacturing industry in Germany is behind that of Great Britain.—We also publish a letter asking for an explanation of a point in Mr. Devereux's article on the Cardiff telephone exchange, and have appended the author's reply. (Page 776.)

The Engineers of the South Metropolitan Electric Light & Power Co. and the Beckenham Electricity Works are to meet in reference to linking up the two undertakings.—The Local Government Board has now sanctioned the loan for the sub-station at Brighouse, in connection with the supply from the Yorkshire Electric Power Co.—A non-statutory electric light company is to commence operations in Chippenham.—The Dublin Electric Lighting Committee report that the number of units sold for lighting purposes shows a tendency to diminish, owing to the use of metal filament lamps, but much better results are anticipated during the next twelve months.—As the experiment of fitting a smoke prevention apparatus at the Stepney Electricity Works has not proved absolutely successful during the trial period, an extension of one month has been granted to the company whose apparatus has been installed.—There has been a loss of £1,900 and £200 upon the Lowestoft municipal tramways and lighting undertakings respectively for the year to September 30th.—Arbitration proceedings are taking place with reference

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to the purchase by the Corporation of the Morecambe horse tramways.—Detailed figures have been prepared in regard to the introduction of the trackless trolley system at Newport (Mon.). The adoption of the system is recommended on six routes inside the borough and four routes outside, the total length being about 12 miles.—A writ has been served upon the West Ham Corporation to prevent the payment of interest on an overdraft from the Bank which has not been sanctioned by the Local Government Board.—The Wolverhampton & District Tramways Co. have notified the Corporation of their intention to discontinue the through service between their trolley lines and the surface contact system in the town. (Page 795.)

Five water-tube boilers with economisers, mechanical stokers, &c., are required by the Sydney Corporation. Local Government Board inquiries have been, or shortly will be, held as follows: Dover (£4,600), Eccles (£8,000), Keighley (£12,820), Leyton (£1,299), and Radcliffe (£14,500). The tender of Messrs. Dick, Kerr & Co. has been accepted at £82,715 for the roadwork and plate-laying in connection with the reconstruction of the L.C.C. tramways from Hackney Road to Stamford Hill. (Pages 798–799.)

The report for the year to September 30th of the Underground Electric Railways Co. of London states that the scheme for the conversion of the profit-sharing secured notes, sanctioned by the Court, has been carried into effect. In future half-yearly accounts will be submitted to the shareholders in June and December. An issue of £500,000 4¼ per cent. perpetual consolidated debenture stock of the British Columbia Electric Railway Co. has been advertised during the week. Quarterly interim dividends are announced by the Eastern Telegraph Co., Eastern Extension Co., Globe Telegraph & Trust Co., Great Northern Telegraph Co., and the Western Telegraph Co. (Page 799.)

The letter from Berlin which we publish in our Correspondence Column this week, presents what may be regarded as the German point of view with regard to the matters dealt with in Mr. Mordey's recent Presidential Address. In the first place the writer joins issue with Mr. Mordey on the question of accuracy of statistics, complaining that Mr. Mordey has not taken account, in his comparative figures, of the large amount of power supplied in Germany from independent generating stations owned by groups of mines, ironworks, &c., far exceeding that supplied by non-statutory electricity works in this country. Yet since the aggregate capacity of all the electricity works is given by Mr. Mordey as 9·7 watts per inhabitant in Germany, as against 21·8 watts per inhabitant in Great Britain, it is very improbable that the correction which our correspondent suggests would be sufficient to make up this enormous difference. Mr. Mordey's other figures bear this out, and in addition his figures, showing the cheaper generation of electrical energy in this country, and the lower selling price to the consumer cannot be gainsaid. Secondly, our correspondent insists that wages in Germany are higher than in England, that coal is dearer, and that elegance and roominess of the German central stations is considered more essential there than here. Whether the first point is conceded or not makes little difference, as the wages item is but a small proportion of the total, and the difference in the wages per unit is very small. Again, whether coal be dearer or not, a comparison of the steam consumption per unit would still, on the whole, be in favour of British practice. As to the roominess of engine-rooms and adornment of switchboards, there can be no doubt that this is carried too far in many German stations. Its effect in encouraging the men to keep the machinery in better condition is measurable by the cost of repairs and maintenance, and there is nothing to show that this charge on the undertaking is higher here than in Germany. We cannot concede that we are behind Germany in power-station design, and we are certainly in advance of that country in economical station management. Nor can it be said at the present day that our methods of manufacture are antiquated or inefficient. The depression in the electrical manufacturing industry is not due to backwardness in our engineering ability, but is solely attributable to the commercial side. Although the serious cutting of prices came in the first instance from Germany, we can agree with our correspondent on one point, viz., that, in the selling of electrical machinery at the present time, it is not the German, but the British firms who are the sinners in this respect. There are signs, however, of a slight revival in the industry, and we trust that the increased activity in electric lighting is being followed by an increased demand for electric motors and power plant generally. The approaching completion of the electrical equipment of the suburban lines of the London, Brighton, and South Coast Railway, is being awaited with interest by more than one railway company, and even the Miners' Eight Hours Bill may be a blessing in disguise, as far as electrical manufacturers are concerned, for it will result in a greater incentive to mine-owners to take advantage of the economies rendered available by electrically-driven labour-saving machinery.

The result of the debate upon the London Electric Power Bills in the House of Commons on Monday night is that the London County Council's objection to the "eight company" Bill have been overcome, and as the companies have accepted the amendments relating to the terms of purchase, it may be taken that the question of electric supply in London is now settled, at any rate so far as the companies are concerned, until 1931. For the first time since this matter was first opened, it is now possible to look upon a more or less settled condition of affairs, and as some of our readers may not have had leisure to follow the somewhat complicated proceedings of the present session, a concise statement of the present situation will be appreciated. In the first place, in respect of what are known as the eight East End companies, the London County Council has been constituted the purchasing authority in 1931, with one or two reservations, which are set forth in our report of Monday's debate. The terms of purchase are those of Section 2 of the Electric Lighting Act of 1888, and which are embodied in the various Provisional Orders. The same conditions of purchase will apply to the West End companies, but a Bill will be brought in at an early date, definitely constituting the London County Council the purchasing authority. The companies will be allowed to link-up their undertakings, in the widest possible sense, even to the extent of one company handing over the working of its distributing system to another, a very different thing to the limited powers of linking-up—if they can be called such—under an ordinary Provisional Order. These, together with

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the power to supply for traction, &c., for use outside the area of the supplying company, are the main objects of the Bill, and the remainder of the thirty-one clauses are simply the machinery necessary for giving effect to these principles. One important matter of detail is the insertion in both the London Electric Supply and the London (Westminster and Kensington) Electric Supply Bills of a maximum price for power users, viz., £6 15s. per kw. of the maximum demand per annum, plus 0·5d. per unit. Whilst this is high, compared with maximum prices in the bulk supply Bills concerning London, length of tenure is an important factor, the present companies having a remaining life of only 23 years against the 42 years proposed in the bulk supply Bills. As pointed out above, the outstanding matter is to constitute the London County Council as the definite purchasing authority for the West End companies, which was prevented from being put into effect by the Committee, owing to a technical difficulty, and when this has been accomplished, all the difficulties and complications surrounding the purchase of the existing companies, which have been a conspicuous feature of the problem since the introduction of the Electric Lighting Act of 1882, will have disappeared.

MUCH interest attaches to the first decision of the Comptroller-General of Patents, under what is known as the revocation clause of the new Patents Act. He has issued an order revoking two patents which are being worked exclusively outside the United Kingdom, and in doing so he has given his reasons at considerable length, so that the document forms a useful guide as to how this part of the Act will be interpreted in similar cases. Of course, until the decision of the High Court has been given upon the appeal which is certain to follow, the case cannot be regarded as a definite precedent to which the manufacturing industries can turn with absolute confidence for guidance, but in the meantime the Comptroller-General's interpretation may be accepted as sound and logical, and one likely to be upheld. It is, in fact, a perfectly literal interpretation, and although he is vested with discretionary powers to determine whether or not the patentee has given "satisfactory reasons" for not having manufactured his patented article here, it is evident that the Comptroller has followed the spirit of the Act in giving his decision. The patent is not an "electrical" one, but the subject of the patent would in any case not have much bearing on the matter, unless some process were in question which it would be practically impossible to carry on in this country on a commercial basis. The plea that it might cost a little more owing to higher wages having to be paid has not been admitted. The owners of the patent also contended that they had honestly endeavoured to make arrangements for the sale of the British patent, or for finding licensees in this country by the insertion of advertisements in technical papers, and by circularising manufacturers who might be inclined to take up the patent in question. This same perfunctory proceeding has been carried out with so many patents that it is interesting to note the Comptroller's view as to the inadequacy of this method of endeavouring to evade the consequences of the Act. He says: "It seems to me impossible to hold that a patentee can relieve himself from the duty of manufacturing in this country by the insertion at any time of a few advertisements, and the sending round to manufacturers of a few circulars, to which no replies are received. The advertisements and offers in this case were, I may say, of the vaguest description; they gave no intimation of the terms on which the owners of the patents were prepared to treat, beyond the statement that such terms would be reasonable." The description in the last sentence might apply to the greater number of patents that were advertised in this way last August, and we pointed out in our issue of September 3rd, the week after the revocation clause came into force, that advertising the patent by title only, and not supplementing the announcement by active personal endeavours to start manufacture in this country, or to find firms to manufacture under licence, would rather prejudice than assist the patentee in attempting to oppose a subsequent application for revocation. Those interested in the question should refer to the issue of ELECTRICAL ENGINEERING mentioned (September 3rd, 1908), as in the same article was set forth the procedure that must be followed by applicants desiring to have a patent revoked.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, DECEMBER 17TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read: "The Electric Discharge and the Production of Nitric Acid," by W. Cramp and B. Hoyle.

Rugby Engineering Society.

8 p.m. Ordinary meeting. Paper to be read: "The Utilisation of Exhaust Steam with Low-pressure Turbines," by E. Halliwell.

FRIDAY, DECEMBER 18TH.

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. General meeting at the Literary and Philosophical Society, Westgate Road, Newcastle-on-Tyne. The discussion on Mr. J. B. Duckitt's Paper on "The Electrical Equipment of Cranes" will be resumed.

Electro-harmonic Society.

8 p.m. Smoking Concert at Holborn Restaurant (King's Hall).

Institution of Engineers and Shipbuilders in Scotland.

8 p.m. Meeting at 39 Elmbank Crescent, Glasgow. Paper to be read: "Standardisation and its Relation to the Trade of the Country," by Sir John Wolfe-Barry, K.C.B., F.R.S.

MONDAY, DECEMBER 21ST.

Faraday Society.

8 p.m. Meeting at the Institution of Electrical Engineers, 92 Victoria Street, Westminster, London. Paper to be read:—"The Influence of Cheap Electricity on Electrolytic and Electrothermal Industries," by E. A. Ashcroft.

Institution of Civil Engineers.

8 p.m. Ordinary meeting. Paper to be read:—"An Investigation of the Heat Losses in an Electric Power Station," by F. H. Corson.

Telegraph Traffic.—The submarine telegraph cable between Zanzibar and Mombassa, which was interrupted during September, October, and November, again ceased working on the 11th instant. A quick repair was effected on the 12th inst., however. The line between Bagdad and Bassorah has failed again.

Wireless Telegraphy.—Regulations relating to wireless telegraphy in the British East Africa Protectorate have been issued recently; these provide that no person may establish any wireless station, or instal any apparatus for wireless telegraphy in any place, except under licence granted by the Governor.

According to the *Financial News*, Signor Marconi is said to have stated that a wireless telegraphic service at a penny per word will shortly be in operation between England and Italy. France, it is said, objected to the scheme originally, as telegrams between England and Italy pass over her lines at present; but has since withdrawn her opposition. It is stated that the service will be commenced as soon as the wireless station at Coltano is completed.

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THE BOLT HEAD WIRELESS TELEGRAPH STATION OF THE GENERAL POST OFFICE

THE new wireless telegraph station of the General Post Office, which was opened by the Postmaster-General on Friday last, is situated at Bolt Head, near Kingsbridge, South Devon, and stands some 350 feet above the sea level. Considerable interest attached to the station, as it will be the first to be used in the public service for the purpose of communicating with ships at sea. The other wireless telegraph stations owned by the General Post Office, notably those at the Wash and in the Isle of Mull, were more or less experimental, and did not accept messages for ships at sea. The present station will give public communication with all the ships going up and down the channel that have wireless apparatus, whatever their nationality or system, thus complying with the regulations of the International Radio-Telegraphic Convention of 1906. The normal range of the station is 250 miles.

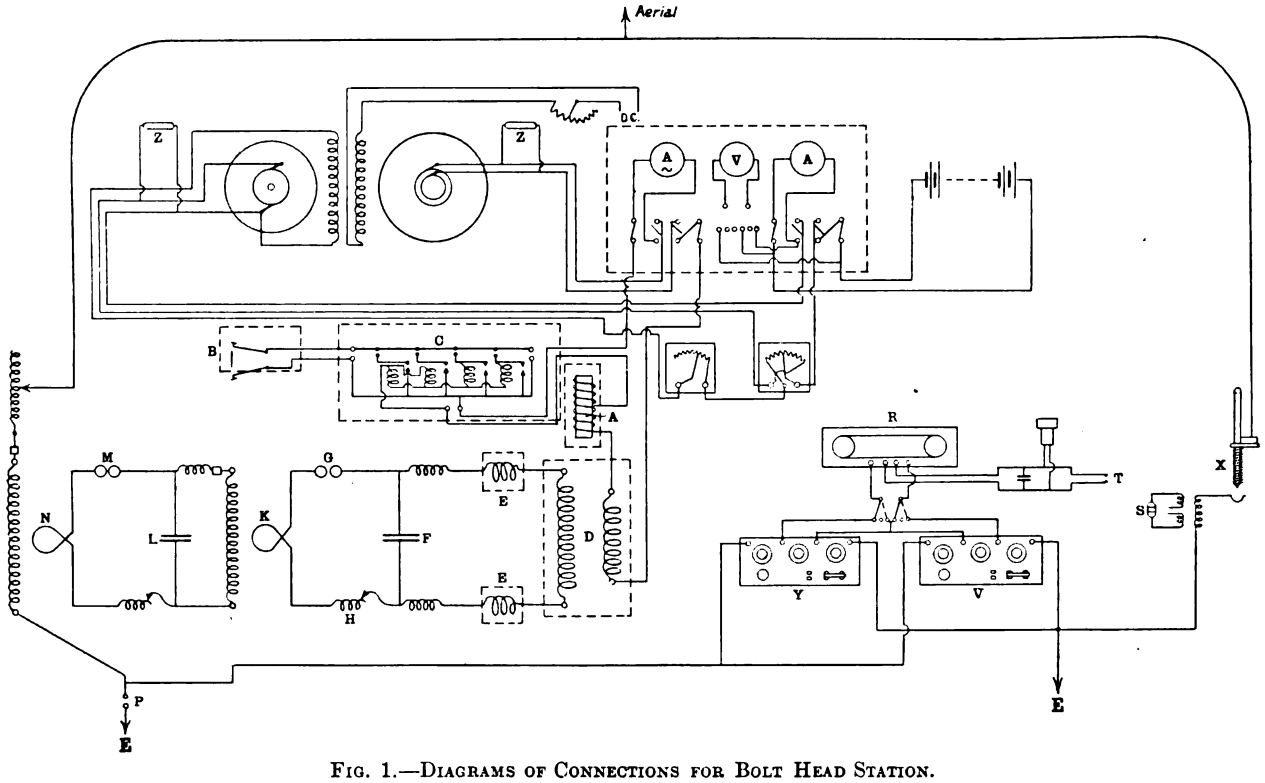

FIG. 1.—DIAGRAMS OF CONNECTIONS FOR BOLT HEAD STATION.

Through the courtesy of Major W. A. J. O'Meara, Engineer-in-Chief to the Post Office, we are enabled to give the following description of the main features of the installation. The generating plant and apparatus for the new station are contained in a one-storey brick building, 15 feet wide by 55 feet long, which has been erected close to the previously existing coastguard station. In order that the plant can be started up immediately when required, and also to eliminate noise as much as possible, the 3-kw. alternating-current generator is coupled to a direct-current machine, which, under normal conditions, is run as a motor from an accumulator battery. To charge the battery, the two machines are driven through a clutch by an 8 b.h.p. horizontal Campbell oil engine, running at 265 r.p.m. Current for the wireless apparatus can be taken from the alternator at the same time. Alternating-current is generated at 100 volts, 50 cycles, and is transformed up to from 15,000 to 20,000 volts, according to the length of the spark gap which is being used. The secondary pressure of the transformer, which is of the ordinary oil-cooled pattern, with a capacity of three kw., is varied by means of an inductance, *A*, in the primary circuit, as indicated in the diagram of connections given in Fig. 1. Besides driving the motor-generator set, the battery is used for lighting the building. The capacity of the battery, which consists of 52 cells of the D.P. Accumulator Co.'s pattern in glass boxes, is 180 ampere-hours on a nine-hour discharge rate. As shown in the diagram, the signalling is done in the generator circuit by means of an ordinary Morse manipulating key, *B*, which controls a special form of magnetic key, *C*. The function of this latter key is to prevent the circuit from being opened at any time except when the alternating-current is passing through its zero value; injurious sparking at the contacts of the manipulating key is thus prevented. The secondary of the main transformer, *D*, is connected through two iron core choking coils, *E*, and two air choking coils, to the battery of condensers, *F*; and the oscillatory circuit, consisting of the spark gap, *G*, high-frequency tuning inductance, *H*, and the primary coil of the high-frequency oscillation transformer, *K*, is connected across the condenser as shown. The iron core choking coils *E* prevent any high-frequency oscillations from reaching the main transformer *D*. Fig. 2 shows the construction of the spark gap, which is of the standard Marconi pattern; the one illustrated, however, is for a 1·5-kw. plant, and is rather smaller than that installed in the present station. The mushroom-shaped electrodes are of iron, and are mounted on ebonite pillars. In order to vary the gap, which can be anything between 2 and 8 mm., the electrodes are screwed to the left or right as desired. The normal working value of the gap is 5 mm. As shown in the figure, the spark-gap is entirely boxed in to deaden the noise of the discharge. Fixed to the pillars are two guard

D

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points, which are set to limit the pressure across the gap to a certain amount, in order to protect the condensers.

There are four condenser tanks similar in design to that illustrated in Fig. 3, and consisting of a number of thin iron plates separated by glass plates, and immersed in oil. It will be noticed that the condenser illustrated has a zinc-lined box with a further internal lining of cork. When the condensers are connected in two groups (of two in parallel) in series, the total capacity is 0·07 microfarads, and the corresponding inductance in the oscillating circuit is 2·3 microhenries. The primary of the high-frequency oscillation transformer consists of one turn only, and the secondary of ten turns. Adjustable couplings have been provided in the oscillation transformers in this station, and these permit of a loose coupling being made between the oscillating circuits; in consequence a sharper and more defined wave can be obtained, with improved tuning capabilities. When it is desired to operate with a 600 metre wave, one terminal of the secondary of the oscillation transformer is connected to the aerial, and the other is earthed. As shown in the diagram of Fig. 1, however, a further oscillating circuit can be connected in cascade with the first one for the purpose of working with a different wave-length. In that case the secondary of the oscillating transformer K is connected across a second battery of condensers L, in circuit with which is a second spark-gap M, a tuning inductance, and the primary of a second oscillation transformer N. The secondary of the latter is then connected to the aerial and to earth, as shown in the diagram. In neither case is the aerial directly earthed through the secondary, as a small "arrester" spark-gap P is interposed between the latter and the earth connection. The function of this will be explained later, but it may be mentioned here that, when transmitting, this gap is practically non-existent, as a discharge to earth occurs every time the aerial is charged.

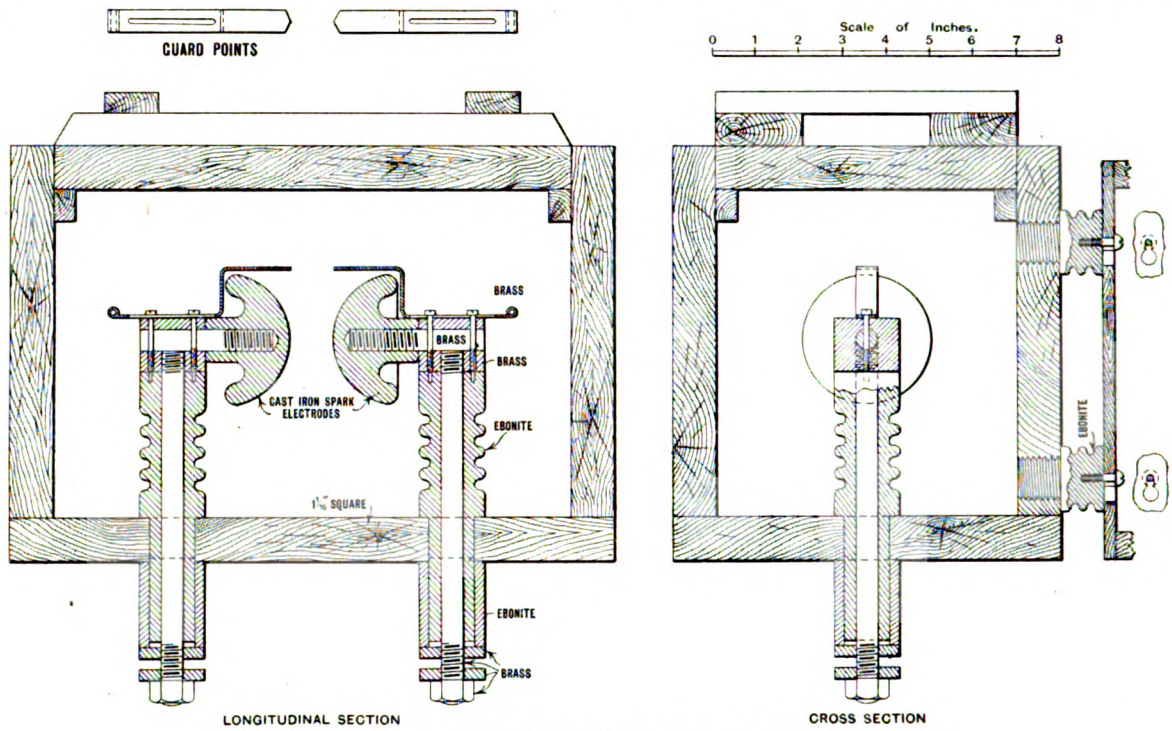
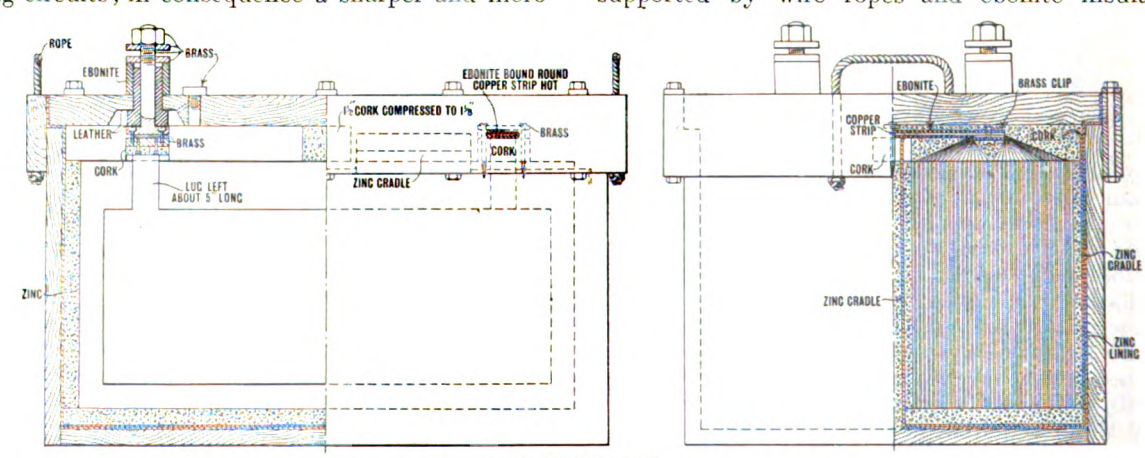


Fig. 2.—Sections of Enclosed Spark Gap.

The arrangement of the mast and aerial is shown by the sketch of Fig. 4. Four small 30-ft. poles surround the main mast, which is 160 ft. high, and the aerial conductors, which consist of stranded copper-wire, are supported by wire ropes and ebonite insulators, as shown. The aerial is thus of the umbrella type, with four radiating arms and two central conductors, which terminate at the instrument house. To protect the instruments from lightning, a "thunderstorm switch" is provided. This consists of a metal ring connected to the aerial, which slides on a long ebonite rod; during a thunderstorm this ring is pulled along the rod by means of a cord, extending into the instrument room,



(Scale ¼th full size.)

Fig. 3.—Sections showing Construction of Condensers.

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until it touches an earthed metal flange at the extreme end of the rod. The aerial is led into the instrument room through a Bradfield insulator. To provide an efficient earth connection, thirty galvanised iron plates have been buried edgewise in a circle round the station, and these are connected by sixty wires to the earth conductor in the instrument room.

The receiving apparatus is of the usual Marconi pattern, and comprises a magnetic receiver B, and a separate filing coherer receiving set S, which is connected direct to the aerial, as shown in Fig. 1, and left in circuit when the operator is not using the magnetic receiver, so that an audible bell call can be given. When transmitting, the coherer receiving set is automatically disconnected from the aerial by the switch X. The Marconi form of magnetic receiver consists of a moving band of iron wires, which passes through two concentric coils, one of which is connected to a telephone receiver, and the other between the aerial and earth. The portion of the band in the coils at any instant is under the influence of a permanent magnet, and variations in the magnetism of the band, produced by the aerial current, cause corresponding sounds in the telephone receiver. This type of receiver, in conjunction with many others, was described in an article on receivers in ELECTRICAL ENGINEERING, Vol. I., page 241. An important feature in this installation is the provision of means whereby the operator can be interrupted while dispatching a message. This is done as

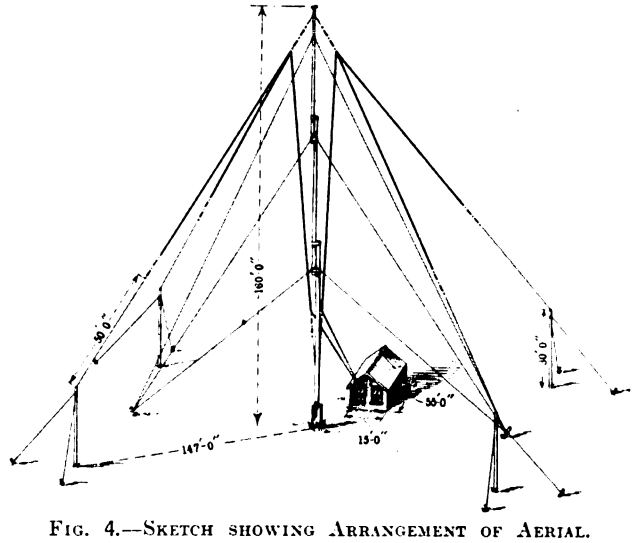

FIG. 4.—SKETCH SHOWING ARRANGEMENT OF AERIAL.

follows:—Both the magnetic receiving instrument and the transmitting instruments are always connected to the aerial, but the telephone receiver of the former is automatically short-circuited by means of the contacts shown in the diagram of connections at T, when the manipulating key B, in the transmitting circuit, is depressed. It would not of course be practical to have the aerial coil of the magnetic receiver in series with the aerial, either directly or indirectly through a transformer, when transmitting, but this difficulty has been got over by placing the previously mentioned "arrester" spark-gap P in the aerial circuit, and connecting the magnetic receiver R across this gap through the "tuners" V or Y. This gap, which offers little or no resistance to the current surges during transmission, compels the small induced receiving currents to pass through the receiving instruments. It is evident that were the gap not present, the receiving apparatus would be short-circuited. As the operator always has the telephone at his ear, signals received during the intervals of transmission can be heard.

For tuning purposes, the receiving apparatus includes two units of the latest pattern of the "Marconi" multiple tuner V and Y, the function of which is to tune the receiver or render it immune to interference from other stations. It may also be used for measuring the lengths of the transmitted and received waves, and under certain conditions for estimating the distance of a known station. The V unit is for large-wave lengths, and the Y unit for short wave-lengths. The instrument contains three separate circuits called the aerial circuit, the intermediate circuit, and the detector circuit. The first consists of a tuning inductance in series with a tuning condenser and an inducing inductance, the latter in magnetic relation with an inductance in the intermediate circuit. In the latter circuit there are two inductances in magnetic relation with the other two circuits respectively, and a tuning condenser in parallel with the inductances. The third circuit consists of an inductance in series with a tuning condenser and the detector or receiver. The two inductances in the aerial circuit and the three tuning condensers are all adjustable, and by means of these adjustments all the three circuits are tuned to the received wave-lengths. The oscillations in the aerial circuit then induce oscillations in the intermediate circuit, which in turn induce oscillations in the detector circuit. In addition, the coils in magnetic relation may be moved relatively to one another, so that the couplings between the three circuits may be varied. The instrument is also fitted with a micrometer spark-gap and a shunt inductance of the order of 80,000 microhenries, connected between the aerial and earth terminals to prevent the accumulation of an electrostatic charge in the aerial. A change-over switch by means of which the tuned circuits can be cut out, and the receiver instantly rendered sensitive to a wide range of wave lengths, is also provided. One terminal of the aerial circuit is connected to earth, and the other is connected to the top of the "arrester" spark-gap, so that connection is made through the secondary of the oscillation transformer N to the aerial, as shown in the diagram of Fig. 1. When receiving with this instrument, first the inductances and then the condensers are adjusted until the strongest signals are obtained. The wave-length can be read off on one of the dials of the instrument. When the apparatus is left without an attendant, the aerial is connected direct to the filing coherer set S by the switch X; and this set, in conjunction with a relay and a Morse ink receiver, records all the signals received.

The station is in direct telegraphic communication with Exeter, and messages received from ships at sea will be transmitted inland via that city. In order that messages from Exeter may be received by the operator in the transmitting room, he has a "head-sounder," by means of which he is enabled to receive the messages in spite of the noise. It is also proposed to install a system of relays and lamps in order to render the signals visible. It is officially stated that the charge for communication with ships will be, in most cases, 8d. per word. This charge is made up of 3½d. per word for the coast station, 4d. per word for the station on board the ship, and the ordinary telegraphic rate of ½d. per word for the transmission by wire to and from the station. Great precautions had to be taken to prevent the magnetic receiver from being affected by the telegraph circuits. The speed of signalling which has been attained with the system used in this station is that usual with key operation—namely, about 30 words per minute. A large 10-inch spark-coil is included in the equipment of the station, and this could be supplied direct from the battery, and used instead of the ordinary generating plant, in case of a breakdown of the latter. Attention may also be drawn to the so-called "guard-lamps" Z, which are ordinary straight carbon filament lamps connected across the machines, to prevent the high-frequency oscillations reaching the armatures. The whole of the wireless apparatus, the mast, and the aerial were supplied by Marconi's Wireless Telegraph Co., Ltd., and the generating plant was installed by the Westminster Engineering Co.

In conclusion, we wish to express our thanks to Mr. J. E. Taylor, Assistant Superintending Engineer of

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the Metropolitan Central District, under whose supervision the work was completed, and to Mr. J. Robb, of the Engineer-in-Chief's department, for putting at our disposal the drawings from which the illustrations in this article have been prepared, and for giving our representative particulars of the work. We also wish to acknowledge the assistance of the Marconi Co., who accorded us full information respecting the equipment supplied by them.

At the opening of the station on Friday last, the Postmaster-General was supported by Sir H. Babington Smith, Secretary of the Post Office, and several Post Office officials of the Western District. In declaring the station open, Mr. Buxton referred in a short speech to the previous work of the Post Office in the domain of wireless telegraphy, but pointed out that the present station was the first one which would be used by the Post Office for commercial purposes, under the regulations of the Radio-Telegraphic Convention. The cost of the station, he said, was about £2,000, whereas the cost of a submarine cable was between £200 and £400 a knot, so that communication could be effected much cheaper by wireless telegraphy than by cable. He then referred to the good work done at the International Convention by Sir H. Babington Smith on behalf of Great Britain, and expressed the view that the results of the Conference were very favourable to British interests.

THE FIRST REVOCATION OF PATENTS UNDER THE PATENTS ACT OF 1907

ON Wednesday last week, the Comptroller-General of Patents issued an Order that two patents covering a manufacturing process which is being carried on exclusively outside the United Kingdom, are revoked. This is the first decision under the revocation clause of the Patents and Designs Act, 1907, which provides that after August 28th, 1908, any person may apply for the revocation of a patent not less than four years old, on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom. The decision is subject to appeal to the High Court, and of course until the appeal has been heard the case cannot be regarded as establishing a certain precedent, but in the meantime it is interesting to note the point of view taken by the Comptroller, for he is vested in wide discretionary powers under the Act. He is authorised to refuse to revoke the patent if satisfactory reasons are given for the patentee having neglected to work his patent in this country.

The subject of the patent hardly comes into question at all, except in so far as it may have a bearing on the reasons why the patented article has not been manufactured here. In this case, the patents are not for any electrical apparatus, but relate to a process for making thin imitation stone slabs or tiles, and it appears that there has been a demand for these particular slabs in this country, as one-sixth of the total sales from the Belgian factory, where the process is carried on, are placed on the British market. After examining the evidence, the Comptroller came to the conclusion that there is no inherent reason why the process should not be carried on commercially in this country. It was admitted by the company owning the patents that the articles in question are produced in Germany at a very cheap rate, and on a very extensive scale, and there is also a factory in France. There is little, if any, difference in the prices at home and abroad of the materials used or in the facilities for obtaining them, and the only other reason which has been alleged why the process can be more profitably carried on in Belgium, Germany, and France, than in the United Kingdom, is that the wages of the workpeople in those countries, who in the carrying out of the patented process now under consideration for the most part are unskilled labourers, are lower than in England. If this reason is an insuperable bar to the introduction of the industry to this country, the Comptroller remarks, it is very difficult to understand how many industries which are carried on successfully in the United Kingdom continue to be so carried on.

The next point dealt with by the Comptroller was the steps which the owners of the patents asserted that they had taken to dispose of their rights in this country. During last August, it will be remembered, large numbers of advertisements were inserted in the technical papers for buyers or licensees of patents, which were at the time worked only abroad. In the large majority of cases the patents were advertised by title only, and it would certainly appear to the average mind that the fact of no reply having been received to an advertisement of this nature could hardly constitute an adequate reason for the non-working of the patent in this country. In this particular case, a few letters or circulars were also sent to British manufacturers of bricks and tiles, offering to sell the patents or to grant a licence under them. The Comptroller's views with regard to such advertisements and offers are set forth very clearly in his decision. He says that he cannot regard the fact that no answers were received by the patentees to their advertisements and offers as a satisfactory reason for not manufacturing in this country. "In the first place, they were not inserted or made until very near the expiration of the year of grace which had been allowed the patentees by the Act; and, even if they had attracted the attention of persons who might otherwise have been willing to work the process, the fact that only a month of the year of grace remained unexpired would naturally make manufacturers less willing than they otherwise might have been to enter into arrangements with the patentees. For anyone acquiring the patent rights would be in no better position to defend the patents against applications for revocation than that which the patentees themselves from whom he bought them possessed. It seems to me impossible to hold that a patentee can relieve himself from the duty of manufacturing in this country by the mere insertion at any time of a few advertisements, and the sending round to manufacturers of a few circulars to which no replies are received. The advertisements and offers in this case were, I may say, of the vaguest description; they gave no intimation of the terms on which the owners of the patents were prepared to treat, beyond the statement that such terms would be reasonable."

In answer to the suggestion that patentees who had taken out their patents before the passing of the Act should be treated with greater leniency than those who have since taken out patents, the Comptroller points out that a year of grace was allowed by the Act itself, and that nothing in the Act would justify him in lengthening this period. The two patents in question were taken out in 1900, but the same would apply to any patents more than four years old.

Another important conclusion is that the motives of the applicant for the revocation are apparently quite irrelevant to the issue. In this case it had been suggested that the applicant was disentitled to succeed in his applications, because he had no intention of manufacturing the patented article himself, his only object being to obtain liberty to import from France or Germany. "I have often heard it suggested," the Comptroller says, "that the section is unduly hard on patentees because it enables any person to apply for revocation even though he, in doing so, may be a mere

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busybody concerning himself in a matter in which he has no personal interest whatever. This is the first time I have heard it suggested that an applicant is disentitled to obtain an order for revocation because he is personally interested in the revocation."

This point is somewhat elaborated. The Comptroller says:—"It has further been contended by the counsel for the patentees that the object of the section being merely to bring about the establishment of new industries in this country, a patent may not be revoked under it unless it can be shown that the revocation will lead to the establishment of such new industries. In the present instance, if the patents are revoked, it seems to me impossible to say that a new industry will not be established in this country where no royalties will be payable in respect of the carrying on of the process; but even if no such industry is started here, their revocation will undoubtedly have one beneficial result, for it will free the trade in the patented article and enable French and German manufacturers to import it freely into this country, the effect of which may very possibly be to reduce its price and, whilst in no way preventing its importation from the Belgian factory, give purchasers an opportunity of selecting for themselves between the articles manufactured there and at other foreign factories. . . . I have always regarded the object of the section as being to put a check on the practice, which was alleged to prevail very extensively, of taking out and maintaining patents in this country, not with any intention of working them here, but with the object of preventing the patented articles from being manufactured here, and from being imported by any other parties than the patentees."

The decision concludes as follows:—"Having come to the conclusion that the patents should be revoked, the question arises whether I should revoke them forthwith, or, as I am authorised to do under subsection 2 (*b*) of the section, after a reasonable interval to be specified in the Order. I cannot think that any advantage would be gained by allowing such an interval. The only step alleged to have been taken by the patentees with a view to compliance with the requirements of the section, before the application for revocation was made, was the issue of the vague and futile advertisements and offers above referred to during the last month of the year of grace allowed by the Act. If I were to allow any further opportunity to the patentees to comply with the requirements of the law I should be establishing a precedent, the practical result of which would be to encourage patentees to defer compliance with the requirements of the section until applications are made to revoke their patents. Moreover, if it be true as has been urged on behalf of the patentees, that they cannot afford to work the patented process in this country, and that, if they do, they must raise the price to the consumer, it will be no real kindness either to them or to the public to delay the revocation of the patents. If the patents are revoked forthwith, as it appears to me they should be, it is by no means improbable that someone else may undertake the working of the patented process in this country; but, whether or not such a person can be found, the trade will be freed, and liberty given to import the patented article, not only from Belgium, but also from France and Germany, and any other country in which it may be produced."

As an indication of the cost of procedure under this section of the Act, we may add that, although in this case there were comparatively few witnesses on either side, the Comptroller decided that the patentees should pay the applicant 45 guineas in respect of the costs of his applications.

COMMERCIAL ELECTRIC HEATING

IN his Paper, which was down for reading before the Institution of Electrical Engineers last Thursday, but which, owing to considerations of time, had to be taken as read, Mr. J. Roberts, of Durban, referred first to the effect of a universal demand for current for heating and cooking purposes, and said that many engineers who had been driven to increase their distribution pressures to 2×230 volts did not care to contemplate what would be the result even if the maximum demand of the average small residence went up from, say, 3 amperes to 20 amperes. This, he thought, constituted a strong plea for higher distributing pressures in conjunction with reducing transformers, and in connection with the questions of alternating *versus* continuous current, which this opened up, he briefly recapitulated the advantages of two-phase generation and distribution, and suggested the adoption of 800 volts as a distributing pressure, with a simple form of distributing mains consisting of single conductors with waterproof insulation laid on porcelain insulators in water-tight iron troughs.

The author strongly condemned the pressure of 230 volts as quite unsuitable for use on consumers' premises, especially with some forms of cooking apparatus on the market. "In order to obtain the full benefits of the safety and convenience of electricity," he said, "we must get back to low pressures for both heating and lighting, for the mischievous raising of pressures has been the deliberate means of discounting these two important advantages. I need not refer to the superiority of low-pressure lamps. The metallic filament lamp emphasises it. I sincerely hope, in the best interests of the industry, that a 16-c.p. 230-volt lamp will never be practicable, so that sheer necessity will force us to give a more rational pressure to the consumer."

The Paper then passed on to the consideration of cooking apparatus, and submitted that for such purposes, also, low pressures were advantageous. High-pressure cooking appliances were, from their very nature, expensive and likely to get out of order, and that the chief advantages of electricity—*safety* and *convenience*—could only be fully realised by the use of low pressures. Another essential for the realisation of his ideal was that ordinary cooking work should be done with utensils without flexible cords. It follows that utensils must be heated by placing them in contact with hot plates, and a proper corollary follows that hot plates must be designed to prevent radiation of heat in any direction other than where it is wanted.

It was also highly desirable that utensils should be double walled to economise heat to the last degree.

Figs. 1 and 2 show in section and elevation a form of stove

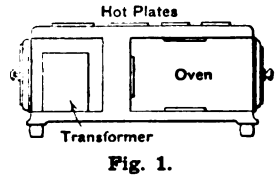

Fig. 1.
STOVE IN SECTION

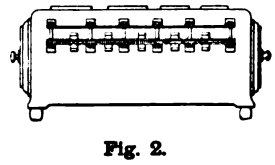

Fig. 2.
ELEVATION OF STOVE.

proposed by the author to meet these conditions. The outer case is made of sheet-iron or steel, the top is fitted for four hot plates, two large and two small. The body is taken up on the right-hand side by the oven, a compartment on the left holds the reducing transformer, fed by the 800-volt distribution mains, and wound so that 50 volts can be taken out for the lighting circuit. Three other taps from the secondary are brought to copper bars running across the front of the stove, so that 7, 12½, or 20 volts can be applied to the elements. The stove is vacuum insulated, and the elements are securely fixed to the under side of the hot plates and to the lining of the oven. Fig. 3 shows in detail the construction of the hot plate. The hot plate as commonly made to-day is usually wrongly designed in that there is no proper insulation of the heating element underneath the plate, so that draughts carry off heat and reduce its temperature, and there is no provision to shield the imperfect surfaces of contact between plate and utensil, so that convection currents of air circulate across them and reduce efficiency. The type of element suggested for use on 20 volts is shown in Fig. 4. It is made of a circular sheet of metal of proper thickness cut spirally, sufficient metal being removed at the cuts so that no insulation is wanted between the turns so

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formed. Fig. 3 of the assembled hot plate in section shows that the element is secured between the under side of the hot plate and a strongly ribbed casting in order to hold it in as close contact as possible with thin sheets of mica as insulation. Rivets clamp everything together thoroughly. The assembled

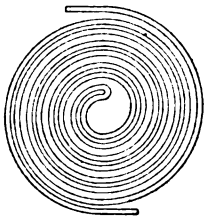

Fig. 4.

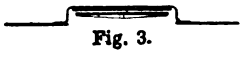

Fig. 3.

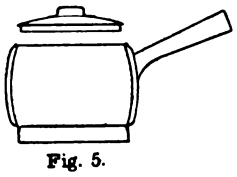

Fig. 5.

plate is fixed to the top of the stove through a ring of asbestos to prevent conduction as far as possible laterally. Fig. 5 shows a pot suitable for use with the plate. The sides of the pot project below the bottom in order to shield it from draughts of air blowing between it and the plate, and the whole is double lined, as also the lid.

One end of the winding of each element is permanently connected to the end of the transformer secondary, and the other to a contact so arranged that a plug can be made to connect either of the three copper bars running across the front of the stove.

Figs. 6 and 7 show a side and a front elevation of the three

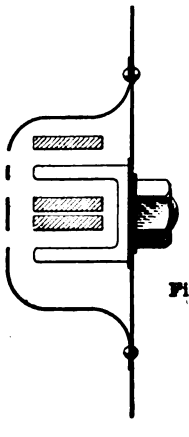

Fig. 6.

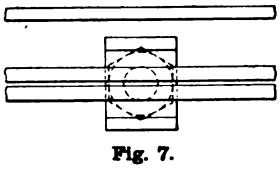

Fig. 7.

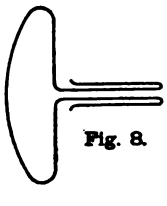

Fig. 8.

bars on the stove with the contacts connected to the heating element. Fig. 8 shows the form of plug. No insulation is used on the handle. The plug can be inserted so as to connect to any of the bars, and the handle is so shaped that two plugs cannot be inadvertently used on the same element and so short circuit a transformer winding. The transformer will be of efficient design and will not dissipate much energy. What is lost will, however, help to keep the stove warm, and will not be wasted.

The Paper concluded with a few remarks on systems of charging suitable for mixed power and lighting loads. The author was in favour of the "Norwich" system, which involves a fixed charge depending on the rateable value of the premises, plus a small price per unit used.

The Mile End Road Surface Contact Tramway.—In a report this week, the Highways Committee of the London County Council states that a question having been raised and varying statements having been made as to incidents which have occurred during the experimental working of the G.B. system in the Mile End Road, they have decided to make the following report to the Council of information given by the Council's officers as to the number of live studs, accidents, and claims incidental to the working of that system of electric traction on the Aldgate to Bow tramways. There were 927 occasions recorded on which alarm indicators operated on cars, showing that studs remained alive immediately after the cars left the studs; 728 of these cleared themselves; 185 cleared after being hammered; 7 studs would not clear and remained alive. The total number of cases in which it had been reported that accidents occurred, or were alleged to have occurred, is seven. In three cases claims were received and dealt with by Mr. Godfray, the solicitor acting for the Council in connection with accidents on its northern system of tramways, and under the general authority given to him to settle claims during the summer recess up to £50, or between meetings of the Committee up to £25, Mr. Godfray settled these claims by payments amounting in all to £60 4s.

THE PHYSICAL SOCIETY'S EXHIBITION

THE annual exhibition of electrical, optical, and other physical apparatus was held last Friday by the Physical Society of London at the Royal College of Science, South Kensington, when about twenty manufacturers of instruments, experimental and demonstration apparatus displayed their latest productions. Telegraph apparatus was represented on the stand of the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., who showed examples of the Raymond-Barker two-tone transmitter, by means of which in conjunction with the Gott fault-searcher coil inductive signalling has been carried on over a distance of 60 miles between a cable-ship and a submarine cable station during the making of the final joint and splice of a cable repair. On the same stand were shown the Appleyard conductormeter and conductivity bridge, and several patterns of the well-known Silvertown portable testing sets.

Among the displays of instruments may be mentioned that of Messrs. Nalder Brothers & Thompson, Ltd., which included testing sets and a new temperature measuring apparatus known as the telethermometer. It consists of a moving-coil ohmmeter, and is worked on the bridge principle. A coil of wire having a high temperature-coefficient is mounted in the metal case and corresponds to the thermometer; leads are brought from this to the indicating instrument. The voltmeter is supplied from a small hand generator, or alternatively from the lighting mains.

One of the most interesting instruments on the stand of Messrs. Everett, Edgecumbe & Co., Ltd., was a high-tension electrostatic voltmeter of the Jena pattern, ranging up to 60,000 volts. The Trotter universal photometer was also shown (see Electrical Engineering, Vol. I., page 849), and a very representative collection of indicating and recording instruments. Another good display of instruments was made by Messrs. Elliott Bros. Among these, in addition to the galvanometers and other laboratory instruments, was shown a centre zero milliammeter arranged with appropriate connections and push buttons for use as a leakage indicator. The portable standard wattmeter shown was also worth examination. In this instrument, which is of the dynamometer pattern, the moving coil swings outside a ball-shaped fixed coil. Other apparatus shown by this firm included the Harrison Universal Photometer. Another firm showing photometer apparatus was Messrs. Alexander Wright & Co., who exhibited the Simmance-Abady patterns of laboratory and street photometers, already described in our columns in connection with the Manchester Exhibition (see Electrical Engineering, October 29th, supplement, page 40).

A large display of instruments was made by Messrs. Siemens Brothers & Co., Ltd., including continuous- and alternating-current ammeters, voltmeters, &c., for testing purposes, combination instruments for a number of ranges, and the conveniently arranged Siemens's "Universal Galvanometer," fitted with a circular slide wire so that a great variety of different kinds of measurements can be made with it. Several patterns of galvanometer were also shown, and a useful form of induction bridge for determining induction constants and energy losses in alternating-current apparatus. Another piece of alternating-current testing apparatus shown was a small high-frequency generator for about 1,000 cycles per second. Other exhibits on the same stand were a magnetic testing outfit and a collapsible photometer. A complete Roentgen-ray equipment was also shown.

Mr. Irwin's hot-wire oscillograph, which he described in a Paper read before the Institution of Electrical Engineers (Electrical Engineering, Vol. I., page 970), was demonstrated, together with other apparatus by Mr. R. W. Paul. Some of Dr. C. V. Drysdale's instruments, including his standard wattmeter and phase-shifting transformer, were exhibited by Messrs. Snell & Tinsley, who also showed some telegraph apparatus.

Laboratory electric furnaces were shown by J. J. Griffin & Son and A. Gallenkamp & Co., and a large display of physical apparatus, among which may be mentioned standard Western cells, constructed according to the suggestions of the International Conference on Electrical Units and Standards, was given by the Cambridge Scientific Instrument Co. Mr. L. H. Walter's tantalum-wave detector was shown by Messrs. A. C. Cossar, Ltd., and among the exhibits of Messrs. Newton & Co. was a pair of lamps for demonstrating the properties of Mr. W. Duddell's musical arcs. Other exhibitors included Messrs. Casella & Co., Messrs. J. H. Dallmeyer, Ltd., Messrs. A. Hilger, Ltd., Messrs. Swift & Sons, and Messrs. Carl Zeiss.

Royal Institution Lecture Arrangements.—The following lectures are among those arranged for at the Royal Institution before Easter, 1909:—Friday Evening Discourses: February 12th, "The Electrical Properties of Flame," by Prof. H. A. Wilson, F.R.S.; March 12th, "Modern Submarine Telegraphy," by S. G. Brown; April 2nd, "Electrical Striations," by Prof. Sir J. J. Thomson, F.R.S. Among the afternoon lectures will be a series of six by Sir J. J. Thomson, on February 27th, March 6th, 13th, 20th, 27th, and April 3rd, the subject being "Properties of Matter." The lecture hour on Tuesday and Thursdays during the 1909 season has been changed to three o'clock.

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SYSTEMS OF RECORDS FOR MAINS

THE Paper on plans and records for electrical distribution systems, read last night by Mr. J. W. Beauchamp at the meeting of the Leeds Local Section of the Institution of Electrical Engineers, emphasised the importance of accurate records of the positions of mains in a complicated network, and, reviewing some of the requirements which should be possessed by a system of records, proceeded to describe the methods adopted in Sheffield.

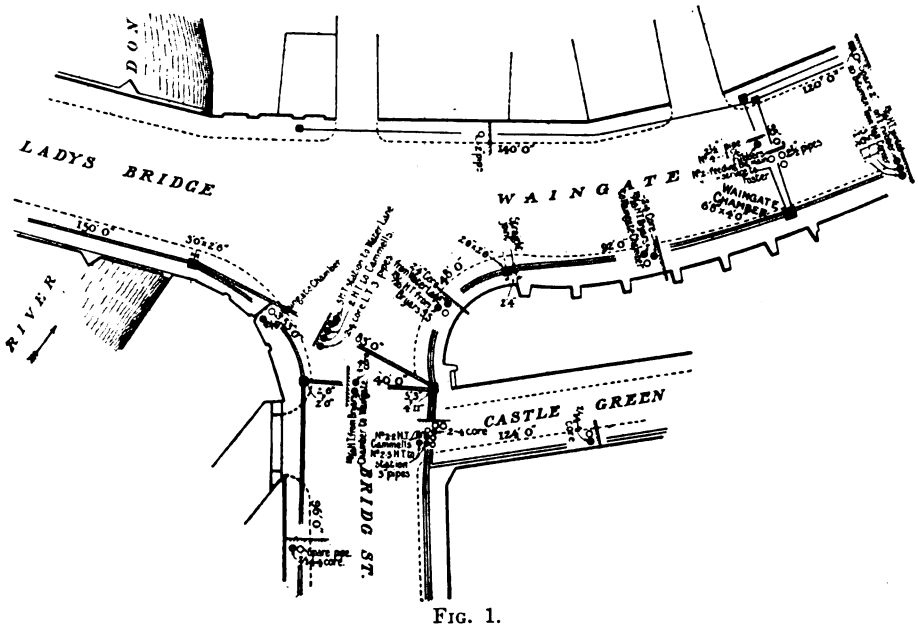

FIG. 1.

The principal features of the method as carried out at present are as follows:—

A key map of the city divided into squares and marked with reference numbers to a set of Ordnance sheets (scale 1 in 500 or 41·66 ft. to 1 in.) to cover the area included in the city boundaries. The area enclosed by lines joining up the extremities of existing mains is about 8 square miles, which represents the size of the district over which supply is at present or can generally be given without making any great extensions. On these Ordnance Sheets the positions occupied by pipes and cables are shown as follows:—All the pipes and cables on either side of a road are represented by a single line on that side of the road on the map, high-tension cables being indicated by a red line, low-tension cables by green, spare pipes by yellow (draw-boxes by a square (black), sub-stations by a square (green), switching pillars and boxes by a circle (green), service connections by a tee-line off the cable, to scale with regard to position along the building line. Densely cabled areas are re-drawn to a larger scale, permitting of more detail and sectional insets are shown where needed (Fig. 1).

On the plans draw-boxes, disconnecting pillars, and sub-stations of every kind are marked with a number referring to lists and cards kept in an index cabinet. These cards are specially ruled, and when filled in each one shows details of size, position, and contents of any two adjacent draw-boxes, and a cross-section of all ducts and cables between them, this information being amplified by means of detail sketches on the back of the card where the complexity of the work calls for it. Numbers referring to the Ordnance Sheets on which the courses of the detailed cables appear are also given on the card.

When extensions are proposed, full particulars of pipes, cables, and courses to be followed are entered on a printed form. This constitutes an instruction to the draughtsman who makes the tracing from the Ordnance Sheet or Sheets of the locality where this work is to be carried out, and the proposed cables are shown upon it in a different colour from that used to indicate existing works. From this a card is entered up and the course of the cables laid is marked on the Ordnance Sheet in the proper colours, where also the draw-box positions are marked with the consecutive numbers which give reference to the street card, which is then filed alphabetically under the name of the street.

Service connections are similarly dealt with, but the detail record is allowed to remain in the ruled sketch-books, which are preserved for reference. In addition to these records the whole of the high-tension cable system and transforming points are shown on a skeleton map.

Some figures concerning the size of the system at Sheffield and cost of record-keeping are given in the Paper. The network joins up two generating stations about 1¾ miles apart, and is complete in the central area. Its limits extend some four miles from the old station in the centre of the city, and in the residential portion it is in a fairly complete condition. In the eastern industrial districts there is also an extensive and heavy mains system, although apparently great increases will be called for before the demand in this direction is fully met; consumers' connections aggregate about 16,000 kw. The work of recording all mains extensions, services, and alterations is carried out by one draughtsman and two assistants occupying only a part of their time, about equal to the continuous labour of one man and a junior, to which must be added the cost of supervision by the chief draughtsman, and a small allowance for the attention of the mains engineers. For labour, say £200 per annum, the equipment consists of a set of maps and cards and filing cabinets—approximate value, £60; in addition, a considerable amount of drawing-office material is used.

From experience gained of working with the present method several useful improvements of this system of records have suggested themselves, and are being considered.

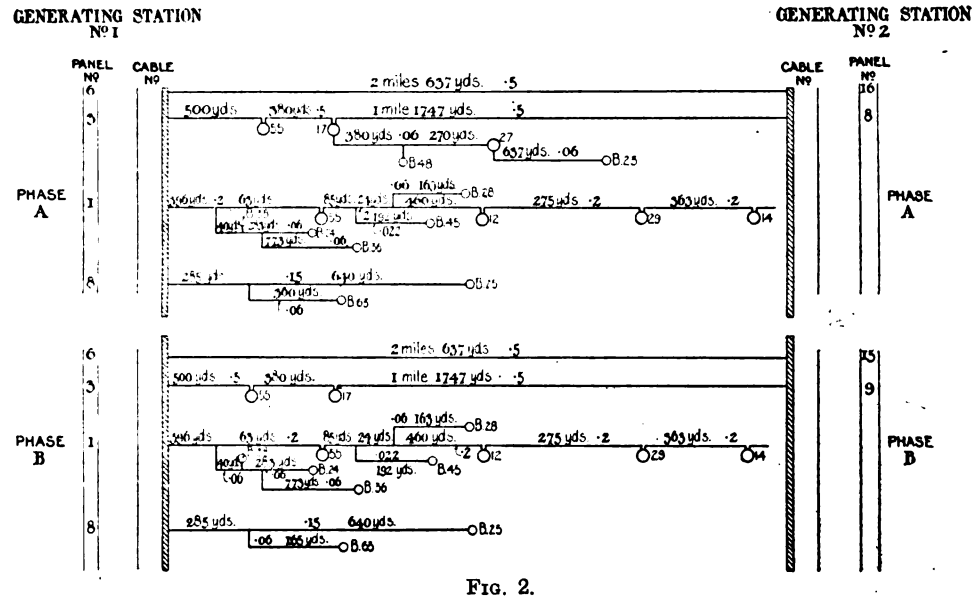

FIG. 2.

In the complete system proposed below, the object has been to provide for every needful detail of cables and their position, and in addition to give particulars of connections, loading, and balancing in an accessible form.

The following are the essentials of the system:—

I.—Key map of the area giving reference to the Ordnance Sheets.

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II.—Set of Ordnance Sheets on which the course of (*a*) High- and low-tension cables and spare ducts are shown with single lines of different colours; (*b*) Sub-stations, disconnecting pillars, and boxes, by reference letters and numbers; (*c*) Street draw-boxes or selected points in thoroughfares by numbers referring to the card on which details of the works at these points are shown.

III.—A map of the whole area on the largest practicable scale with high-tension feeders and low-tension distributors shown by a suitably coloured line, and all high-tension terminal points, sub-stations, or transformer boxes, public or private, indicated by their reference number.

IV.—A diagram of all high-tension cables showing (*a*) The generating station and switch panel from which each originates; (*b*) all tee, in-and-out, and terminal points with reference numbers; (*c*) sizes and lengths of cables.

V.—A list of reference numbers and symbols for (*a*) All high-tension sub-stations, pillars, boxes, and terminal points; (*b*) all low-tension disconnecting pillars and boxes.

VI.—A set of cards for particulars concerning all sub-stations.

VII.—A set of street cards presenting diagrammatic plans of the thoroughfares and sections of all the mains at points as near together and numerous as is necessary to present a complete record of the network, also particulars of consumers' connections filled into spaces which are provided for *all* premises along the course of the mains.

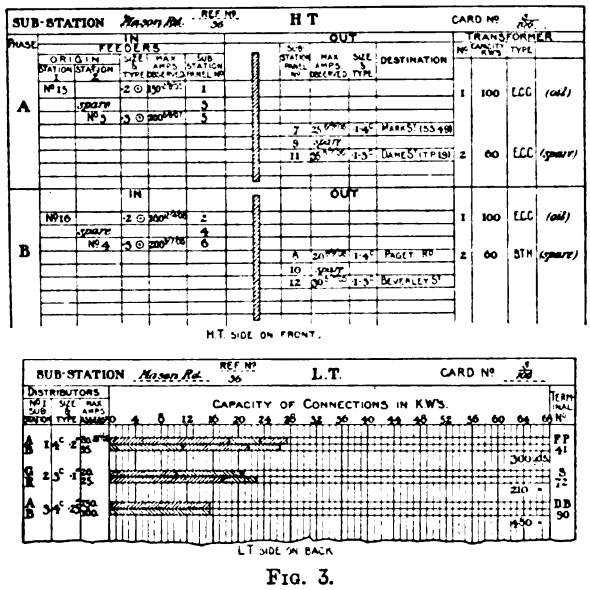

FIG. 3.

VIII.—A file of the extension and service note-books used by the draughtsmen to record daily work on the mains.

The key map should be divided into as many squares as there are Ordnance Sheets in the set, each square bearing the number of the section sheet, which is an enlarged copy of it. The set of Ordnance Sheets should be kept flat in suitable drawers and arranged in order of their reference numbers. These sheets should be kept up to date in all details, by re-drawing from time to time any portions where roads and building lines are altered, and the position of all cables should be shown as nearly as possible to scale by a line on each side of, or crossing the roads, a system of colours being adopted to distinguish between feeders and distributors and empty pipes. The position of service connections may also be shown upon them to scale with regard to street corners or salient points on adjacent buildings. Sub-stations and distributing boxes of all classes are marked with letters and numbers, referring to the cards which give details of them. Numerous points are also indicated by simple numbers which refer to the alphabetically indexed cards in which the whole of the streets are shown in short portions with cross-sections and full details of the work at every point. Beyond this no details are given on the Ordnance Sheets, which really act as a large scale key map to the rest of the record equipment, and provide exact particulars for every part of the area for use in planning and estimating for new work.

The general map of the area to a large scale, has all mains shown in one or two colours, and the numbers of all feeder or high-tension terminals marked on. This map may appear to be a scanty repetition of the information given on the Ordnance Sheets, but in practice it should be found useful to give a bird's-eye view of the feeding system, and a quick reference to its principal points, while keeping in view the form and growth of the network and relative distances.

The diagram of the whole of the high-tension or feeder cables from their origin at the station switchboard is shown in Fig. 2. With reference to the details of every tee, in-and-out, and terminal point, with length and sizes, further vertical columns may also be used to record maximum amperes observed on each feeder, and reference to periodical insulation tests.

As an alternative to large sheets for this diagram, long, narrow strips of card might be used, one for each panel on the switchboard, with space for reasonable increase being made in the number of tees and branches off the cable. This would render it easy to re-draw any particular feeder in the event of great extension or alteration. The numerical list of important points and terminals divided into classes is arranged alphabetically as well as consecutively, each number preceded by a distinguishing letter. The sub-station cards are ruled on each side, the front (Fig. 3) showing every high-tension cable entering and leaving the sub-station, with particulars of: (*a*) Origin or destination; (*b*) panel number on the sub-station switchboard; (*c*) size and type of cable; (*d*) Maximum load observed; (*e*) transformers, number and type. The back of the card (Fig. 3) shows similar particulars of each low-tension distributor leaving the sub-station, and in addition a graphic representation of the capacity and state of balance of consumers' connections upon it. A further vertical column might with advantage be added to the main high-tension diagram and the high- and low-tension sides of the sub-station cards, in which particulars of the fuses or circuit-breaker settings could be inserted.

The street cards are filed vertically in alphabetical order under the names of roads and streets, and bear reference numbers to the detail points on the Ordnance Sheets and to the cards of immediately contiguous positions; the front of these cards is printed to represent a portion of the footpaths and roadway with horizontal ruled spaces, in which are entered the street number and a letter describing every building or premises along the road, whether connected or not.

Vertical columns at the sides marked "Distributor" represent low-tension cables, and as consumers' connections are made the watts applied for are to be entered under the sign A.B. or +. −. as the case may be, giving in conjunction with the low-tension side of the local sub-station card the state of the balance on each cable and the necessary information for deciding the polarity of each new customer. In the central squared portion circles and squares are marked in to indicate cables, pipes, or draw-boxes, disconnecting pillars, &c. On the back of the card detailed information is found concerning each numbered duct, cable, or other item: (*a*) Its position and depth; (*b*) size of pipe or box; (*c*) size of cable, type, maker's name, date of laying, and names of men responsible for the work, references to tests made and to the terminal points which it lies between.

Although the system outlined herein renders it easy to trace the details of any cable in the draw-boxes, it may be found convenient actually to label the cables with the leading particulars of their origin, supply, and size, at the time of jointing up. It will be obvious that in a simplified form particulars of the above-described system can be well adapted to recording the details of large private installations as found in factories, mines, and shipyards.

A Russian Electrolytic Copper Works.—It is announced that an electrolytic copper works will shortly be opened in the district of Kychtym. The works will have a capacity for turning out from 5,000 to 6,000 tons per annum, and arrangements have been entered into with the copper producers in the Urals for the supply of raw material.

Birmingham and District Electric Club.—At the annual meeting on Saturday, the following officers were elected as Council for the ensuing session:—President, Mr. George T. Wood; vice-presidents, Mr. Vincent E. Walters and Mr. G. A. Pope; treasurer, Mr. E. A. Morgan; secretary, W. G. L. Riddle, 82 New Street; committee, Messrs. John J. Inniss, Joseph A. Jeckell, E. R. Phillips, W. H. Whitehouse, G. O. Donovan, H. W. Brady, and J. Hill. Mr. Wood will deliver his presidential address early in January.

Non-magnetic Ship for Magnetic Investigations.—We understand that the Carnegie Institution of New York is building a vessel, every portion of which is entirely non-magnetic. The vessel is to be used for conducting experiments in the study of terrestrial magnetic conditions in all parts of the world.

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SOME GENERALISATIONS IN THE DESIGN OF ELECTRICAL MACHINERY

THE Paper read before the Institution of Electrical Engineers on Thursday last by Messrs. J. C. Macfarlane and H. Burge, both of Messrs. Crompton & Co., Ltd., was an attempt to indicate the factors which limit the output which can be obtained from a given core size of a medium-speed dynamo or motor, and to show, by means of diagrams, the relations which exist between output and dimensions for machines designed according to average modern practice. The Paper was divided into three parts: namely, direct-current machines, three-phase induction motors, and three-phase alternators.

Direct-current Machinery.

Since the introduction of the interpole, the output that can be obtained from a given core size is no longer governed by the sparking limit, but depends on the permissible temperature rise. The well-known relation between the dimensions, the output factor, and the output per revolution of a dynamo-electric machine, given by Prof. S. P. Thompson, is as follows:—

$$d^2l = \left(\frac{60{\cdot}8 \times 10^7}{B \times q \times \psi}\right) \times \frac{\text{watts}}{\text{R.P.M.}}$$

where d = diameter of armature at face in inches, l = net length of armature core without ventilating ducts in inches, B = flux density in air-gap in C.G.S. lines per square inch (magnetic loading intensity), q = electric loading intensity (ampere conductors per inch of periphery of armature), ψ = ratio of pole arc ÷ pole pitch, and R.P.M. = revolutions per minute.

This relation can be expressed in a different manner, as shown by the equation below, in which the ratio ψ has been taken as 0·7.

$$B \times q = 870 \times 10^6 \times \frac{\text{watts}}{\text{R.P.M.}} \div d^2l.$$

This equation shows that, for a given ratio of pole arc to pole pitch, the product of the electric and magnetic loading intensities is proportional to the watts per revolution per d^2l. The relations between the quantity d^2l and the other quantities for large direct-current machines are shown plotted in the diagram of Fig. 1. In this diagram, quadrant 1 gives the relation between the output per revolution and the product of the magnetic and electric loading intensities ($B \times q$); quadrant 2

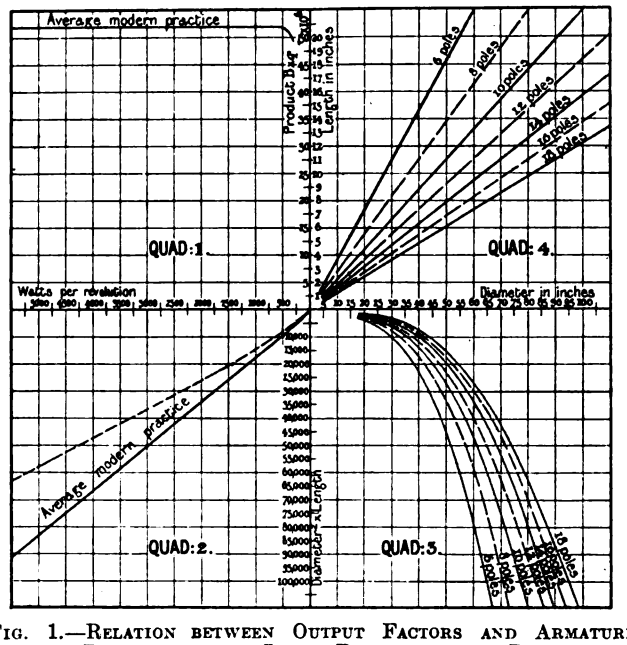

Fig. 1.—Relation between Output Factors and Armature Core Dimensions for Large Direct-current Dynamos.

gives the relation between the output per revolution and the size of the armature core (the d^2l); quadrant 3 gives the relation between the diameter of the armature and the d^2l value of the armature for various numbers of poles, on the assumption that the poles have square faces; and quadrant 4 gives the relation between the diameter and length of the machine for any number of poles. In making up these diagrams, a large number of interpole machines of modern design were considered, and the outputs were reduced to watts per revolution, and altered so as to correspond with machines with a 70 per cent. ratio of pole arc to pole pitch, and with square pole faces.

These diagrams enable the values of the product of the electric and magnetic loading intensities, the d^2l value, and the diameter and length of the armature core of a machine having

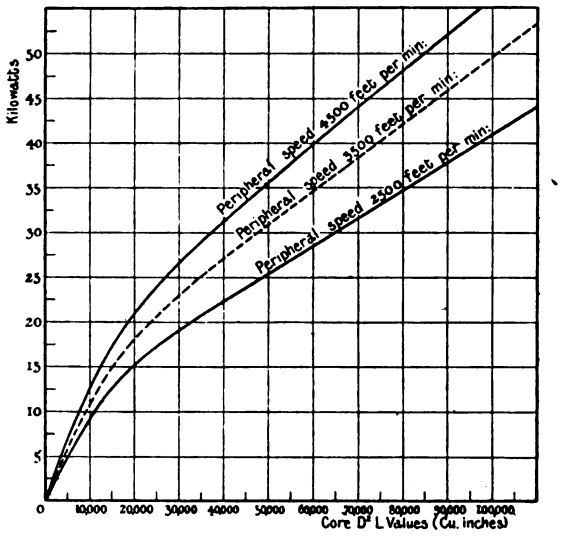

Fig. 2.—Permissible Kilowatts Loss in Armatures of Direct-current Dynamos.

square pole faces, to be obtained at a glance for any selected value of the output, and for any number of poles; but it is to be noted that this core size will only be large enough to give the selected output with a temperature rise not exceeding 75° F., provided the sum of the losses in the armature does not exceed the value obtained from the curve, in Fig. 2, corresponding to the d^2l value found. The values of the armature losses plotted in Fig. 2 were obtained from the average test results of a large number of machines, and represent the permissible armature losses for open-type machines at certain peripheral speeds, for a given temperature rise of 75° Fahr.

There are three directions in which to look for extension in the output limit of direct-current machines, namely, (1) improvements in the active materials used in the construction of the armature; (2) improvements in the ventilation; and (3) improvements in disposing and proportioning the active materials on the machine. Points 1 and 2 will not be considered in the following discussion, as they do not lie entirely in the domain of the electrical designer. In considering point 3, it has already been seen from the second equation that the output per revolution per d^2l is directly proportional to the product $B \times q$. It is obvious, therefore, that in order to increase the output per d^2l it will be necessary to increase the product $B \times q$, the value of which is influenced by the slot space-factor, the depth of the slot, the flux density in the teeth, and the relative cost of the active materials. The slot space-factor is increased generally by increasing the size of the slot, and this means that for a good slot factor the number of slots per pole should be small, and the depth of the slot great. The limit of width is settled by questions of humming, eddy currents in the pole faces, and the width of the interpole face. An increase in the depth of slot increases the slot space-factor, and allows more copper to be stored round the armature periphery, but the section at the root of the tooth and consequently the factor B are reduced. The maximum value of the product $B \times q$ occurs when the net width of copper in the slot is equal to the width of iron at the root of the tooth, and when the depth of slot is approximately equal to one-sixth of the armature diameter.

An expression can easily be obtained from the output equation given at the beginning of the Paper, which shows that the total magnetic loading of a machine (the total flux of all the poles) varies in inverse proportion to the total electric loading (the total ampere-wires on the armature periphery) for a constant output, and it may be observed that the amount of material in the magnetic circuit, *i.e.*, the iron and shunt copper, varies almost directly with this loading. Also the amount of

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material in the electric circuit, that is, on the armature and interpole windings, varies approximately in direct proportion with the electric loading. From the above it is obvious that there is some value for the ratio of the total magnetic to the total electric loading, which makes the cost of the active material for any machine a minimum. This minimum value occurs when the cost of the material in the magnetic circuit is equal to the cost of the material in the electric circuit; that is, when the cost of the material in the armature winding, plus the cost of the material in the interpole winding, is equal to the cost of material in the shunt winding, plus the cost of the effective iron and steel in the magnetic circuit. In general, this occurs when the ratio of the total magnetic to the total electric loading lies between 250 : 1 and 350 : 1, approaching the lower limit when the machine is small and has an armature diameter great as compared with its length, and the higher limit when the machine is large and has an armature diameter small as compared with its length. The efficiency is a maximum when the loss in the magnetic circuit is approximately equal to the loss in the electric circuit, and this occurs when the ratio of the total magnetic to total electric loading is approximately the same as for the cost minimum. Obviously the total cost of active material will depend on the number of poles; but it is very difficult to set down any hard and fast rules as to the best value for the frequency. In the authors' opinion, 33 cycles should not be exceeded for medium-speed direct-current machines, and it is a waste of material to go below 20 cycles, where the number of poles is not limited by mechanical considerations.

In order to obtain an equation by which the iron losses could be readily estimated, some tests were made, and from the results obtained it appears that the core loss varies approximately as the 1·3 power of the frequency, and approximately as the second power of the density; therefore, if V_t = volume of the iron in the teeth in cubic inches, V_i = volume of the iron in the core in cubic inches, and W = total watts loss on the armature; then—

$$W = \frac{3}{10^{12}} f^{1\cdot3}(V_t B_t^2 + V_c B_c^2)$$

From the above considerations it is clear that the maximum output is obtained from a given d^2l value when the width of the copper in the slot is equal to the width of the root of the tooth, and when the depth of slot is approximately one-sixth of the armature diameter, the losses being kept within the permissible value by increasing the radial depth of the armature core. In quadrant 2 of Fig. 1 is given a dotted line curve which shows the increased outputs which may be expected from machines designed on these lines, the permissible losses being taken from the curve of Fig. 2, and the densities of the roots of the teeth being fixed at 135,000 C.G.S. lines per square inch. The actual iron losses were checked by the above equation. It is also seen that for the present prices of copper and iron, the cost of active material is a minimum when the ratio of the total magnetic to electric loading lies between 250 : 1 and 350 : 1. With regard to the commutator, this, with interpole machines, can be made much smaller than with non-interpolars, because of the diminished brush contact loss, but for ordinary direct-current interpole dynamos the average E.M.F. between the bars should not exceed 25 volts. As to the field system, good proportions for the interpole section are 50 per cent. of the core lengths, and 15 per cent. ratio of pole arc to pole pitch. With these dimensions the M.M.F. provided on each interpole should exceed the armature M.M.F. per pole by about 30 per cent. In concluding this part of the Paper, it may be observed that by using the proper multiplying factors, the diagram of Fig. 1 applies equally to direct-current motors and rotary converters.

THREE-PHASE MOTORS.

Unlike the direct-current machine, the core size of the asynchronous motor is not usually limited by heating considerations, but by the value of the leakage factor, on which the value of the maximum power factor depends. The leakage factor will be defined for this purpose as the ratio of the ideal light-load current to the ideal short-circuit current. The light-load current for three-phase motors (when wound with half as many coils per phase as poles) is obtained from the fact that the maximum value of the M.M.F. per pole is equal to the number of turns in one coil × the maximum value of the magnetising current flowing in that coil, this product being equal to a constant × the length of the air-gap × value of the maximum flux density in the air-gap. Values obtained in this way, however, will require to be increased from 40 per cent. to 80 per cent. in commercial motors, to allow for the magnetic resistance of the iron path of the motor and the increase in the air-gap density caused by slot openings. These are best allowed for by adding equivalent air-gaps to the actual air-gap; and for this purpose the authors gave a curve showing that the extra air-gap equivalent to the magnetic resistance of the iron circuit could amount to as much as 0·035 inch for a machine with a pole pitch of 20 inches. For a pole pitch of 10 inches, the equivalent air-gap amounts to about 0·018 inch. If it is assumed that the number of slots per pole per phase is proportional to the pole pitch, the air-gap equivalent to the extra resistance caused by slot openings amounts to about 10 per cent. of the actual air-gap. In order that the magnetising currents may be estimated for a whole series of machines, it now remains to suggest values for the actual air-gap δ_1 for any size of machine. The only consideration which influences the size of the air-gap in most cases is a mechanical one, and the curves, Fig. 3, give suggested air-gap values for machines as a function

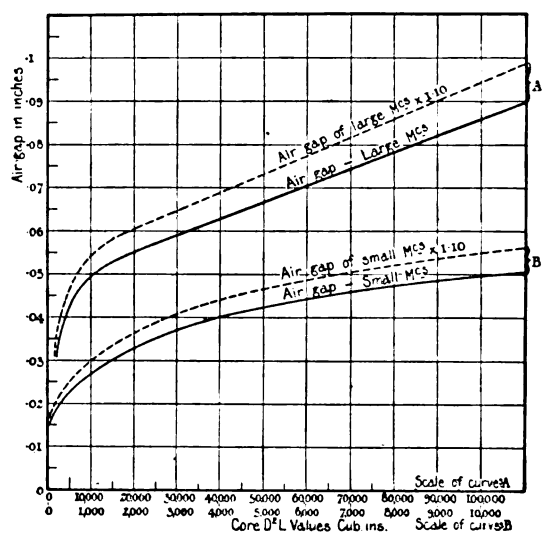

FIG. 3.—PROPOSED VALUES FOR AIR-GAP OF INDUCTION MOTORS.

of their d^2l values. After having found the values of the two equivalent air-gaps, these and the actual air-gap are added together, and if the sum is expressed by the symbol Δ, the value of the light-load current can be estimated from the following equation :—

$$C_o = \frac{0\cdot23\Delta B_{max.}}{S},$$

where $B_{max.}$ = maximum flux density in the gap (C.G.S. per square inch); S = the number of turns in one coil of each phase of the winding; C_o = ideal light load, or magnetising current in virtual amperes in each phase of the winding.

The value of the ideal short-circuit current per phase of a polyphase motor can be estimated by assuming certain values per ampere-turn per inch for the embedded and free lengths of the stator conductor. It has been pointed out by Hobart that the leakage per ampere-turn per inch of embedded length varies inversely as the pole pitch, and the authors of this Paper have found this to be true, provided the number of slots per pole per phase varies in direct proportion to the pole pitch. For motors with wound rotors and nearly closed slots the average value of the stator and rotor leakage per ampere-turn per inch of embedded length is about 2·3 C.G.S. lines for 18 slots per pole, and a 10-in. pitch, and the free length leakage is about 1 C.G.S. line per ampere-turn per inch. From these considerations the total leakage for any motor may be estimated, and from this, an equation for the short-circuit current can be derived; thus,

$$C_{SH} = \frac{0\cdot353N}{SN_2},$$

where C_{SH} = ideal short-circuit current in amperes per phase (effective value); N = total flux per pole crossing the air-gap (C.G.S. lines); and N_2 = leakage flux per ampere turn (C.G.S. lines). The value of the leakage factor σ will therefore be expressed by—

$$\sigma = \frac{C_o}{C_{SH}} = \frac{1\cdot05\Delta(46l + 2\cdot8T^2)}{T^2l}$$

where T = pole pitch in inches, and l = net length of stator core in inches.

From this equation it can be proved that for any size of machine with a constant number of poles (that is, for T^2l a constant) the leakage factor σ is a minimum when the ratio $\frac{l}{T}$ is equal to the quotient of T divided by a constant 16·4, provided Δ is also constant. The authors gave some curves, showing the values of

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$\frac{l}{T}$ plotted as a function of T. One of these curves is represented by the above relation, and is meant to show the values of $\frac{l}{T}$, which will give the maximum power factor for a given d^2l and a large air-gap. This shows that for large values of the pole pitch, the ratio core length ÷ pole pitch should be large, and for small values of the pole pitch this ratio should be small. As the value of the total equivalent air-gap Δ is not constant, however, for a given T^2l value, other curves were given for medium and the smallest possible air-gap respectively; these curves give somewhat higher values for the ratio. The medium curve gives $\frac{l}{T} = 0{\cdot}6$ for T = 8; and for T = 19, the value of $\frac{l}{T}$ is 1·6. On this latter curve as a basis, the authors have constructed a set of diagrams to show the relation between maximum power and leakage factors, and the principal core dimensions for large induction motors. These are given in Fig. 4, and show at a glance the maximum power factor that can be commercially obtained from any core volumes, provided the motor has a wound rotor and is designed in accordance with the foregoing considerations. The output of induction motors for a given d^2l has not been so large

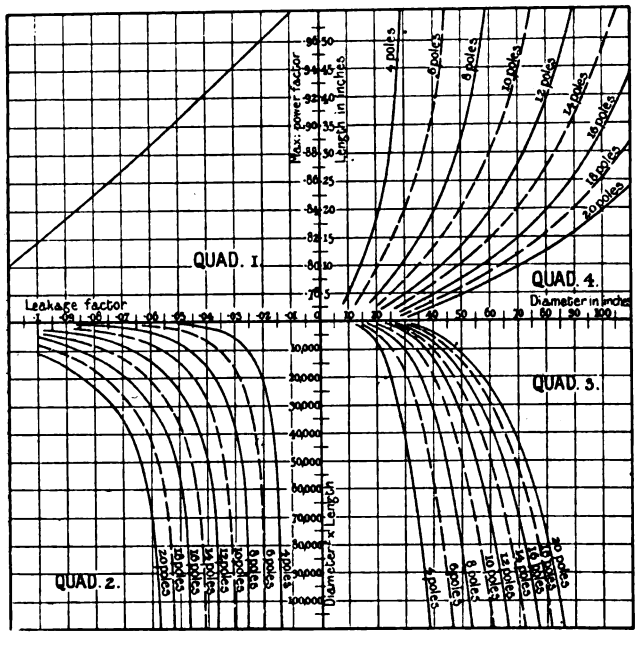

Fig. 4.—Relations between Maximum Power and Leakage Factors and Principal Core Dimensions for Induction Motors.

as that for direct-current machines. But in the author's opinion the advantages of high tooth density and uniform gap density in the latter machines are compensated for by the better distribution of the windings in an induction motor, so that it will be sufficiently near to take the curves in quadrant 2, Fig. 1, of d^2l values for direct-current machines as the limit to the size of induction motors for any output, provided the size is not already limited by power-factor considerations. When the number of poles is small, it is possible to reduce the core size until the limit of output is that of temperature rise only, although this tends to slightly reduce the maximum value of the power factor that can be obtained. In some cases it is convenient to use fractional pitch windings for induction motors, because in the case of high-speed motors, which usually have large pole pitches, the free ends of the winding become inconveniently long. With two-pole motors the authors consider that a fractional pitch of 50 per cent. should be used in almost every case, as this is easily obtained by winding the motor for four poles and reversing one of the coils in each phase. But this is almost the only case in which the use of the fractional pitch winding is advantageous.

Alternators.

The output to be obtained from the armature of a synchronous alternating-current dynamo is not in any way limited by questions of temperature rise, but is entirely limited by the permissible value of the potential rise from full load to no load when working on the maximum inductive load. In a similar manner to that adopted when dealing with direct-current machines, a formula connecting the product of the magnetic and electric loading intensities can be obtained. This is as follows:—

$$B \times q = 784 \times 10^6 \frac{\text{volt-amps.}}{\text{RPM}} \div d^2l$$

and it will be noticed that the only difference between the formulæ for alternating and direct-current machines is in the constant, which is smaller than for the direct-current machines.

In the diagram of Fig. 5, quadrant 1 gives the relation between the output per revolution and the product of the magnetic and electric loading intensities ($B \times q$); quadrant 2 gives the relation between the output per revolution and the size of the armature core (the d^2l); quadrant 3 gives the relation between the diameter of the armature and the d^2l value of the armature for various numbers of poles; and quadrant 4 gives the relation

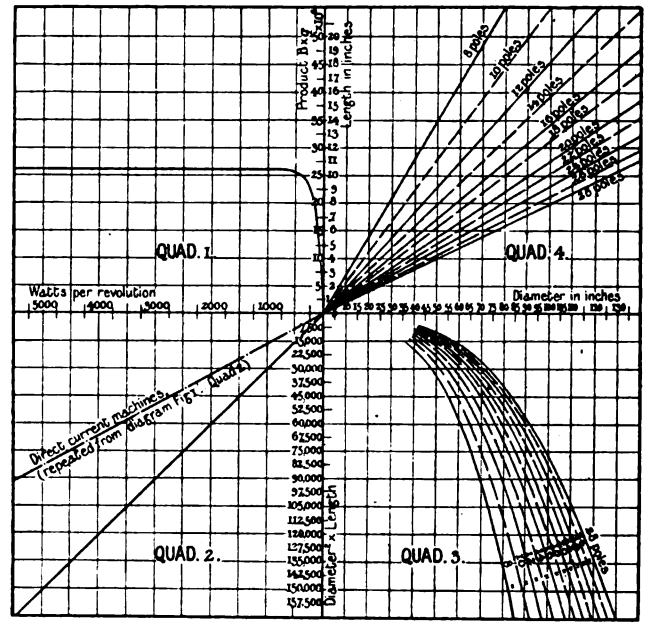

Fig. 5.—Relation between Output Factors and Armature Core Dimensions for Alternators.

between the diameter and length of the machine for any number of poles. By comparing the diagrams of Figs. 1 and 5, it will be seen that for the same output alternators are approximately twice as large as direct-current machines. The outputs of alternators are limited by the permissible potential rise from full load to no load, and this rise depends chiefly on the ratio of the field ampere-turns per pole to the effective armature ampere-turns per pole, which is usually about 4 to 1 in modern machines. The chief difficulty does not therefore lie with the armature, but it is a question of storing sufficient field copper on the alternator poles. This is due to the fact that the ratio of field ampere-turns to armature ampere-turns has to be very great.

The authors gave a method for calculating the potential rise, which took into account the resistance and reactance of both internal and external circuits, and then considered the possible means of increasing the output of alternators for a given core dimension. In the authors' opinion the old method of saturating a part of the iron section of the magnetic circuit might be made to give good results by careful design, and to produce this saturation, they suggest the use of a screw hole in the body of each field pole, extending almost to the pole face. The iron part of the pole above the tip of the screw becomes highly saturated, and this has the effect of flattening out the no-load characteristic. In order to obtain the best results the ratio of the reluctance of the iron part of the magnetic circuit to that of the air-gap should be made very high. This can only be done by reducing the air-gap density to the lowest possible value, by increasing the pole-face area, using semi-enclosed slots, and by reducing the length of the air-gap to a minimum. If the pole is over-saturated, so that the requisite E.M.F. cannot be obtained on full load, the length of the saturated part of the pole can be reduced by screwing the holding-on bolts further into the pole.

DISCUSSION.

Col. R. E. Crompton, who opened the discussion, after expressing his pride in the work of the authors, who are connected with Messrs. Crompton & Co., referred to the early days of dynamo design, when the core of the machine was considered a sort of adjunct of little or no importance. There were those present that evening who remembered the Gramme machine, with a few turns of iron wire for the core and a sort of pudding or winding surrounding it. It was this latter which was considered

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the matter of real importance, the core itself being considered more as a sort of support for the winding, and the fact that it was made of magnetic material was of secondary importance. He was delighted to see the quadrant diagrams in the Paper; since they had been put into their hands, eight or ten years ago, an enormous amount of time had been saved by their use. The Paper, he thought, prevented it being urged against British engineers as a reproach that they were rule-of-thumb engineers. The results given in the Paper were not based upon the experience in the one works only, and he knew, although he was not so competent to criticise the Paper theoretically as many others, that the practical results obtained by the authors were second to none.

MR. C. C. HAWKINS put in a plea for a more definite terminology on this subject. As was very well known, revolutions per minute being an angular velocity, the quotient of watts or output divided by the angular velocity gave torque, and this might be regarded as the specific torque of the machine. It was this which the purchaser bought, and the machine had to give. The speed was, so to speak, a somewhat secondary matter, as the cost depended on this particular torque. The quotient of the specific torque divided by the d^2l, he would then suggest should be called the dimensional torque—*i.e.*, the torque which could be obtained for every cubic inch of d^2l. This dimensional torque appeared in the equation—

$$B \times q = 870 \times 10^6 \times \frac{\text{Watts}}{\text{R.p.m.}} \div d^2l.$$

The reciprocal he suggested should have the name of "size constant." This was the quantity which appeared in the first equation, and was then called the "output factor." Fig. 1 showed a flat curve for the product $B \times q$, and he agreed with the authors that for large machines it did practically become flat. When it was expressed in terms of lines in the air-gap per square *centimetre*, and ampere wires per *inch* of armature periphery, this quantity gave about 8·1 millions, and it might be definitely divided into $B = 9{,}000$ C.G.S. lines per square centimetre, and $q = 900$ ampere wires per inch of armature periphery. This was the value for average modern practice, but the authors' figure was 10 millions. He would suggest that this was obtained by $B = 10{,}000$ and $q = 1{,}000$, but he would like to know what quantities the authors had in their minds. He did not think the authors had quite sufficiently emphasised the influence of voltage. It had not so much effect on large machines, but it had a very great effect on small machines at high voltage. There was no real reason why a small machine should not give as large an output per cubic inch as the large one, except for indirect reasons, but there was a very great difference between a small machine at 500 volts and one which had to give 100 volts. This, of course, depended upon the space factor, which was mentioned by the authors, but rather in connection with the number of slots than the number of wires inside them and their insulation. He did not quite follow why the authors laid considerable emphasis on square pole faces. He took it that the desire was to have a square pole core as the most economical to secure a circular magnetising coil. Turning to alternators, he did not think that at the present time curves could be got out with nearly the same validity as they could for continuous-current machines. Probably in course of time such curves would come to be well established, but there were so many secondary conditions coming in to affect the values, apart from the power factor, which was to some extent taken in by using k.v.a. instead of kw. There came in, in addition, the question of frequency and also fly-wheel effect, both of which quite upset many calculations as to the best size of machine, or even the smallest size of machine. With regard to highly saturating the pole of an alternator, this was, of course, a recognised method of producing a small rise, but he took it that the authors considered that their special method would be a very useful means of getting over the difficulties of not being able to count securely on the quality of the steel, as the saturation could be varied. He would suggest, in order to get over the difficulty of making a machine having a small rise of potential, the employment of a Tirrill regulator. In conclusion, he criticised the authors' method of calculating the rise of potential with an alternator, in which the cross reaction of the armature was neglected. He thought that it was better to adhere to the long method which was first devised by Prof. Blondel. The great accuracy of this had been demonstrated before the Institution in the Paper read some years ago at the Glasgow Local Section by Messrs. Henderson and Nicholson.

DR. SILVANUS THOMPSON, F.R.S., added a reminiscence to those already mentioned by Col. Crompton. About the time Col. Crompton mentioned, a certain patent was taken out and a certain dynamo was constructed. The patent was taken out in two names, and both gentlemen afterwards became Presidents of the Institution. The main part of the patent was to substitute for the iron core of the Gramme machine a phosphor-bronze core. In his own lectures at the Society of Arts, he drew attention to the fact that the magnetic loading of a machine ran into millions, and that the electric loading was generally of the order of thousands. The ratio, therefore, of the whole magnetic loading to the electric loading was something of the order of 1,000 in any machine, small or large. Dr. Goldschmidt, in his recent Paper before the Institution, had assumed 800 as the ratio, and to-night they were invited to contemplate machines in which the ratio was something of the order of 250 to 350. This meant that armatures were now to be, relatively to the field magnets, three times as powerful as they used to be. They were getting more work from the copper relatively to the iron, and that clearly could not possibly have been obtained but for the general introduction of the auxiliary pole, so that it was clear that the immediate effect on practice of the introduction of auxiliary poles had been to enable them to make a smaller machine, and to make them more of copper, which was costly relatively to the iron, which was comparatively cheap. But it was not so in reality, because they used a much less weight of copper even now than they did of iron. The new rule that the total costs of the copper and iron of the active parts should be made equal, he thought, would have to be modified in some cases, as, for instance, when considering standard sizes and so forth, which would somewhat upset the calculations. He wished to know whether the authors were justified in the assumption that the cost of the material in each of the parts, electric and magnetic, was really proportional to the total electric and magnetic loadings, or whether this was only approximate. He also wished to ask whether the authors found, when they examined any standard line of modern machines, any difference in the ratio of the magnetic to the electric loading for machines of the same size that were intended to be used as generators and those intended to be used as motors. The authors, Dr. Thompson said, had found a new and, assuming it to be true, very valuable rule for the value of core losses, viz., that the core loss varies approximately as the 1·3 power of the frequency. Passing on to the portion of the Paper relating to induction motors, he expressed a doubt that the leakage per ampere turn per inch of embedded length always varies inversely as the pole pitch. Clearly it could not be true unless the number of slots per pole per phase was constant. If this varied, then all the values were different. With respect to the proposition for obtaining alternators with a flat curve by putting a big air space into the middle of the pole where a screw could be introduced, he confessed himself not convinced. It was not very many months ago that Mr. Miles Walker gave, he thought, conclusive reasons for preferring machines in which the flattening of the curve was got in another way, and in which the air-gap was made comparatively wide. Lastly, with regard to the rule for making the width of copper in the slot the same width as the root of the tooth, did not this cease to be true with very large sizes of machines where the tooth was nearly parallel, for it was only in the small sizes of machine that the root of the tooth was very much smaller than the crown? With respect to the predetermination of the leakage factor of induction motors, it was well known that there was a difference in the amount of self induction of end bends of stators and rotors according to whether they turned up near the iron or stood out straight. If they stood out straight, there was less self induction. Now if the end bends were made straight out instead of turning any of them up—as could be done by adopting a drum-winding—not only was there the advantage of the straight out bends having less self induction, but they began to get the advantage of mutual induction between the end bends of the rotor and those of the stator, and the mutual induction actually reduced the self induction.

MR. MILES WALKER (British Westinghouse Co.) first pointed out the difficult nature of the problem which the authors had attempted to solve in expressing graphically the relations between size and output for three-phase induction motors. He then drew attention to the curves given by the authors for the limiting values of the ratio l/T as by a function of the pole pitch. These values, he said, had been derived by means of several assumptions, and were given as representing the values which would give the lowest leakage factors. From these curves it was seen that with a pole pitch of 10 inches, the value of the ratio l/T should be about 0·6, which meant that for a T^2l value of 600, the length would have to be 6 inches. It might, however, for manufacturing or other considerations be more convenient to use the values 8·4 and 8·4 for the pole pitch and iron length respectively, in which case the ratio l/T would be 1. He had calculated the leakage factor which would be obtained with these last values, and found that it was different by only 4 per cent. from the value obtained with the authors' ratio of 0·6. Thus it was seen that the authors' minimum leakage factor for this particular case could be reached within 4 per cent. with a value of l/T, 50 per cent. greater than taken by them. From this it was evident that the curves for the best values of l/T given by the authors could only be considered as a means for obtaining the quadrant diagram of Fig. 4. It was also interesting to consider how far the figures of 2·3 and 1, as the number of leakage lines per inch, could be varied. Both were capable of very wide variations, and the former could certainly be varied 50 per cent. either way. This rather struck at the root of the ratio of l/T, and he was rather sorry it was so, because it would be of the utmost use to designers if they could generalise in this way, and if they could find some general formula by which they could prove that for a motor of a given output, a particular

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length and diameter would be actually the best. The motors dealt with by the authors were said to be commercial motors. They might be commercial to manufacture, but were they commercial to sell? He rather thought a 500 h.p. motor at 50 cycles with a power factor of 0·87 (see Fig. 3) would be rather difficult to sell.

[Owing to shortness of time, Mr. Walker was asked by the President to send his further remarks for insertion in the *Journal*.]

Mr. G. G. Stoney (Messrs. C. A. Parsons & Co.) also related a reminiscence of the early days. He said there was a Siemens shuttle-wound dynamo in which the core was solid, and two Fellows of the Royal Society discussed why the core got hot. They finally decided that they could not give a reason, but determined to drill a hole down the middle and pass water through, and this was actually done. This was about 28 years ago. When Mr. Parsons started his high-speed dynamos running at 18,000 revs. per minute, nobody knew whether the magnetism would follow so fast. The late Prof. George Fitzgerald expressed the opinion that it would; as a result Mr. Parsons tried it, and we now knew it did. As Prof. Thompson had pointed out, the specific loading of armatures had been immensely increased by either compensated windings or interpoles, or combinations of both. In his own work he was getting over three times the specific loading with compensated windings than he had been able to get without them, and in addition, such a thing as shifting the brushes was now unknown. He was rather sorry that the authors had not discussed improvements in active material, as these were most important to electrical engineers. Within his recollection the hysteresis losses in ordinary armature iron had gone down one-quarter compared with the old days. They used to think that if they got iron which gave 1·2 watts per pound they had done very well; but now they could easily get iron to give 0·3 watts per pound, and with the special silicon steels—in which Mr. Mordey had done so much work—they could get down to 0·2 watts per pound, or one-sixth of what it was 20 years ago. At the same time, the specific resistance of the material was about six times higher, so that the eddy current loss was only about one-sixth. The authors had also purposely left out ventilation. Yet this was one of the most important things in a dynamo or alternator. One of the problems of the designer was to put the maximum of copper and iron and the maximum of ventilation into a given space. The authors stated that the output obtainable from the armature of a synchronous alternating-current dynamo was not in any way limited by temperature rise. This was also mixed up with ventilation, and he only wished it were true, because in his experience temperature rise was even more important than permissible rise of potential. Some alternators, he believed, had been rejected owing to excessive temperature rise. The Tirrill regulator had been mentioned, but his firm had been using the compensated alternator, which was described in the Paper by Mr. Laws and himself before the Institution last session, with very satisfactory results. From experience with this it was found that the lag due to the very small alteration of the magnetism was quite inappreciable, and he thought it would prove more satisfactory in connection with the compensating of alternators than the Tirrill regulator, as there were no moving parts whatsoever. The high saturation mentioned by the authors was, in actual commercial alternator design, a dangerous thing. If there was the smallest error in estimating the leakages, or if the material was not as good as might be expected, they failed completely to get the result desired, and especially so on an inductive load. For ability to run up the voltage a bit in case the drops in the mains were more than were expected, or that some portion of the system required higher voltage, it was most important that there should not be too much saturation. It also enabled them to deal with a lower power factor than was expected. He therefore cautioned all young designers of alternating-current machinery not to trust too much to saturation.

Mr. S. E. Glendenning (Messrs. Laurence, Scott & Co.) disagreed with the authors that deeper slots necessarily meant improved commutation. As a general rule, a machine with shallow slots, other things being equal, ran better than a machine with deep slots. More important was the design of the commutators; it was very easy to turn a good machine into a bad one by economising too much in the commutator. By making it too small, they could not keep the temperature low, on account of the C^2R losses, and if they made the current density too high the brushes were reduced to coke in the course of a few weeks. Again, if they put in too few sections, the limit of reactance voltage might be reached. He had not gone beyond 23 volts, and he thought that was quite high enough. He suggested that the method by which the output had been increased in recent years was by increasing the windage and cooling surface of the machine by somewhat increasing the diameter, and he had got results 35 per cent. higher than those given by the authors in Fig. 2, with a peripheral speed of 3,500, by boring a big hole in the core. As the authors had suggested that the radial depth of the iron should be great, it looked as if they had been working with rather small holes. With regard to materials, the new armature steels, when the price dropped, would be a considerable help, especially in high-speed machinery. At the present time, however, "stalloy," for instance, was about three times the cost of ordinary armature steel. It was possible with this material to reduce the core loss by 40 per cent. Again, there was the question of enamel-covered wire. This could now be got with a thickness of one mil, which would stand 1,000 volts, even with some bending. It would also stand solder heat for a considerable time. At present, for moderate gauges, enamel wire was about 30 per cent. dearer than cotton-covered wire. There was also another item which might help in reducing the cost of field windings, although hardly an increase in the output of the machine, viz., aluminium. Of course, for commutators it would never be used, as it was a bad friction metal. With regard to ventilation, some firms had experimented with fans on the armatures, and they had certainly succeeding in ventilating the engine room, if not in cooling the armature. The ventilation of the field coils had been improved by increasing the size of the ducts, and by keeping the coils well apart from each other.

The following written communications to the discussion have been received:—

Mr. T. Carter (Newcastle-on-Tyne) writes:—It is stated at the beginning of the Paper that neglecting armature copper loss, E.C. is the output in watts. The Paper includes dynamos and motors, and it is only in a dynamo that this statement is accurate, as in a motor some of the watts contained in E.C. are used up in overcoming windage, bearing friction, and core loss, and these may in small machines be a comparatively large percentage of E.C. With regard to the expression, "output per revolution" in the formulæ, this expression is correctly denoted as watts/r.p.m., but whenever it is given in words, it is expressed so as to have no physical meaning whatever. "Watts/r.p.m." expresses obviously a measure of the *work done per revolution* of the machine. It is therefore also closely connected with the tangential force existing round the armature circumference. From Quadrant 4 in Fig. 1, it is clear that the ratio of diameter to length for square pole faces is very nearly half the number of poles in the machine. This is a very easy rule to remember, and as in a line of machines there are usually two or more lengths for one diameter, it is usually accurate enough to take the mean value of the ratio for a given diameter as equal to half the number of poles. Finally the slot depth of one-sixth the diameter of armature seems so very far away from anything adopted in practice that the utility of the expression is quite doubtful. It is quite impossible to think of a slot, say, 10 inches deep in an armature of 60 inches diameter, and a slot of 2 inches deep in an armature 12 inches diameter seems also rather odd, unless the saturations are very different from what are now used. This may be possible with interpoles.

Mr. R. Livingstone (Messrs. Dick, Kerr & Co., Preston) writes:—In considering D.C. machines, the authors leave out of consideration machines without interpoles. At present commutating poles are used chiefly on high-speed or variable voltage generators and variable-speed motors, and ordinary generators and motors are still built without them. Economy is one of the first considerations of any manufacturing firm, so that it is evident that for ordinary machines commutating poles are not considered economical. The ordinary D.C. generator can be designed so that the full output, as limited by temperature rise, can be obtained with excellent commutation. The use of interpoles in such cases can hardly be economical. In the authors' Paper a density of 135,000 C.G.S. lines per sq. inch is given for the limit of tooth density. Many machines are running with an "uncorrected" tooth density 15 to 20 per cent. greater than this (at frequencies of 25 to 30 ~), and I should like to know the authors' reasons for keeping this density so low. The depth of slot will have an influence on the A.T. required on the commutating pole. A deep slot gives a high reactance voltage, and the high armature strength gives a large distortion of flux in the interpolar gap. These two factors influence the commutation adversely, so that more turns would be required on the commutating pole. Would not this affect the ratio of depth of slot to diameter of armature, and also the dotted line curve in Quadrant 2, Fig. 1? In variable-speed motors or generators the increase of volts between adjacent commutator bars due to field distortion becomes of some importance, and would put a limit to the depth of slot. The armature A.T. increase almost directly as the depth of slot, but the field A.T. would not increase, so that the ratio of armature A.T. to field A.T. would be increased.

Mr. P. R. Friedlaender called attention to the fact that some of the curves contained in the Paper were entirely dependent on the ventilation arrangements adopted, and although large improvements in this direction had taken place within the last few years, the possible limit had by no means been reached yet. He also remarked that the exact causes of the greater part of the iron loss in direct-current armatures were at present unexplained. It was well known that this loss was usually two or three times as great as that calculated from the hysteresis and eddy current constants of the iron, and this excess was probably due to additional eddy currents produced partly by the burring over of the discs during construction, and partly in the thick end discs used to support the armature and

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in the magnet pole faces. In connection with their remarks on induction motors, the authors had not explained how they estimated the total flux per pole. Apparently they had assumed a sine wave space distribution of the flux, but this was not quite justified for normal motors.

DR. ALEXANDER RUSSELL also sent in a communication, in which he criticised some of the authors' formulæ. In the case of that for total iron loss, the effect of variations in the thickness and resistivity of the iron stampings had not been taken into account, and he found difficulty in accepting the empirical formula for leakage factor, as it did not consider the number of turns and the nature of the windings of the stator and rotor. In their deductions as to a "best ratio" for core length to core pitch, they had also apparently assumed that the equivalent air-gap did not vary with the diameter of the rotor. He then proceeded to indicate a method for arriving at a formula for demagnetising ampere-turns due to the current in the armature.

The authors will reply to the discussion in the "Journal."

ELECTRICITY SUPPLY AND DOMESTIC HEATING AND COOKING

Dublin Discussion

THE Paper on "Domestic Electric Supply (including heating and cooking) as affected by Tariffs," read by Mr. W. R. Cooper on November 26th, before the London meeting of the Institution of Electrical Engineers, was further discussed by the Dublin Local Section of the Institution last Thursday. In the paper itself, which was given at some length on page 725 of ELECTRICAL ENGINEERING of December 3rd, Mr. Cooper considered the various methods of charging which had been proposed from time to time in relation to a supply both for lighting and domestic heating and cooking. He condemned all existing systems, especially the maximum demand system, and proposed one involving the payment of a fixed sum per annum, based on the total wattage of the lamps installed, plus ¾d. per unit used. The latter portion of the paper dealt with electric cooking and domestic heating.

Mr. W. J. U. SOWTER (Chief Electrical Engineer, Bray) said that he agreed with the author's strictures regarding the maximum demand system, but he differed from the author in thinking that it had been educational to the consumer. On the contrary, Mr. Sowter was convinced that it had in some cases done actual harm to supply undertakings; consumers did not understand it, and no system of charging which the consumer cannot follow and be able to check his account can be regarded as satisfactory. In places where the maximum demand system existed it was a work of considerable difficulty to frame another scale to take its place. It was impossible to substitute a flat rate because such a rate would, in order to give satisfaction, have to be as low as the average charge per unit to the longest hour consumer. Mr. Sowter considered that the proposal of the author to base the charge upon the number of lamps fixed would be unworkable in practice. Consumers often changed their lamps or had additional ones installed without notifying the authority, and there would doubtless be endless disputes regarding this. Of course, the proper way to charge was by the number of lamps *used*, but this brought them back to the demand indicator. In the speaker's opinion, the most satisfactory way to use the demand indicator was that adopted by Mr. Leonard Andrews at Hastings, viz., the indicator was calibrated for 30 watt lamps, and a fixed charge per annum made for each 30-watt lamp indicated, plus a small charge per unit for energy consumed. Every consumer understood such a system. As the author pointed out, the chief objection to any method of using demand or rebate indicators was that no account was taken of the *time* the maximum demand occurred. It was there that the two-rate meter stepped in. In ordinary lighting stations, "peak loads" must exist, and all the engineer could do was to try to broaden the peak as much as possible, and charge a remunerative price for energy used at such times. That was exactly what the two-rate system did, and in the speaker's opinion it was, in spite of the increased cost of meters and extra complication involved, the most equitable system yet introduced. There was no reason why *per se* a heating device—say, an electric kettle—should be charged at a cheaper rate when used at "peak time" because it *was* a kettle and not a lamp. Regarding cooking by electricity, there was no doubt that there is a field for extensive operations in that direction, particularly in view of the high price of gas in the Dublin district. In order to emulate the energy of the gas company in that direction, it was necessary to adopt their methods by hiring out apparatus to consumers. Unfortunately, however, the very high cost of such apparatus militated against success. A complete set of electrical cooking apparatus cost at least £12, as against about £3 for the corresponding gas apparatus; further, the maintenance of such electrical apparatus was a costly item, so that altogether he was afraid that, although granted that the cost of energy in each case would be about the same, it would be necessary, in order to carry out the project commercially, to charge a rental many times greater than the gas company did, with the result that the public would not entertain the suggestions even of the most pursuasive and eloquent canvasser. Therefore, one could only hope that the manufacturers would be able in the near future to place upon the market cheap and simple apparatus to compete with gas cooking and heating stoves.

Mr. A. E. PORTE remarked that Richmond was a typical residential district, and that the bulk of the demand was for private house lighting. The load curves given in the Paper showed clearly the necessity of pushing the sale of energy for cooking and heating. He did not think that the cooking and lighting loads would overlap to any great extent, but if they did, then a meter which differentiated between the hours of supply, viz., a two-rate meter, would render it easy to frame an equitable scale of charges. For instance, in the Richmond case, during the winter months, the higher rate of charge might endure between the hours of 4 and 10 p.m., and in the summer from 8 to 10.30 or 11 p.m. Two-rate meters were expensive at present, but he thought that they might be made much cheaper. Mr. Porte thought that there should be a considerable field for the use of radiators in offices in large cities, which during the winter months would form a substantial day load. Regarding the proposed domiciliary visit necessary in connection with the scheme of charging based on the lamps connected, he (Mr. Porte) thought that such a necessity would render the system very unpopular, and he doubted very much whether corporate bodies could spend the ratepayers' money for the purpose of employing the necessary officials for the work. Of course, a private company had far more latitude in this respect. Turning to the subject of cooking by electricity, Mr. Porte referred to an electric oven invented by a Dublin man who, curiously enough, had very little knowledge of electrical matters. The oven consisted of a cylinder with shelves arranged round, over which a well-shaped cover fitted. The chief feature of this apparatus was that it was very thoroughly lagged, and the number of heating elements could be varied at will. In ordinary electric ovens their inefficiency was largely due to the number of times it was necessary to open or shut the door, and the very poor method of lagging. The apparatus then referred to would cook a large ham with one unit of electricity, and he thought that a considerable advance. Mr. Porte had had some experience with electric flat-irons, and found that an 8 lb. iron consumed 0·5 unit per hour, while a 14 lb. iron required 1 unit per hour. This was slightly higher than the cost for gas irons.

Mr. L. J. KETTLE (Dublin Corporation) said it appeared that "Tariff Reform" was still in the air. The suggested method of charging, according to lamps fixed, was no novelty, as it had been tried on the Continent, and abandoned in favour of an ordinary flat-rate. If, however, such a system were adopted he thought undertakers should charge for the candle-power irrespective of efficiency. He noticed that Mr. Cooper, in making his calculations concerning the cost of producing extra energy for cooking and heating, assumed a load factor of 25 per cent., but it seemed to Mr. Kettle that it would not be anything like so high. That being so, the whole argument fell to the ground, and cooking and heating should be charged at a somewhat higher rate than those suggested. Of course, if some arrangement could be made whereby such apparatus could be kept off the mains at "peak time," then energy could be supplied cheaply for heating and cooking. He noticed that in the table of costs of different methods of cooking given in the Paper, that oil was apparently only half the cost of gas; why, then, was gas used at all? It was, of course, purely a matter of convenience. That being so, electrical cooking for just the same reason would probably supersede gas cooking. Referring to the question of tariffs, he thought that the maximum demand system had been useful in making charges equitable between consumers, but, on the whole, a flat rate was likely to prove the more satisfactory, although not so satisfactory to the station engineer.

Mr. W. TATLOW (Messrs. Egan & Tatlow) saw no reason for the introduction of another new tariff, and thought that a tariff based on the number of lamps installed would prove particularly objectionable. The public would not take kindly to the intrusion of officials for the purpose of inspective installations. Such schemes paved the way for the "bogus" inspector, whose "inspections" probably would not be limited to installation and lamps. The speaker did not consider that the cost of separate wiring for heating and cooking would be great. In any case, extra wiring was essential. Contractors were not usually so liberal in their estimates of copper necessary for the lighting circuits. A radiator absorbing one kilowatt could not be attached to an ordinary pendant fitting, and must be wired up separately; why not therefore put in a separate circuit? Similarly, the supply authorities would have to instal a larger meter.

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The course adopted by the Dublin Corporation—and doubtless it was a correct one—was to put in separate meters for such purposes. Concerning cooking apparatus, Mr. Tatlow, judging from his own experience, thought that the cook often needed improving as well as the apparatus; otherwise it would soon be ruined. Flexible cords were an objectionable feature, and if an alternating current apparatus could be devised consisting of a large magnet energised by the circuit, and the kettle, hot-plate, or other apparatus containing short circuited conductors were placed on top, the eddy currents induced would furnish the necessary heat. Such an apparatus, if practical, would be a distinct advance. Touching upon the question of heating buildings, he referred to the fact that in America the central station authorities carried out a good deal of heating, but by steam exhaust, which was distributed. This, of course, involved the location of the generating station in a central position.

Mr. P. S. Sheardown (Dublin United Tramways Co.) thought that there were no very definite views expressed in the Paper; the author simply suggested another method of charging without giving any proof of its benefits. He agreed with Mr. Tatlow on the wiring question. If a house was properly wired there should be no room for cooking and heating apparatus. Wiring for such apparatus should be cheap, because a drop of potential on heating circuits was not as serious as on a lighting circuit; therefore the matter was not so serious as Mr. Cooper suggested. Mr. Sheardown expressed himself in favour of the two-rate method, which he thought would lead to cooking and so on being conducted at other than "peak" times.

Mr. G. F. Pilditch (Chairman), in closing the discussion, agreed that the proper system was to use separate circuits with independent flat rates for lighting and heating. Gas consumers had no restrictions placed upon them, and he was afraid that if electrical undertakers imposed all kinds of restrictions on consumers they would not take it up. The cost of wiring was not a serious matter, but local authorities should have powers to wire up and let out cooking apparatus in the same way that the gas companies did. Mr. Pilditch thought engineers worried too much over the peak; they should endeavour to push heating and cooking as much as possible in order to level up the curve. Two-rate meters were complicated and expensive to maintain, and consumers using them always thought when the quarterly account was presented that they had used no energy at the higher price, and consequently that the meter was wrong. Electrical flat-irons were usually well used, and should be encouraged.

LONDON ELECTRIC POWER BILLS

London Electric Supply Bill.

THIS Bill came up for third reading in the House of Commons on Monday, and was the subject of considerable debate.

Mr. A. C. Morton, on behalf of the City of London Corporation, moved the insertion of a new clause providing that the promoters should obtain the consent of the City Corporation before opening the streets for the purpose of laying mains. Although Mr. Churchill, on behalf of the Board of Trade, was willing to accept this, Sir Luke White, as Chairman of the Committee which considered the Bill, expressed the opinion that if these powers were granted to the City, they would have to be granted to every other local authority. There was considerable general opposition to the clause, and on a division it was rejected by 170 votes.

The following new clause on the motion of Mr. Churchill was then agreed to: "From and after the date when the Council gives notice to purchase the undertaking of a supply Company, it shall not be lawful for that Company, except with the consent of the Board of Trade, to increase its charges for a general supply, as defined in the Schedule to The Electric Lighting (Clauses) Act, 1899. If at any time after the aforesaid date the Company makes any higher charge for electricity supplied to any consumer under agreement than had been charged for a similar supply under similar conditions during the period of twelve months immediately preceding that date, the consumer affected may appeal to the Board of Trade, who, if they consider that the increase is unreasonable, may make an order requiring the Company to reduce the charge accordingly, and any such order shall be binding on the Company."

A further alteration was made in the Bill, permitting the Companies concerned in the London (Westminster and Kensington) Electric Supply Bill to link up their undertakings with the promoters of the present Bill, and in this connection Mr. Churchill gave an undertaking that the Government would at the earliest possible moment introduce a Bill constituting the London County Council the purchasing authority of the Companies concerned in the other Bill. The alteration to the Bill in question renders the other Companies liable to all the provisions of the present Act.

Mr. W. Guinness moved an amendment to Clause 4, which provides that the route of mains shall be agreed between the Companies and the local authorities. The amendment in question gives the London County Council the same rights as the local authorities in this respect. There was considerable opposition to this on behalf of the borough councils, but it was eventually agreed to.

Mr. B. S. Straus, referring to the new schedule of prices for power supply in the Bill—namely, £6 15s. per kilowatt of maximum demand per annum, and 0·5d. per unit, moved that the price per kilowatt be £4 10s., which was the price inserted in the Bill as it originally came before the House of Lords Committee in the form of a bulk supply scheme. It was pointed out, however, that the original scheme provided for a tenure of 42 years, whereas now the Companies only had 23 years, and after Sir Luke White had mentioned that the price now in the Bill had been agreed upon between all parties, this amendment was withdrawn.

The following amendment on the motion of Mr. W. Guinness was made to Clause 15, which is for the protection of the London County Council:—

"(7) The said Council shall, for the purpose of section fourteen of the Schedule to The Electric Lighting (Clauses) Act, 1899, have, in addition to any powers, rights, and privileges possessed by it under the said section, the same rights, powers, and privileges as if they were the local authority for the said county. Provided that nothing in this sub-section shall be deemed to require the works or plans of a local authority who may be an authorised undertaker to be approved by the said Council."

A further amendment at the instance of Mr. W. Guinness was made to Clause 22 (the Purchase Clause), as follows:—

"Provided that this sub-section shall not apply in respect of any part of the undertaking of the Metropolitan Electric Supply Co. which may not in pursuance of this section be purchasable by the Council upon the terms specified in section two of The Electric Lighting Act, 1888."

A further amendment by the same member to Clause 22 was accepted for the purpose of making it clear that any companies not operating under the Electric Lighting Acts of 1882 should be purchasable equally with those who are.

Mr. Churchill then proposed two new sub-sections in Clause 22 in substitution of those in the Bill. These read as follows:—

"(3) The undertakings of the several London Electric Supply Companies within the county, including any lands, buildings, works, materials, and plant provided or constructed under the powers of this Act shall, if purchased by the Council, be paid for upon the terms specified in section two of The Electric Lighting Act, 1888, provided that if the Council give notice for purchase at the twenty-sixth day of August, one thousand nine hundred and thirty-one—

"(*a*) that part of the undertaking of the Charing Cross, West End, and City Electricity Supply Company, Limited, which is authorised by The City of London Electric Lighting Order, 1899, shall be purchased only upon the terms set forth in the said Order; and

"(*b*) the City of London Electric Company, Limited, shall be entitled to such additional compensation as may be agreed upon, or as may in default of agreement be determined by arbitration, for loss of net profits which might have been made by that Company between the said twenty-sixth day of August, one thousand nine hundred and thirty-one, and the eighteenth day of August, one thousand nine hundred and thirty-two.

"(4) The Council shall not be under any obligation to purchase so much of the undertaking of the Metropolitan Electric Supply Company, Limited, in the said county as is not purchasable by a local authority except such lands, buildings, works, materials, and plant as shall have been provided or constructed by that Company under the powers of this Act, but the Council may, if they think fit, purchase so much of the undertaking as aforesaid on such terms, if not agreed upon, as an arbitrator may think reasonable."

In moving these amendments, which were eventually agreed to, Mr. Churchill explained that the presence of the words "on equitable terms" in the instruction to the Committee, which had had so much stress laid upon them by the promoters, had not been intended to open the question of the purchase terms, but only to provide for those cases in which certain companies had a longer term than 1931, so that the County Council could purchase them at that date by giving compensation for the unexpired period.

Mr. W. Guinness moved an amendment providing that the London County Council should have powers, after having purchased all the Companies to sell the distributing system to the local authorities, but the Board of Trade objected to this, and the amendment was withdrawn.

In the same manner a further amendment by Mr. Guinness providing for the purchase of a local authority's undertaking by the County Council, where this was in competition with the

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Company, at the same time the Company's undertaking was purchased, was also withdrawn.

Mr. GUINNESS then moved that three-fourths of the purchase money instead of one half, as proposed in the Bill, should be payable in stock and the remainder in cash. The Companies having agreed to make this concession, the amendment was agreed to.

The following sub-section to Clause 24, "Advances to Companies by Council," was added on the motion of Mr. Churchill :—

"(*d*) The Council shall not be obliged to advance any sum to a Company under this section unless they are satisfied that there is adequate security for the repayment to them of the sum to be advanced and for the payment of the interest thereon."

In this same connection, the following addition was made on the motion of Mr. W. Guinness :—

"It shall be lawful for the Council and any of the London Electric Supply Companies to enter into and carry into effect any agreement or agreements with regard to matters dealt with in this section, and any such agreement may contain any provision for the repayment to the Council of any sum which they may advance to a supply Company in pursuance of this section, notwithstanding the provisions contained in this section."

The Bill was then read a third time.

London (Westminster & Kensington) Electricity Supply Bill

On the third reading consideration of this Bill, a clause was added on the motion of Mr. Lambert on behalf of the Admiralty in precisely the same terms as one which had been accepted by the promoters of the previous Bill, for the protection of the Admiralty. The clause read as follows :—

"If the Admiralty are of opinion that the generation or use of electrical energy under or for the purposes of this Act by the Companies injuriously affects, or is likely injuriously to affect, any instrument or apparatus in or adjacent to the Royal Observatory at Greenwich, including the Magnetic Pavilion, or the efficient working of such instrument or apparatus, the Admiralty may, after such inspection and inquiry as they think proper, require that the Companies shall use such precautions, including insulated returns, as the Admiralty may deem necessary for the prevention of such injurious affection, and the Companies shall forthwith comply with such requisition. For the purpose of this section any person authorised in writing by the Admiralty shall have access at all reasonable times to the works and apparatus of the Companies, who shall give all due facilities for the inspection. Provided always, that in the event of any instrument or apparatus hereafter used in the said Observatory which may be of a different character and of materially greater delicacy than those used therein at the passing of this Act, the Admiralty shall consider, and may in their discretion determine, to what extent the powers of this section should be exercised, regard being had to the interests of the public as well as to the purposes of the instruments or apparatus as the case may be. The Admiralty Suits Act, 1868, shall apply for the purposes of proceedings in regard to any breach of the provisions of this section or for injurious affection of the said Observatory or instruments or apparatus."

Some minor amendments having been made, this Bill was also read a third time.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN order to remove sulphur from the metal in iron smelting furnaces it is necessary to have the slag free from metallic oxides, in particular from oxide of iron. The sulphur must be combined with calcium, and not, as is the case in other metallurgical processes, with manganese. The conversion of the iron sulphide and of the manganese sulphide into calcium sulphide can only take place in presence of a powerful reducing agent. In the Héroult electric furnace, calcium carbide is employed to remove the sulphur, and in the induction furnaces ferro-silicon is used. The desulphurising power is practically the same in both cases, but the use of ferro-silicon is more expensive. In the Héroult process the calcium carbide is made *in situ* by the action of the carbon electrodes on the lime slag. It does not, therefore, require to be first made and then added to the furnace charge, consequently it is found to be about 5s. cheaper per ton of iron smelted than if ferro-silicon were employed. There is also a danger in the use of ferro-silicon that the finished steel may contain too large a quantity of silicon. The employment of calcium carbide to produce a slag poor in metal has been patented by the Elektrostahl-Gesellschaft, German Patent, 163519.

According to *Stahl und Eisen*, 1908, p. 1906, the electrometallurgy of iron and steel has now passed out of the experimental stage, and is a recognised manufacturing process. There are at present

	Induction furnaces.	Arc furnaces.
In operation	21	24
Building	12	18
Projected	2	1
	35	43

P. Askenasy, W. Jarkowsky, and A. Waniczek contribute an interesting note on aluminium carbide in the *Zeitschrift für Elektrochemie* of December 11th. Instead of starting with metallic aluminium and carbon to prepare their carbide, they heat strongly in an electric furnace a mixture of aluminium oxide and carbon. The furnace made of carbon plates was the one electrode, and the other electrode was a rod of carbon. Experiments were made to ascertain the best conditions for the formation of the carbide. The most successful experiment was one in which at 30 volts they employed a current of 600 amperes for one hour. With 40 volts and 200 amperes for 1½ hours the results were not so good. The carbide has a fine yellow crystalline appearance. A peculiar property of the carbide is that if it is heated for some time aluminium is obtained from it, and the carbide becomes black from the deposition of carbon. In one case, on heating some of the carbide for 55 minutes, 52·66 per cent. of aluminium melted out from it. It would appear that the carbide is produced only at high temperatures, but that at moderate temperatures the aluminium and carbon lie side by side. The facts now discovered throw light upon the experiments of Pring, who found, under certain circumstances when aluminium carbide was heated with metallic oxides, that aluminium alloys were obtained, and also that when the carbide is decomposed with water or acids the methane given off was invariably mixed with hydrogen. This means that aluminium carbide always contains some free metallic aluminium.

At a meeting of the Faraday Society, held on the 15th, three Papers were read. The first was by Dr. F. J. Brislee upon "A Redetermination of the Electrolytic Potentials of Silver and Thallium." The potential difference between a metallic electrode and a solution containing ions of the same metal is given by the equation

$$E_{\text{electrode}} - E_{\text{electrolyte}} = E_0 P_1 + \frac{kT}{nF} \log C_0$$

Where C is the ionic concentration of the solution surrounding the electrode, R the gas constant, T the absolute temperature, F the charge per gramme equivalent, and n the valency. The electrolytic potential, *E.P.*, is defined as the potential of a metal against a normal ionic solution of the same metal. The *E.P.* was measured by employing the calomel or hydrogen normal electrode, and determining the E.M.F. between the electrodes of the combination metal. The results obtained for silver were in both acetate and nitrate solutions +1·0757 volt. The most probable value of thallium was found to be −0·0425. Mr. H. Russell Ellis read a Paper on "The Formation of Graphite by the Interaction of Magnesium Powder and Carbonate." The author found in all cases when magnesium powder was heated with carbonates considerable amounts of graphite were formed. The third Paper was by Dr. E. Feilmann, upon "Colloidal Barium Sulphate." The method of preparing this substance was described.

CATALOGUES AND PAMPHLETS RECEIVED

ELECTRIC HOOTERS, BELLS, &c.—Pamphlets from Messrs. Marples, Leach & Co. describe the "Adnil" electric hooter for various signalling purposes, motor cars, &c., and a large and powerful motor-driven electric bell for factories, &c.

THREE-PHASE MOTORS.—A further pamphlet of the series being issued by Mr. G. Wüthrich deals with three-phase variable Oerlikon speed motors for two or four speeds, from ½ to 20 h.p., for pressures up to 500 volts 50 cycles.

ARC LAMPS.—Messrs. Johnson & Phillips have continued the series of new lists they are bringing out by the issue of a catalogue of arc lamps and accessories. Two sizes are included of the firm's patent shuntless single enclosed arc lamps for continuous and alternating current. The "Magnet-Juno" flame lamp is also dealt with, together with a special pattern of vertical carbon flame lamp (see ELECTRICAL ENGINEERING, Vol. II., pages 723 and 776), and a new 60–80-hour magazine flame lamp. A very complete range of accessories is included.

STARTERS, CONTROLLERS, AND RESISTANCES.—A new list of Ward Leonard rheostats, issued by Messrs. W. Geipel & Co., deals with a number of varieties of these well-known field rheostats, ordinary and solenoid motor starters, controllers, theatre dimmers, and also lift controllers, both of a continuous current solenoid pattern and the alternating current form described on page 762 of our last issue. The prices of motor controllers and starters appear to have been considerably reduced, and a useful stock sheet, with special prices for some of those which are in stock for immediate delivery, accompanies the list.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Dec. 10th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1907 Patents

22,868, **Regenerative Braking with Series Motors.** British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*). This invention is for a method of obtaining regenerative braking with continuous-current series traction motors and consists in connecting the armature and field of each motor in series as is usual, and varying the voltage across the field by means of a separate source of supply. This has the effect of fixing a definite speed, below which the machine runs as a motor, and above which, as a generator; in each case the machine runs with a series speed-torque characteristic. To supply the extra field excitation a homopolar machine, with a set of collector rings for each motor, is provided. With this arrangement the motors can be connected in series or parallel in the usual manner. At starting, the homopolar machine is used to strengthen the motor fields. Four claims, eight figures.

25,624, **Prevention of "Over-Commutation."** M. Walker. An improved form of brush for commutators and rectifiers or permutators is described in this specification. To prevent sparking, the collecting brushes are moved into such a position relatively to the magnetic field, that the induced E.M.F. in the short-circuited coil is sufficient to entirely reverse the current. If the E.M.F. is too large, however, "over-commutation" will occur, as the reverse current will be larger than the armature current. To prevent this the present invention provides for a double brush, between the two halves of which an electric valve is placed. The valve thus prevents the current from reversing while the coil is short-circuited. Five claims, eight figures.

25,655, **Manufacture of Conducting Filaments from Natural Earths.** E. von Seemen. This specification describes a process for the manufacture of conducting bodies from such substances as alumina, silica, lime, magnesia, or compounds of these. The substance is fused with a small quantity of an oxide of the iron group in the presence of oxygen. A substance made in this way, and consisting, for example, of 85 to 90 per cent. of magnesia, alumina, or silicate of magnesia, with from 15 to 10 per cent. of iron or chromium oxide, is a good conductor of electricity when cold. Three claims.

25,716, **"Venner" Time Switch and Solenoid Main Switch.** R. F. Venner and R. C. Griesbach. The "Venner" time switch adapted for use on arc-lighting circuits, and the pattern of solenoid-controlled main switch, for use with the above, are described in this specification. An illustrated description of this main switch was given on pages 44 and 45 of the Manchester Exhibition Supplement to Electrical Engineering of October 29th, 1908. Seven claims, five figures.

1908 Patents

3,369, **Detector for Indicating the Existence of High Voltage.** W. M. Thornton, H. W. Clothier, and A. Reyrolle and Co., Ltd. This apparatus consists of one or more condensers in series, with a spark gap. If one side of a condenser is connected to the wire or body to be tested, and one terminal of the spark gap, or of another condenser in series is connected to earth, a spark will occur if the wire or body is at a high potential. The charge to which the spark is due is purely inductive, and this renders the apparatus quite safe to handle. Fuses are connected in circuit to protect the apparatus. Four claims, nine figures.

10,764, **Storage Battery Plates.** A. O. Tate. This and the two following patents, Nos. 10,764 and 10,768, relate to the construction of storage battery plates of the Faure type. The plates described consist of strips of a porous insulating material, such as kaolin, which are grooved on their opposite faces so as to constitute flanges. The active material is located in these grooves, and thin strips of lead are interleaved between the grooved sections. All the anode strips are connected to one supporting and connecting rod, and all the cathode strips to a second supporting rod. The active material in the grooves of the porous strips is entirely covered in on the two sides by the anode and cathode strips respectively, and, therefore, cannot become dislodged. Evolved gases escape through the pores of the insulating material, which also admit the electrolyte. A simpler form of construction in which the active material is sandwiched between thin strips of insulating material and lead alternately, with side plates of porous material, is described in the second specification, and the third specification describes yet another alternative in which each lead strip, whether anode or cathode, is fixed in an insulating frame with active material on either side of the strip, supported by flanges in the insulating frame. These frames are assembled together, alternately anode and cathode, with porous insulating strips between as before. Eleven claims, fourteen figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

12,747, Cowper-Coles. Electrodeposition of iron.
20,774, British Thomson-Houston Co. & Wedmore. Switches.
21,928, Richardson. Globe for electric lights.
25,669, Hausmann. Electrodeposition.
25,878, Davy. Distribution of electricity.
25,884, Miess. Incandescent vapour lamps.
25,968, Anzalone. Combined telephone receivers and transmitters.
26,045, Steinhauff. Railway signalling.
26,143, Eastwood. Lifting magnets.
28,487, British Thomson-Houston Co. (*General Electric Co., U.S.A.*) Machines for coating wires with insulating material.

1908 Patents

112, Van Raden. Magneto-electric machines.
412, Steynis & Chaumat. Production of ozone.
741, Electrolytic Alkali Co., Connor & Stubbs. Treatment of resins, wax, gums, &c., with chlorine.
892, Crompton & Co., Macfarlane & Burge. Alternating current induction.
1,304, Geissinger. Electrical temperature regulating apparatus.
1,950, Kingsbury (*Bell Telephone Manufacturing Co.*) Gravity switches for telephones.
1,956, Edwards. Joints of tramway rails.
2,222, Messier. Electric motor.
4,657, Ruzicka. Manufacture of resistances.
5,596, Kent, Lacell, & Silica Syndicate, Ltd. Mercury and other vapour lamps.
9,636, Siemens-Schuckertwerke Ges. Fittings for lamps.
9,762, Ruzicka. Manufacture of resistances.
9,763, Ruzicka. Manufacture of resistances.
9,832, Peters. Safety-fuses for switchboards.
9,876, De Sainte-Clare. Variable speed gear for electric automobiles.
10,104, Plumb. Signalling systems for mines
10,269, Ruzicka. Arc-lamp.
11,710, Siemens & Halske Akt.-Ges. Manufacture of a plastic mass from tungsten compounds.
12,420, Paulin & Fortune. Telemotor apparatus for ships' steering gear.
15,490, Haber & Koenig. Production of compounds of oxygen and nitrogen.
15,819, Aitken. Telephone cordless switchboards.
17,205, Bradburn. Telephone apparatus.
17,250, Hickie, Brentini, Manzetti & Brentini. Railway systems.
17,414, Siemens Bros. Dynamo Works & Kieffer. Ventilating the rotors of dynamo-electric machines.
17,509, Regina-Bogenlampenfabrik Ges & Hanisch. Arc lamp.
18,216, S. P. (Suchostawer Patents) Syndicate & Sayers. Surface-contact system of electric traction.
21,603, Allegemeine Elektricitäts Ges. Devices for protecting transformers, cables, &c.
22,516, Miess. Incandescent vapour lamps.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

23,348, Gallagher. Statement delivery apparatus for meters.
24,581, Allmänna Svenska Elektriska Aktiebolaget. Means for regulating polyphase commutator machines.

Expiring Patents

The following patents expire during the current week after a life of fourteen years :—

24,876, of December 21st, 1894, **Electric Winding Mechanism for Meters and Clocks.** H. Aron. This device consists of an electromagnet and an armature pivoted between its poles. The armature carries a click which engages with a ratchet wheel geared to the main spring of the clock mechanism.

25,048, of December 24th, 1894, **Junction and Sealing Boxes for Cables.** G. H. Nisbett. This patent covers the provision of a separate water-tight chamber in the base of junction boxes, wall plugs, and other fittings into which a hydroscopic cable (such as a lead-covered paper cable) can be led and sealed.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5% *	10¼—10⅜	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½%	102—106	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5¼	4% *	4⅜—4⅞	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—98	
Brompton & Kensington E. S. Co.,Ld.	5	10	5% *	8¼—9	+¼
Do. 7% Cum. Pref.	5	7	7%	8—8¼	
Central E. S. Co., Ltd.. 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½% *	4¼—4⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—4⅝	
Do. 4% Deb. Red	Stock	4	4%	97—99	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½%	3⅝—4⅜	
Chelsea Electric Supply Co., Ltd.	5	4½	2% *	3¾—4¼	-⅛
Do. 4½% Deb. Red	Stock	4½	4½%	101—10[illegible]	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10—10½	
Do. 6% Cum. Pref.	10	6	6%	12½—13	
Do. 5% Deb. Red	Stock	5	5%	123—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—103	
Cty of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¾—4	
County of London Elect. Sup. Co. Ld.	10	5	—	8¼—9½	+½
Do. 6% Cum. Pref.	10	6	6%	10⅝—11⅛	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	98—101	+1
Edmunson's Electricity Corp., Ltd.	5	—	—	[illegible]—[illegible]	
Do. 6% Cum. Pref.	5	—	—	[illegible]—[illegible]	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	62—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4⅜—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6⅛—6⅝	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E.L.Co.	5	10	4% *	7¾—8¼	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N'tng Hill E.L. Cos. Db.Rd.	Stock	4	4%	97—100	
London Electric Supply Corporation	3	2½	—	1½—1⅞	
Do. 6% Pref.	5	6	6%	4¾—5¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—93 xd	-1
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	5—5⅛	-¼
Do. 4½% Cum. Pref.	5	4½	4½%	4⅝—5⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	88—92	-5
Newcastle-upon-Tyne Elec. Supply.	5	5	2½%	4⅜—5⅛	
Do. (fully paid)	5	8	2½%	4⅜—5⅜	
Do. 5% Pref. Do.	5	5	2½%	5⅛—5⅜	
Do. Do.	5	5	2½%	5—5⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½% *	5⅜—6¼	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5% *	8¼—9	-⅛
Do. 7% Non-Cum. Pref.	5	7	7%	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½%	87—91	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	[illegible]—[illegible]	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅝—3	
South Metropolitan E. L. & P. Co.	1	2½	—	[illegible]—[illegible]	
Do. 7% Cum. Pref.	1	7	7%	1[illegible]—1[illegible]	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100 —103	
Urban Elec. Supply Co., Ltd.	5	5	5%	[illegible]—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Westminster Elec. Sup. Corp., Ltd.	5	10	5% *	8½—8⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95	
Central London	Stock	3	3% *	64—66	
Do. 4% Preferred	Stock	4	4%	84—86	
Do. Deferred	Stock	2	—	50—52	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	86—88	
City and South London Cons.	Stock	4	1½%	29½—30½	
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	107—109	
Great Northern & City Pref. "A"	10	11½d.	—	[illegible]—[illegible]	
Gt. Northern, Piccadilly & Brompton	10	4	2% *	7½—8	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	¼%	36½—37½	-1
Do. 3½% Preference	Stock	3½	3½%	85—87	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	74—77	
Metropolitan District	Stock	—	—	13½—13⅝	+½
Do. 6% Perp. Deb.	Stock	6	6%	123—126	
Do. 4% Deb.	Stock	4	4%	80—83	
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—27	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	93—94	+½
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS.					
Bath Electric Tramways, Ltd.	1	nil	—	[illegible]—[illegible]	
Do. 5% Cum. Pref.	1	5	—	[illegible]—[illegible]	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	[illegible]—[illegible]	
Do. 6% Cum. Pref.	10	6	6%	3¼—4¼	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	-1
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4⅜	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅜—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	[illegible]—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Street Tramways Co.	4	4/6	2½%	[illegible]—[illegible]	
London United Trs., Ld., Cm. Pf.	10	5	—	4⅜—5¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	67—72	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	[illegible]—[illegible]	
Do. % Cum. Pref.	1	5	5%	[illegible]—[illegible]	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	[illegible]—[illegible]	
New General Tr. Co., 6% Cm. Pf.	5	—	—	[illegible]—[illegible]	
North Metropolitan Trams Co.	£4 10s.	1/-	—	[illegible]—[illegible]	
Do. 3½% Mort. Deb.	100	3½	3½%	95—100	
Potteries Electric Traction Co. Ltd.	1	4	—	[illegible]—[illegible]	
Do. 5% Cum. Pref.	1	5	2½%	[illegible]—[illegible]	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	1½% *	4½—5	
Do. 6% Cum. Pref.	10	6	6%	10—11	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	[illegible]—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	81—85	
Yorkshire (West Riding) Elec. Trams	5	—	—	[illegible]—1⅜	
Do. 6% Cum. Pref.	5	—	—	2½—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½% *	57—60	-1
Do. 6% Pref. Ord.	Stock	6	6% *	100½—101½	-1½
Do. Def. Ord.	Stock	1	—	16⅜—16⅝	-⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	87—89	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	13—13½	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	101—103	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	100—102	
Do. do. (Mauritius Sub.)	25	4	4%	99½—101½	
Eastern Ext. Australasia & China	10	7	5%	11½—12	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½% *	129—134	
Do. 3½% Pref.	Stock	3½	3½% *	83—85	-½
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½% *	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½% *	53—56	-1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	[illegible]—[illegible]	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6% *	116—118	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	+¼
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	+¼
Do. 5% 3rd Pref.	5	5	2½%	5[illegible]—5[illegible]	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	101—103	
Western Telegraph Co., Ltd.	10	7	6% *	12⅜—13½	
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	[illegible]—[illegible]	-[illegible]
Do. 6% Cum. Pref.	1	6	8% *	[illegible]—[illegible] xd	-[illegible]
Babcock & Wilcox, Ord.	1	20	16% *	3[illegible]—4[illegible]	
Do. 6% Pref.	1	6	6%	1[illegible]—1[illegible]	
British Insulated & Helsby Cables, Ld.	5	10	8% *	6¾—7	
Do. 6% Cum. Pref.	5	6	—	6¾—6¾	+¼
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	+1
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	[illegible]—[illegible]	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	+3
Brush Electrical Engineering Co.	2	—	—	—	
Do. 6% Pref.	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	65—70	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	49—53	
Callender's Cable and Const. Co., Ld.	5	15	10% *	9—10	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅝ xd	-¼
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	[illegible]—[illegible]	
Crompton & Co., Ltd.	3	5	5%	1[illegible]—1[illegible]	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1[illegible]—1[illegible]	
Do. 6% Cum. Pref.	1	6	6%	1[illegible]—1[illegible]	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £8 paid	5	2/6	1/6 *	[illegible]—[illegible]	
Do. do. (fully paid)	5	4/2	2/6 *	1[illegible]—2[illegible]	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	[illegible]—[illegible]	
Do. 7% Cum. Pref.	2	7	—	[illegible]—1[illegible]	
Do. 4% 1st Mort. Deb.	Stock	4	4%	65—70	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7[illegible]—7[illegible]	+[illegible]
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	83—87	-1
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5% *	11[illegible]—12[illegible]	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5[illegible]	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—107	
I. R. & G. P. Co., Ltd.	10	10	2½% *	16[illegible]—17[illegible]	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10% *	30½—32½	-[illegible]
Do. 4% Deb. Bds. Red	100	4	4%	101½—103½	
Willans & Robinson, Ord. Shres	1	5	1/-	[illegible]—[illegible]	
Do. 6% Cum. Pref.	5	6	3/-	2[illegible]—2[illegible]	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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CORRESPONDENCE

A COMPARISON OF THE BRITISH AND GERMAN ELECTRICAL INDUSTRIES.

The Editor of ELECTRICAL ENGINEERING.

Translation.

SIR,—Mr. Mordey's very interesting address, published in your issue of November 26th, expresses views which, in some respects, call for contradiction on the part of one conversant with both English and German conditions. First of all is the widespread belief in your country that the wages in Germany are lower than in England. For a number of years this assumption has no longer been correct in respect of most trades, particularly for skilled workmen. A comparison between the contracts of the Trade Unions and the wages lists for German workshops shows this clearly. This explains in a far simpler way than Mr. Mordey does why the cost of wages per unit is higher in Germany, the more so if the higher "social" allowances (sick and accident funds, and old age pensions) are added. Likewise the considerably lower costs per car mile in Germany must be attributed not to the cheaper wages, but partly to the fact that in Germany trailers are used very much, by which 25 per cent. of the staff expenses can be saved. The fact must further be taken into account that, owing to the German Sunday, with its more than double traffic, the staff, and consequently the necessary wages per car mile, are used more profitably.

Finally, Table II. in your abstract of the Paper obviously does not include the giant power stations of our mines, built in recent years, which feed the surrounding mines, ironworks, mechanical engineering works, &c., which are not included in the statistics used as they do not deliver current to everyone, but only to a few large consumers. In England, however, such mines and ironworks are very frequently supplied from public high-pressure power stations. A great mistake is made if the conclusion is drawn from Mr. Mordey's statistics that the *use* of electricity in Germany is less than in England. This only applies to lighting and public central stations, and not to power supply and collective generation of electricity.

The mistake is still greater if the smaller application of electricity in Germany, which is asserted, is assumed to imply that the electrotechnical *industry* in Germany—that is to say, the manufacture of electrical machines, cables, and apparatus—is behind that in England. The Briton who really knows the outputs of both industries will not be able to deny that the German one is superior.

It is, perhaps, not uninteresting to examine the reasons why the prices for electrical energy in Germany are, as Mr. Mordey very rightly states, considerably higher than in England.

(1) Coal is dearer and wages much higher, as are also the amounts to be paid to the towns for licences.

(2) Our electricity works pay on the average higher dividends, as a comparison of the share lists will show.

(3) The cost of putting up the works is higher. Here central stations are built more elegantly, the floor and walls are tiled, and windows are designed to give abundance of light and air. The buildings are built with technical architectural adornment, and the switchboards are decorated in a more ornate, but yet practical manner. Everything is bright and polished; there is no speck of dust, and no rust. No money is spared in this, for, apart from æsthetic considerations, such an arrangement is a good investment. Our experience shows that the men pay greater attention and care to their machines and the station if they are encouraged by the clean and attractive appearance of the rooms.

Then, again, our industry is in the position to dictate higher prices by tariffs and cartels. It is compelled to do so by the higher burdens of wages and the social conditions. This explains how, in the tenders for supplying the two 5,000-kw. turbo-generators for the London County Council, the only competing German firm made the highest offer—£20,350 dearer than the cheapest, and £6,463 dearer than the dearest English firm. Thus it comes about that the German firm for which I worked some time ago can never compete in price with English manufacturers, but obtained its numerous contracts only by reason of its superior manufactures.

Nevertheless, among English electrical men we still hear the cry that "the Germans cut the prices."

HUGO HERZFELD (*Dipl. Ing.*)

11 Lützowufer,
Berlin.
December 9th, 1908.

[To avoid confusion of names, we should explain that the writer of the above letter is not Dr. Rudolf Herzfeld, late of the Electrical Co., Ltd., and now with the General Electric Co., Ltd.—ED. E. E.]

THE CARDIFF TELEPHONE EXCHANGE.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Referring to Mr. T. Devereux's article of December 3rd on the new C.B. Exchange at Cardiff, and dealing with the two-way junctions, I see he states that the calling relay of the incoming circuit is actuated by a loop through the distant operatives' telephone. I should like to ask Mr. Devereux what junctions these are "incoming from," as with all C.B. exchanges this is impossible, owing to the secondary condenser used in the operators' headset circuit chiefly to prevent this very state of things from occurring.

Yours faithfully,
A. J. PEARSON.

Glasgow,
Dec. 9th, 1908.

[We have submitted this letter to the author of the article, who writes us as follows:—In reply to the first point raised by your correspondent with reference to the calling relay on the "two-way" junctions, it should perhaps have been stated that these junctions are arranged for working to magneto-exchanges.]

LOCAL NOTES

BECKENHAM: *Charges for Electricity.*—The Council has decided that existing and new "free" wired consumers shall be allowed to have transformers installed and their premises fitted with high efficiency lamps on payment of a fixed charge of 2s. per lamp per annum to cover wiring rent and the cost of the transformer and fixing. The consumer to supply lamps and to pay the meter rent as heretofore. Existing consumers are to enter into new agreements embodying these terms. The present flat rate of 5d. per unit for electricity supply to be continued, but an intimation is to be given to consumers who elect to change over to high efficiency lamps that if in consequence of the introduction of these lamps the revenue is insufficient to enable the Council to carry on the undertaking without loss the price may be increased temporarily. A Sub-Committee have had before them the question of an entire alteration in the system of charging, but after consulting Mr. Manville and on his advice they recommend that the flat rate be continued.

"*Linking Up.*"—The South Metropolitan Electric Light & Power Co. have suggested to the Council that the engineers of the two undertakings should meet with a view to arranging linking up, and this has been agreed to.

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BOURNEMOUTH: *Public Lighting.*—In October the Electric Lighting Committee was requested to consider what further steps could be taken to extend the hours during which the public lamps are kept lighted. The Committee has now presented a further report, in which it is stated that the total cost for one year of an extension of time for the whole of the borough for one extra hour's lighting every night, would be £550. The extra cost of all-night lighting would be £2,522. The Committee, however, report that the present arrangements are sufficient for the requirements of the public, and the Corporation have adopted the report.

BRADFORD: *Extension to the Electricity Plant.*—Extensions to the value of £50,000 for the electricity plant are contemplated. Mr. Thomas Roles, the City Electrical Engineer, has reported upon the matter, and points out that the present full-load capacity of the Valley road generating works is 7,880 kw., but, owing to the limitations of the condensing plant of one of the sets, the actual full-load capacity is 6,800 kw. Any further demands made upon the works, therefore, would have to be made up by overloading the slow-speed engines. There is also a 300-kw. high-speed generating set at the Sunbridge road sub-station. The maximum load during the present winter was reached on November 19th—namely, 6,597 kw.—and the margin is considered to be too small to meet deficiencies. Mr. Roles therefore recommends the installation of two extra high-tension alternating-current turbo-generators of 3,000 kw. capacity each, together with two cooling towers and two water-tube boilers each, with an evaporative capacity of 18,000 lb. per hour, with chain grate stokers, superheaters, &c. The total cost of the scheme, including extra high-tension switchgear, &c., is put at £50,300. We published an advertisement for this plant in our last issue.

BRADNINCH: *Electric Supply.*—The Bradninch & District Electric Supply Co. are now supplying electricity in the district, and street lighting was inaugurated last week.

BRIGHOUSE: *Bulk Supply.*—The Local Government Board has sanctioned a loan of £3,940, the cost of the sub-stations which the Council has erected in order to take a supply in bulk from the Yorkshire Electric Power Co.

CHELTENHAM: *Electricity Works Assessment.*—The Assessment Committee has reduced the rateable value of the electricity undertaking from £4,850 to £3,200. Hitherto the assessment has only been £1,800, and the new figure of £4,850 as proposed by the Assessment Committee was appealed against, with the above result.

CHIPPENHAM: *Electric Lighting.*—As the Council's electric lighting order can only be transferred to a company by means of a further provisional order, it is not thought advisable to incur the expenditure which would be involved owing to the small size of the undertaking which would be necessary. The Council, therefore, have agreed to a non-statutory company being started on the conditions that a member of the Council is appointed to the Board, and that the Council gives its consent to the opening up of roads, &c. It is further stipulated that no overhead wires are to be erected without the consent of the Council.

COLCHESTER: *Overhead Wires.*—An application is to be made to the Board of Trade for sanction to erect an overhead feeder from the power-station to Hythe Quay.

COOKSTOWN: *Electric Lighting.*—A proposal has been placed before the Council by a firm of electrical contractors for the installation of an electricity generating plant, but the Committee which was appointed to consider the matter has reported that they are of the opinion that there is not sufficient guarantee of an adequate consumption to justify the scheme being adopted. Further consideration of the matter has been adjourned until the next meeting.

DOUGLAS (I.O.M.): *Proposed Electric Tramway.*—A proposal by the Manx Electric Railway Co. for converting the horse tramway on the promenade to electric traction has been rejected, the reason given being that the Council think it inadvisable to lose control of this service.

DUBLIN: *The Electrical Undertaking.*—The Electric Lighting Committee have presented their report for the quarter to September 30th, in which they state that the number of consumers has increased during that period from 1721 to 1844. Although the applications for connections are increasing owing to the introduction of metal filament lamps, the demand shows a tendency to diminish for this same reason. The Committee, however, have every hope that this method of cheapening the use of electricity, will bear good fruit within the next 12 months in regard to the number of units sold. The Committee also report favourably with regard to the increasing use of electric motors for industrial purposes, and in this connection point out that the present varying rate for power is not working so satisfactorily as had been anticipated. Some prospective consumers had suggested that a special low rate for the summer months would be advisable, and accordingly the Committee fixed 1d. per unit for power purposes as the charge during six months of the year, with 1½d. per unit for the winter and autumn six months. This, they say, has not brought about any appreciable extra demand during the summer months, and the Committee have decided, subject to the approval of the Corporation, to adopt a uniform rate for power, heating, and similar purposes throughout the year from March 31st next, of 1¼d. per unit. This rate is a fraction under the present average for the year. The estimated expenditure for the year to March 31st, 1909, is £58,491, and the revenue £61,391. The actual income for the six months to September 30th was £24,785, and the expenditure £29,929.

DUDLEY: *Tramway Agreement.*—The agreement with the Tramway Company for the lease of the local tramways has now been completed, and awaits ratification in the Bill which has been deposited in Parliament. The tramway company will bear the taxed costs of the Bill.

DUNDEE: *Tramway Accounts.*—The accounts for the first half of the current year of the tramways undertaking show an income of £32,019, which is £148 below the estimate, and an expenditure of £19,978, which is £329 less than the estimate. The receipts show an increase of £1,454, compared with the corresponding period of last year.

GLASGOW: *Tramways and Street Widenings.*—A provisional order, which the Corporation propose to introduce into the next session of Parliament, deals with various matters, including new tramways. One of the clauses under this head has relation to the acquisition of portions only of properties required for the purpose of new tramways, and an effort was made by one of the Councillors to compel the Corporation to acquire the whole and not portions of such properties. Only two members, however, were in favour of this, and the model clause was inserted.

Proposed Tramway Abandoned.—In deference to the protest of the officials of the University, the Corporation has decided to abandon the proposed tramway running along the road skirting the University grounds. It had been pointed out to the Tramways Committee that the running of tramcars along this road would disturb the work and teaching of all departments where delicate instruments are in use.

HAMILTON (N.B.): *"Free" Wiring.*—A provisional order authorising the Council to spend money on "free" wiring is to be promoted.

HARROGATE: *Underground Telephone Wires.*—Permission has been given to the National Telephone Co. to lay underground telephone cables in certain part of the town.

KIRKINTILLOCH: *Opposition to Proposed Tramways.*—The Merchants' Association has unanimously decided to ask the Town Council to abandon the proposal recently put before the Glasgow Corporation for an extension of the tramways system of the latter to Kirkintilloch, on the ground that such an extension would be disastrous to the shop-keeping interests of the town.

LONDON: *London County Council.*—The Highways Committee report having had under consideration the question of rearranging the plant at present installed at the Elephant and Castle sub-station in order that sufficient power may be provided for working the Victoria Embankment tramways, and also the lines which are to be laid over Blackfriars Bridge when it is widened. Experience has shown that it is advisable that the Victoria Embankment lines should be worked from the Elephant and Castle sub-station as a part of the southern system, instead of, as at present, from the Holborn sub-station as a part of the northern system. At the present time, in the event of a fault occurring at the Holborn sub-station, the car services on the Victoria Embankment tramways are affected, with the result that the whole of the services on the southern routes, which run to the Victoria Embankment, are interfered with. The capacity of the existing plant at the Elephant and Castle sub-station is insufficient for the working of the additional lines, and it is proposed that two 1,500 kw. motor generators should be erected in place of the four 300 kw. motor generators at present at the station. The motor generators displaced will be transferred to certain of the outlying sub-stations. The total cost of the work is estimated at £19,000, of which about £3,000 will be chargeable to maintenance account and about £16,000 to capital account. None of the expenditure will come into charge during the current financial year, and provision for the expenditure on maintenance account will be made in the annual estimates for 1909-10. It is pointed out that by installing larger machines at the sub-station not only will the cost per kilowatt of capacity be less, but the traffic conditions will be considerably improved: further, if the lines on the Victoria Embankment were to continue to be worked from the Holborn sub-station when they are extended over Blackfriars Bridge, expenditure on capital account, amounting to about £25,000, would be required for new machines, switch-gear, and cables at that sub-station: so that the proposed rearrangement of the plant at the Elephant and Castle sub-station will represent a considerable ultimate saving.

London County Council: Tramways.—A deputation from the Lewisham Borough Council and the New Cross, Brockley, and Crofton and Sydenham and Forest Hill Tramways Committees have waited upon the Highways Committee of the London County Council urging the construction of the authorised tramways between Lewisham High Road and Forest Hill. No definite reply was given by the Highways Committee, although it was understood that the Council intend to construct the line as soon as convenient.

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Bermondsey: New Tramways.—The Borough Council have formally consented to the electrification of the tramways from London Bridge to Deptford, subject to various street widenings being carried out at no expense to the Council. The estimated cost of the widenings in Bermondsey is £63,850, of which £40,250 represents the cost of acquiring property.

Stepney: Smoke Prevention.—In July last the Council allowed the British Fuel Economiser & Smoke Preventer Co. to fit up two sets of their apparatus for one month, to prevent any possible smoke nuisance at the Electricity Works, in each of two boilers, and agreed that if the apparatus fulfilled its guarantee, it was to be taken over by the Council on payment of £105. If the test proved unsuccessful, the Company were to remove the apparatus. The Electric Supply Committee have had submitted to them the report of the Electrical Engineer, with the result that the Committee say there is every reason to believe that the Company will not have fulfilled the guarantees within the period of trial, and they have decided that, should this be so, and should the Company be desirous of continuing their experiments for another month, they should be accorded an extension, on condition that it is granted without prejudice to the existing contract and guarantees, which are to remain in full force and effect, and on condition that the Company will not use more steam than the Engineer deems sufficient to obtain a successful issue.

LOUGHBOROUGH: *Expert Advice.*—Mr. J. F. C. Snell, Consulting Engineer, of London, has been retained at a fee of 60 guineas, plus first-class travelling and out-of-pocket expenses, to report upon the financial position and future management of the Council's electricity undertaking.

LOWESTOFT: *Electricity and Tramways Undertaking.*—At the last monthly meeting of the Council, it was reported that there had been a loss of £1,900 on the year's working of the tramways undertaking to September 30th, and £200 loss on the electricity undertaking. To meet the former deficiency, it has been decided to raise certain fares. The loss upon the electricity undertaking is solely due to the high price of coal, which has cost £872 more than in the previous year.

MALDEN & COOMBE: *Electric Lighting.*—The County of London Electric Supply Co., who hold a provisional order for this district, have informed the Council that they hope to commence works next spring. The Council are dissatisfied with this reply, as they state that the company has repeatedly shelved the matter, and the correspondence with the company is to be placed in the hands of the Board of Trade.

MEXBOROUGH: *Damage by Surface Contact Tramways.* In the Rotherham County Court on Friday, a cab proprietor was awarded £10 10s. damages owing to his horse having been injured in February last by treading on a stud which proved to be "alive." It will be remembered that the line has now been converted to the trolley system.

MIDDLESEX: *London United Tramways Co.*—The Councils of Ealing, Acton, Chiswick, and Hanwell are forming a deputation to wait upon the Board of Trade, together with the Members of Parliament for the districts, in respect of the alleged noise caused by the cars and track of the London United Tramways, Ltd. The Board will be asked to interfere, and take the necessary action against the company to prevent the continuance of the noise complained of.

MORECAMBE: *The Tramways Purchase.*—Arbitration proceedings have been taking place in London with regard to the purchase by the Corporation of the horse tramways in Morecambe. Major Cardew is acting as arbitrator, and the claim made by the company amounts to £16,000.

NEWCASTLE: *Noisy Tramcars.*—The General Manager of the Corporation tramways undertaking, Mr. E. Hatton, has reported to the Tramways Committee in reference to the noise made by the tramcars. Mr. Hatton points out that it is absolutely impossible to carry heavy weights on steel tyred wheels, or any form of metal, over metal rails without making any noise, although if the rails were laid in a more or less flexible manner, the vibration and noise would be partially deadened. The Newcastle track, however, he adds, is laid in a very rigid manner, and so far as the track is concerned, very little can be done to abate the present noise. With reference to the cars, most of the noise has arisen from the wearing of the pinion gearing, and the cars are being overhauled in this respect. Another source of noise is that the magnetic brakes are suspended from the cars by springs, and until some device has been introduced to operate the brakes in some other manner, Mr. Hatton has no recommendation to make which would not sacrifice efficiency. It is probable that a sub-committee will be appointed to deal with the matter.

NEWPORT: *Trackless Trolley System.*—Mr. H. Collings Bishop, General Manager of the tramways undertaking, has reported in favour of the adoption of the trackless trolley system for the outlying districts, to be worked in conjunction with the present tramway undertaking. In a report which Mr. Bishop has presented, he gives detailed figures of the estimated cost per mile of the system, including capital charges. He recommends the adoption of the trackless trolley system upon six routes inside the borough, and four routes outside the borough, making in all a total of some 12 miles, and his figure for the total cost of the equipment per mile, exclusive of cars, but including overhead work, cables, and contingencies, is £1,500. The cost of eight cars is put at £5,000.

NUNEATON: *Light Railway Scheme.*—Estimates have now been prepared of the cost of the proposed light railway between Nuneaton and Bedworth, a distance of three miles, the figure being put at about £50,000.

SOUTH SHIELDS: *Wayleaves to Power Company.*—It is stated that in consequence of the Corporation wishing to charge £250 wayleaves to the Durham Electric Power Co., for supplying the Hanton Coal Co., a clause will be proposed in the Bill deposited for next session, authorising the Company to take their mains through the Borough for this purpose, free of charge. We understand, however, that the Corporation have invited the parties to a round table conference in order to endeavour to arrive at an amicable arrangement. The Coal Company have offered £20 against the £250 asked by the Corporation.

SWATOW (CHINA): *Electric Supply.*—The *Hong Kong Daily Press* states that Swatow is in the peculiar position of having an electric installation, but no light. The undertaking, which started so well a year or two ago, is now closed down, and the plant is lying idle. The Chinese company which owns it is averse to foreign capital being invested in the enterprise, with the result that all attempts of Europeans to obtain control of the undertaking have proved unavailing. When the company commenced lighting, it had only contracts for 300 lights, but within three months that number had grown to 900. When the company ceased working on the first occasion it was supplying some 1,700 lights. It was re-started, but the works have since been closed down. The light was remarkably cheap, perhaps too cheap (says our contemporary), the charge being only a dollar per month per lamp, and it is declared with confidence by those who ought to know that at $1·50 per lamp the undertaking would have paid even on the existing basis. But lack of capital handicapped the work, and as shareholders who had already paid out $30,000 beyond the stated capital refused to contribute further, there was no other recourse but to shut down the works.

TAUNTON: *Condition of Tramway Track.*—A report has been prepared by Mr. J. S. D. Moffett, Manager of the Rochdale Corporation Tramways, upon the condition of the tramway track of the Taunton Electric Traction Co., Ltd., on behalf of the Corporation. Mr. Moffett states that the nuisances complained of with regard to noise, &c., could be removed at a trifling cost. The Tramways Co. is to be requested to carry out the suggested alterations.

TORQUAY: *Public Lighting.*—The Surveyor has prepared a report on the cost of public electric lighting in various towns, which has been printed and circulated amongst the members of the Electric Lighting Committee. The Works and Highways Committee, who have had this matter in hand, recommend that the Electric Lighting Committee should be recommended to grant a reduction in the present charge for public lighting.

URUGUAY: *Telephonic Communication.*—The *Review of the River Plate* states that the Uruguayan Government intends to spend £20,000 on a telephone system for the police stations throughout the Republic. Mr. A. Bennett has arrived from England, under his agreement with the Uruguayan Government, for establishing an automatic telephone service in Montevideo.

WATFORD: *Euston-Watford Electric Railway.*—The London & North Western Railway Co. have informed the Council that work upon the new electric railway from Euston to Watford is about to be commenced, but that no date can be given for its completion.

WEST HAM: *Writ Served on Council.*—The India Rubber, Gutta Percha & Telegraph Works Co., Ltd., presumably as ratepayers, have issued a writ to restrain the Corporation from paying interest on an overdraft from the bank in connection with the electricity undertaking. The sum in question has not been sanctioned by the Local Government Board, and the Company claim that the payment of the interest upon it is illegal.

WESTON-SUPER-MARE: *Condition of Tramway Track.*—Representations are to be made to the Board of Trade concerning the condition of the tramway track, which is alleged to be a nuisance and a source of danger to the ordinary traffic.

WOLVERHAMPTON: *Tramway Intercommunication Abandoned.*—For nearly two years the overhead trolley cars of the Wolverhampton & District Tramways Co. have been running over certain of the lines of the surface-contact lines in the borough. The company, however, has stated its intention of abandoning the arrangement next year for the reasons given below. It is pointed out that the through service from Dudley to Wolverhampton has been a loss to the company. The additional weight (nearly one ton) thrown on the cars by the addition of the skate has increased the consumption of current by 0·30 of a unit per car mile, and the constant repairs necessary for the skate equipment have further increased the expenses, due somewhat to having to fit such equipment to trucks which were not originally designed for the purpose. Further, the fact is that revenues have not in the least improved by the arrangement. The company state they have taken time and much pains to try and overcome the losses, but the position after nearly two years does not improve. They do not know how far the Corporation would again allow them to offer the suggestion as to the equipment of the line from the Fighting Cocks to Snow Hill on the overhead system, but this would be the means of enabling the company to satisfactorily continue the through

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services. Failing this, the company ask the Corporation to allow the through services from Dudley to be discontinued. As a result, notice is given that the intercommunication between Wolverhampton and Dudley will cease on January 10th next unless a satisfactory arrangement can be entered into.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA: *Sydney.*—Tenders are invited on behalf of the Sydney Municipal Council by Messrs. Preece & Cardew for five water-tube boilers each capable of evaporating 24,000 lbs. of water per hour; also economisers, mechanical stokers, feed-pumps, pipe-work, &c. Particulars from Messrs. Preece & Cardew, 8 Queen Anne's Gate, Westminster, fee £1 1s. returnable; and tenders to the Town Clerk, Town Hall, Sydney, N.S.W., by February 22nd, 1909.

BEDFORD.—The Finance Committee are in negotiation with several companies with a view to obtaining a loan of £10,000 for electric lighting purposes.

BLACKPOOL.—Tenders are invited for the supply of coal to the electricity department during 1909. Particulars from the Borough Electrical Engineer, and tenders by December 22nd.

CLACTON.—Tenders will shortly be invited for a crane for the electricity works.

DOVER.—A Local Government Board inquiry will be held to-morrow into an application for sanction to borrow £4,600 for electrical extensions.

ECCLES.—The Local Government Board has sanctioned the borrowing of the following sums :—£4,091 for new machinery, £2,000 for mains, £800 for transformers, £1,200 for house services, and £500 for motors on hire. Sanction has also been received to the borrowing of £4,150 excess expenditure.

GLASGOW.—The Secretary for Scotland has granted leave for the borrowing of £150,000 for extensions to the electrical undertaking.

KEIGHLEY.—An application is to be made to the Local Government Board for sanction to borrow £12,820 for electric lighting purposes.

LEYTON.—A Local Government Board inquiry was held last week into an application by the Council to borrow £1,299 for electric lighting purposes. This sum is required for new mains.

LONDON: *Battersea.*—Tenders are invited for the supply of coal for the Electricity Department during 1909. Particulars from the Electrical Engineer, and tenders to the Town Clerk by December 22nd.

Hackney.—A loan of £3,290 for mains extensions, repayable in 30 years, has been sanctioned by the Finance Committee of the London County Council.

RADCLIFFE.—The Local Government Board inquiry referred to in our issue of November 19th in connection with the Council's application for sanction to borrow £14,500 for electrical extensions, was continued on Wednesday last week. Opposition was offered by several large firms in the district and by the Lancashire Electric Power Co., it being contended that the power company was in a position to supply current at cheaper rates than the Council could generate it.

SOFIA.—A scheme for lighting the harbour by electricity is to be formulated.

WIGAN.—Tenders are invited for the supply of cables and electrical accessories during the coming year. Particulars from the Electrical Engineer, and tenders to the Town Clerk by December 21st.

Miscellaneous

AUSTRALIA.—The Board of Trade correspondent at Melbourne (Mr. M. Hirsch) has forwarded a copy of the conditions and specifications relating to the supply, delivery and erection, at the Post Office, William Street, Sydney, of a branching metallic multiple magnetic switchboard. Tenders will be received by the Deputy Postmaster-General at Sydney up to 2.30 p.m. on April 28th, 1909. The conditions may be obtained at the Commonwealth Offices in London, and copies may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade.

LEEDS.—The Tramways and Electricity Committee invite tenders for the insurance of their third-party risks in connection with the tramways undertaking. Particulars from the General Manager, and tenders to the Town Clerk by January 4th.

MANCHESTER.—Tenders are invited for an installation of electric bells and telephones at the Bradford Baths. Particulars from the Town Clerk, and tenders by December 23rd.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.W.—Alterations and additions, Seto Works, Mead's Road, Little Stanmore, Hendon, for R. E. Thomas.

YARMOUTH: *Tramway Extension.*—As the cost of extending the tramway service on the South Denes is estimated at £2,000, the Corporation has decided not to carry out this extension, owing to the small amount of traffic which is likely to be attracted by it.

Buildings, corner of High Street, Camden Town and Kentish Town Road. Architect, D. Joseph, 73 Basinghall Street, E.C.

Lodge Building, Lower William Street, Regent's Park. Architect, F. M. Elgood, 98 Wimpole Street, W.

S.W.—Police station and quarters, Battersea. Architect, J. Dixon Butler, New Scotland Yard, S.W.

Alterations and additions at Blenheim Club, King Street, St. James's. Architect G. A. Lansdown, 9 Regent Street, S.W.

S.E.—Factory, Somer's Place, Lambeth, for the Trustees of the Stockwell Orphanage.

Re-building, Joiners' Arms Public House, Church Street, Deptford. Architects, Wylson and Long, 16 King William Street, E.C.

Re-building "High Cliff," Wellington Grove, Greenwich, in connection with Ursuline Convent. Builder, W. Nash, Childers Street, Deptford.

W.—Development of Park Royal Estate, North Acton. Solicitors, Redfern and Hunt, 13-14 Abchurch Lane, E.C.

Additions to Aylesbury Dairy Co.'s premises, St. Petersburgh Place. Architect, W. J. Keith, 7 East India Avenue, E.C.

W.C.—Alterations to laboratories at 17 Bloomsbury Square (£647). Architect, G. A. Lansdown, 9 Regent Street, S.W.

Building, Tottenham Court Road, for Central Young Men's Christian Association. Architect, R. Plumbe, 13 Fitzroy Square, W.

PROVINCES.

ABERBORGOED (MON.).—County School. Architect, J. Bain, Arcade Chambers, High Street, Newport, Mon.

ABERDARE.—Receiving Home. Architect, T. Roderick, Aberdare.

BARNET (HERTS).—Extension of girls' grammar school (£4,300). Architect, J. Ladds, 93 Pemberton Road, Harringay, N.

BOOTLE.—Workmen's dwelling (£7,100). B. J. Wolfenden, Engineer and Surveyor, Town Council.

CAMBRIDGE.—Agricultural college. Architect, Arnold Mitchell, 17 Hanover Square, W; builders, Messrs. Pringle, of Cambridge.

School (£15,000). Surveyor, — Julian, Town Council.

CARDIFF.—Extensions at Roath, abattoirs and meat market. W. Harper, City Engineer, Town Hall.

CHESTER.—Proposed secondary school. Reginald Potts, Clerk to Cheshire County Council, Chester.

COLCHESTER.—Co-operative stores and premises. Architects, Goodey & Cressall, High Street.

DEVONPORT.—Church. Architect, G. H. F. Prynne, 6 Queen Anne's Gate, S.W.

FOLKESTONE (Kent).—Library. A. E. Nicholls, Borough Surveyor, Folkestone.

GREAT YARMOUTH.—Addition, hospital. Architects, Olley & Howard, Queen Street.

Additions, infirmary. Architect, H. Arnott, High Street, Gorleston-on-Sea.

MANCHESTER.—Tenders are invited for the wiring and fitting for electric lighting of the Bradford Baths. Particulars from the Town Clerk, and tenders by December 23rd.

MARDY (Glamorganshire).—Additional pavilion at Mardy Isolation Hospital, Merthyr Tydfil (£3,370). T. F. Harvey, Borough Engineer, Merthyr.

NEATH (Glamorgan).—Bank for Metropolitan Bank of England and Wales. Architect, J. Moxham, Castle Street, Swansea.

NORTHAMPTON.—Hippodrome. Architect, Bertie Crewe, 75 Shaftesbury Avenue, W.C.

NORWICH.—New offices for Guardians. Architects, Morgan & Buckingham, 1 Upper King Street, Norwich.

PETERBOROUGH.—Church Institute. Architect, S. Dodson, Peterborough.

Fire station. Architect, F. J. Gill, 236 Rolfe Street, Smethwick, Birmingham.

School, Fletton. Architect, H. Leete, Huntingdon.

PORTSMOUTH.—Workmen's dwellings. P. Murch, Engineer and Surveyor, Town Council.

SUTTON.—Additions to buildings of Sutton Co-operative Society.

WALSALL.—Rolling mill and chimney stack, Green Lane, Birchills, for the Talbot Stead Tube Co., Ltd.

Alterations and extensions to works, Bloxwick, for the New Delaville Spelter Co., Ltd.

WIGAN.—Fifty houses for tramway men (£11,100). Wm. Balton, surveyor, Town Council.

WINTON (BOURNEMOUTH).—School, Brassey Road. Surveyor, Frederick Wm. Lacey, Bournemouth County Borough Council.

WOKING.—Technical school. Architects, Jarvis & Richards, Queen Anne's Gate, S.W.

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TENDERS RECEIVED AND ACCEPTED

ARGENTINE.—A concession has been granted to Señores Gandulfo and Diaz Valdez for the construction of an electric tramway in the town of Buenos Aires. Plans must be presented within six months, and within three months of the date of approval work must be begun. The whole work is to be completed within two years.

BOURNEMOUTH.—The tender of Messrs. W. Cory & Sons for the supply of Welsh smokeless coal for the tramways power house during the coming year has been accepted at 17s. 5d. per ton.

CARDIFF.—The Electrical Engineer has been authorised to purchase from Mr. A. G. Brown, of Manchester, at £80, a vacuum and pressure dry insulating machine, varnish tank and pump, for use in connection with the re-insulation of armatures and field coils. Two patent rail grinders fitted with carborundum blocks are to be purchased from the National Rail & Tramway Appliance Co., Ltd., Liverpool, at £25 each.

CLACTON.—The tender of Messrs. Elliott Bros. for two ammeters has been accepted at £18 16s. 6d.

DERBY.—The Electric Lighting Committee has accepted the tender of the Derby Coal Co. for the supply of 1,000 tons of coal for the electricity department. The tender of the Lea Recorder Co. for a second water recorder at £46 10s. has also been accepted.

LONDON: *London County Council.*—The following tenders have been received, for the roadwork and platelaying, exclusive of the supply of rails and special trackwork, in connection with the reconstruction, on the underground conduit system of electric traction, of the existing tramways from Hackney Road, *via* Mare Street, and Lower and Upper Clapton Roads, to Stamford Hill, and the construction on the same system of traction of the authorised tramway in Amhurst Road and Dalston Lane. The tenders also contain provision for the execution of certain paving works outside the tramway tracks in connection with the widenings along the route:—Dick, Kerr & Co. (recommended), £82,715; W. Manders, £84,333; A. M. Coles, £84,555; J. Mowlem & Co., £88,664. The chief engineer's estimates, comparable with the tenders, are £84,090 for tramway works, and £3,887 for paving works, or a total of £87,977. Provisional sums, amounting to £15,700, are included in each of the tenders for alterations of pipes, mains, &c., the cost of which works cannot be more accurately estimated beforehand, and a sum of £5,000 is also included for any other contingencies which may arise. The tender of Messrs. Dick, Kerr & Co., Ltd., is recommended. Messrs. Dick, Kerr & Co., Ltd., are to be allowed to sub-let to the undermentioned firms the following portions of the work:—(1) to the Anderston Foundry Co., Ltd., or Wilsons Pease & Co., Ltd., the yokes; (2) to Doulton & Co., Ltd., or Buller's, Ltd., the insulators; (3) to Bayliss, Jones & Bayliss, or Guest, Keen & Nettlefold, Ltd., the tiebars, bolts, &c.; (4) to the Associated Portland Cement Manufacturers, Ltd., the cement; (5) to Harrison & Co. (Lincoln), Ltd., and Hadfield's Steel Foundry Co., Ltd., the plough boxes and drain boxes; and (6) to the Forest City Electric Co., Ltd., the bonds.

London County Council.—The Fire Brigade Committee report that certain alterations will be necessary in the Post Office telephone arrangements at the chief station of the fire brigade as the result of the reconstruction, now being carried out, of the engine-house block. There are in the existing watch-room a cabinet with which all the telephone lines to other stations, &c., are connected, and an inter-departmental board with which certain lines to various parts of the building are connected. The inter-departmental board and the telephone lines connected therewith will be abolished, and it is proposed to have fixed in the new watch-room a new cabinet (in place of the existing cabinet) to which all the telephones and fire-signal apparatus at present on the existing cabinet will be transferred, and to provide in connection with this new cabinet 10 additional extensions (to the stables, dynamo-room, duty-room, and various other rooms and offices in the station), most of which are rendered necessary by the abolition of the inter-departmental board. The annual charge, under a new 10 years' lease, for the new cabinet and extensions will be £52 7s. 6d., and the annual charges of £31 7s. 6d. and £34 respectively now paid for the existing cabinet and the inter-departmental board will cease. The effect of the alterations will consequently be a net reduction of £14 a year, and it is recommended that this arrangement be entered into with the Post Office.

The Main Drainage Committee, having dispensed with the electric battery in use at the Crossness outfall works, and entered into an agreement with the Erith Urban District Council for the supply of electricity required at the works, the following offers have been received for the purchase and removal of the battery: Mr. E. J. Webster, Stratford, E. (recommended), £205; Hart Accumulator Co., Ltd., Stratford, E. (£7 10s. a ton, about), £200; Premier Accumulator Co., Ltd., Northampton, £150; Electrical Power Storage Co., Ltd., Great Winchester Street, £110.

London County Council.—The Fire Brigade Committee of the Council have received the following tenders for the electric lighting of the Camden Town fire station, which is at present lighted by gas: Tredegar & Co., 56 Victoria Street, S.W. (recommended), £166 10s.; Nursey & Marr, 53 Victoria Street, S.W., £175; W. J. Fryer & Co., Bravington Road Works, Paddington, W., £193; Chas. Pullan, 51 and 52 King's Arcade, Bradford, and 68A Lincoln's Inn Fields, W.C., £235; W. Leonard & Co., 4 Soho Street, Oxford Street, W., £275.

Bermondsey.—The Council have accepted the quotation of Johnson & Phillips, Ltd., at £7 1s. 6d., less 2½ per cent., for the supply of 110 yards 7/22 twin lead-covered armoured cable, also the tender of the British Electric Calibrated Fuse Co., at £9 3s. 10d., for six switchboard fuses.

Stepney.—For the supply and delivery of a quantity of rubber cable, the Council has received the following tenders:—Baxter & Caunter, £87 6s. 6d. (accepted); W. T. Henley's Telegraph Works Co., Ltd., £106 17s. 8d.; W. T. Glover & Co., Ltd., £106 17s. 8d.; The India Rubber Gutta Percha & Telegraph Works Co., £106 17s. 7d.

Wandsworth.—The Council have accepted the tender of H. J. Whitehead, at £14 15s., to carry out certain works required to the electric installation at the Wandsworth Town Hall.

LUTON.—The tender of the Hudson Economiser Co. for the erection of a cooling tower of 100,000 gallons capacity per hour, at £556, has been accepted, and that of the Sheepbridge Coal & Iron Co. for iron piping, at £137 15s.

SUNDERLAND.—The following tenders have been accepted:—Lead-sheathed E.H.T. cable, India Rubber, Gutta Percha & Telegraph Works Co., Ltd.; cable racks, Messrs. Doulton & Co.

COMPANIES' MEETINGS AND REPORTS

BLACKPOOL, ST. ANNE'S & LYTHAM TRAMWAYS CO.—At the annual meeting on Thursday the report and accounts given in our last issue were adopted. The fact that the traffic receipts during the year were less by £370 was attributed by the Chairman to the bad weather and to the counter attractions in London, such as the Franco-British Exhibition. The sinking fund, he said, was being put aside for paying off prior debentures, and it now stood at £6,000. The conversion of the share and debentures of the Blackpool Electric Tramways (South) Co. into share and debentures of the present Company was being proceeded with in accordance with the resolutions on the subject, and the trustees for the debenture holders had approved of the payment of 2½ per cent. on account of arrears of interest on debenture stock.

DORMAN, LONG & CO.—At the annual general meeting last week, the report and accounts, given in our issue for November 19th, were adopted. The chairman, Mr. A. J. Dorman, in his speech, mentioned that the new electrically-driven rolling mill was at work, and, so far as they could see at present, it promised to be a great success. The electrically-driven cogging mill was expected to be in operation during February. When all this plant was in working order the works, he said, would be capable of turning out a large additional quantity of steel at a low cost.

INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS CO.—At the annual meeting on Monday, the report and accounts given in our last issue were adopted. Major Leonard Darwin, who presided, stated that the general turn-over during the year had considerably increased, although in some branches of the business there had been a falling off.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—The report for the year ended September 30th states that since the date of the last report the scheme for the conversion of the profit-sharing secured notes and for raising further money by means of prior lien bonds, which was duly sanctioned by the Court, has been carried into effect, and the voluntary liquidation which was necessary to carry the scheme under the Joint Stock Companies Arrangement Act, 1870, was closed under order of Court on July 21st, 1908. Since the date of the balance-sheet the loan of £183,175 to the Metropolitan District Railway Co. has been repaid, and the sum of £64,998 appearing in the balance-sheet has been paid to the trustees of the power house depreciation fund. Half-yearly accounts will, in future, be submitted to the shareholders, made up to June 30th and December 31st in each year. It is proposed to hold half-yearly meetings, and at the meeting to be held next February there will be submitted a balance-sheet made up to the 31st inst., with a revenue account of the company from the close of the liquidation to the end of the year. The meeting to be held on the 21st inst. has only been convened in order to comply with the provisions of the Companies' Acts, which, in effect, require a company to hold one ordinary general meeting in each year. The business to be transacted will, therefore, be of a purely formal nature.

P. & O. Batti Wallahs' Society.—(Birmingham Local Section.)—Meetings are held at 7.30 p.m. on the last Thursday in each month at Prince's Café, Corporation Street, Birmingham. It is hoped that every member will endeavour to attend these meetings regularly throughout the winter season.

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MISCELLANEOUS CITY NOTES

ANGLO-ARGENTINE TRAMWAYS CO.—The directors have declared a final dividend of 5s. per share for the year to December 31st upon the second non-cumulative preference shares. A final dividend of 3s. for the same period has also been declared on the cumulative first preference shares, being at the rate of 6 per cent. per annum. Both dividends are less tax.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—Subscriptions have been invited this week for an issue of £500,000 4½ per cent. perpetual consolidated debenture stock. This stock is perpetual and irredeemable, and is entitled to the benefits of a trust deed dated February 23rd, 1907, in favour of the British Empire Trust Co., Ltd., whereby the whole of the company's assets and undertaking, including its uncalled capital, are charged by way of first floating charge according to English law, subject to the existing mortgages and charges created to secure £233,200 first mortgage debenture and £212,600 Vancouver power debentures. The properties of the company include over 65 miles of electric railway, and 14 miles which are being operated under agreement with the Canadian Pacific Railway Co. On September 30th, 1908, the number of 8-c.p. lamps connected to the electric lighting system was 310,866, in addition to 9,759 h.p of motors. The proceeds of the present issue are required for the general purposes of the company, and more particularly in connection with the further increase of the water-power electric plant at Lake Buntzen, and additional electric railways.

BRITISH INSULATED & HELSBY CABLES.—The transfer books will be closed from the 18th to the 31st inst., both days inclusive, for the preparation of warrants for interest on the debenture stock of this company. The warrants will be posted on the 31st inst.

EASTERN TELEGRAPH CO.—A dividend of 3½ per cent. per annum, less tax, on the preference shares for the quarter ending December 31st, 1908, and a third quarterly dividend of 1¼ per cent. on the ordinary shares, free of tax, in respect of profits for the year 1908, has been announced.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—An interim dividend for the quarter ended September 30th of 2s. 6d. per share free of tax has been announced.

GATESHEAD & DISTRICT TRAMWAYS CO.—Parr's Bank, Ltd., has been authorised to receive applications for the purchase of £10 shares at £8 15s. per share of this company, ranking for a full year's dividend at the next meeting.

GLOBE TELEGRAPH & TRUST CO.—A quarterly dividend of 2s. per share has been declared upon the ordinary shares.

GREAT NORTHERN TELEGRAPH CO.—An interim dividend of 5s. per share, less income tax, has been declared.

MEXICAN LIGHT & POWER CO.—The directors have authorised the statement, for the information of the shareholders, that although they are opposed to a lease of the company to the Mexico Tramways Co., as set out in our last issue, they are agreeable to an amalgamation as an alternative.

NATIONAL TELEPHONE CO.—The transfer books of three-and-a-half per cent. and four per cent. debenture stocks will be closed from December 18th to December 31st, inclusive, for the preparation of the warrants for the interest due January 1st.

NORTH MELBOURNE ELECTRIC TRAMWAYS & LIGHTING CO.—A meeting of the debenture holders will be held to-morrow to consider the following resolutions: (1) That the security shall not become enforceable nor the principal become payable solely on account of the interest being in arrear during any part of the period from November 30th, 1908, up to and including December 1st, 1913; and (2) that the moneys paid by J. G. White & Co., Ltd., under their guarantee of debenture interest, due December 1st, 1908, may be applied for the general purposes of the company.

UNITED RIVER PLATE TELEPHONE CO.—An interim dividend of 6 per cent., free of tax, upon the ordinary shares has been announced.

WESTERN TELEGRAPH CO.—The directors have declared the first quarterly interim dividend of three shillings per share, free of income tax, for the year ending June 30th, 1908, being at the rate of 6 per cent. per annum. The transfer books will be closed from December 14th to 19th, both days inclusive, and the dividend will be payable on the 21st inst.

Dissipation of Fog by Electricity.—The Works Committee of the Westminster City Council has received a letter from Mr. E. L. Walford, 47 Hamilton Terrace, N.W., stating that he proposes to form a small syndicate to try on a practical scale Sir Oliver Lodge's system of dissipating fog by means of electricity. He asked for permission to try the experiment in Westminster upon land the property of the Council. The Works Committee have agreed (subject to the usual sanction) to allow Mr. Walford to experiment on a portion of the Grosvenor Canal property, provided the experiment can be conveniently carried out without detriment to the Council's work and without danger.

APPOINTMENTS AND PERSONAL NOTES

Eighty-eight applications were received by the Stoke Newington Borough Council for the post of engine-driver for the new electricity engine-house. Mr. Alexander Turnbull has been appointed to the post.

The salary of Mr. Lloyd Jones, station superintendent at West Ham, has been increased from £280 to £300 per annum.

Applications are invited for the post of secretary to the Institution of Electrical Engineers. (See an advertisement this week.)

The Rawtenstall Corporation require a Borough Electrical and Tramways Engineer at a salary of £200 per annum. Applications to the Town Clerk by December 23rd.

Tenders applications have been received by the Erith Urban District Council for the dual position of electrical engineer and tramways manager. Two officers are at present engaged in the respective departments, but it has been decided on the ground of economy to dispense with the services of one of them. The applications include the present tramway manager and the present electrical engineer, in addition to Mr. J. D. Pember, electrical engineer to the Dartford Urban District Council, and Mr. W. A. Tester, electrical engineer and tramways manager to the Lancaster Corporation.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Son, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £65 10s. to £66 per ton (last week, £65 to £65 10s. per ton).

CHANGE OF ADDRESS.—On and after the 21st inst. the London offices of Messrs. Stewarts & Lloyds, Ltd., will be removed to Winchester House, Old Broad Street, E.C.

BANKRUPTCIES.—A petition for the winding-up of the Aluminium Corporation, Ltd., will be heard on January 12th, 1909, before Mr. Justice Swinfen Eady, and persons desiring to appear are requested to communicate with Mr. Elvy Robb, 79-83 Temple Chambers, London, E.C.

A meeting of the Private Telephone Co. (old company) will be held at 27 Chancery Lane, London, on Wednesday, January 20th, at 12.30 p.m., to receive the liquidator's report of the winding up.

CHRISTMAS HOLIDAYS.—The offices, works, and stores of the Union Electric Co., Park Street, Southwark, will be closed from December 25th to 29th.

MESSRS. BRUCE PEEBLES & CO.—This company has been successfully reconstructed, and is actively engaged in the manufacture of all the different classes of electrical machinery with which its name has for so long been associated. The business has been conducted without interruption, and as its control is now in the hands of an entirely new and influential board of directors, it is believed that the success of the business is assured. The new board consists of the following gentlemen: Messrs. A. W. Tait, M. B, Mountain, C. J. Shiells, Alex. Mackenzie, Chas. H. M'Euen, F. E. Andrews. The company owns the sole manufacturing rights in Great Britain and the Colonies of the well-known La Cour Motor Converter.

"GRAL" LAMPS.—We are informed that since the announcement of the reduction in price of "Gral" metal filament lamps, the Armorduct Manufacturing Co., Ltd. (Farringdon Avenue, E.C.) have been working at considerable pressure in filling orders for these lamps. Arrangements have been made for a much larger supply shortly, which will enable good stocks to be kept. The 100–135-volt lamps are made in sizes of 20–30, 50, and 100 c.p., and the 200–265-volt lamps in 40–50 and 100 c.p. An efficiency of 1 watt or slightly more per Hefner candle-power is claimed. Lists will be sent to any of our readers on application to the firm.

Institution of Electrical Engineers.—At the meeting of the Institution of Electrical Engineers on January 14th, a Paper will be read by Mr. Stanley Clegg, Electrical Engineer and Tramways Manager to the Lincoln Corporation, upon "The G.B. System from a Tramway Manager's Point of View."

The Proposed Tax on Electricity in Germany.—The Paper which was read by G. Dettmar, the Secretary of the Verband Deutscher Elektrotechniker, at the special meeting on November 24th of the Elektrotechnische Verein in Berlin, on the proposals of the German Government relating to the taxation of electricity, has just been published, together with the ensuing discussion, in the *Elektrotechnische Zeitschrift*. The author showed that the Government had considerably over-estimated the probable gross revenue from the proposed tax, and had also under-estimated the costs of administration, with the result the net revenue would fall very short of what was expected. He also considered in detail the effect of the tax on the industries of the country, and concluded with a formidable list of telling objections to the imposition of the tax. A long discussion followed the Paper, in which most of the speakers strongly condemned the tax.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

An account is given of the proceedings at a Local Government Board inquiry before Mr. Hooper, at which the Lancashire Electric Power Co. opposed the application of the Radcliffe Urban District Council for sanction to raise a loan to extend the Council's works. The power company, who were supported by a number of local manufacturing firms, contended that the Council would find it more economical to buy energy in bulk from the company's station at Radcliffe, and they also complained of the difficulties the Council had placed in the way of the company obtaining power consumers in this district, although the Council's own works were on too small a scale to supply large power consumers. It was elicited that both the Radcliffe and the Farnworth District Councils made the company pay them 2½ per cent. on the gross revenue derived from consumers supplied by the company in these areas. (Page 804.)

The new generating station of the North Metropolitan Electric Power Supply Company at St. Albans is of particular interest, as it depends entirely on refuse for fuel. A continuous-current supply at 2 × 230 volts is given in the town of St. Albans, but by an ingenious arrangement of compensators supplied from slip-rings connected to the generator armatures, two further constant potential points are obtained, and a five-wire supply at 4 × 115 volts will be given to a neighbouring factory which has at present a private 115-volt lighting and power system. As the total voltage of the main generators is thus only about 460 volts, it is raised to the station pressure of 470 to 480 volts by means of boosters. The booster sets can be used for boosting either for battery charging or discharging, or for the above purpose. When the main generators are not running, one booster set is used as a motor generator driven from the battery for supplying the above-mentioned factory. Only two generating sets, with a capacity of 150 kw. each, are installed at present. The engines are run non-condensing. (Page 805.)

In the discussion on Mr. J. W. Beauchamp's Paper on "Plans and Records for Electrical Distributio

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Systems," by the Leeds Local Section of the Institution of Electrical Engineers last week, several mains engineers and others gave particulars of their practice in this respect, and all the speakers agreed as to the importance of an accurate but not too elaborate system of mains recording. (Page 809.)

The Paper on "The Production of Nitric Acid by the Electric Discharge" by Messrs. W. Cramp and B. Hoyle, discussed last Thursday at the London meeting of the Institution of Electrical Engineers, and also before the Manchester Local Section of the Institution on the preceding Tuesday, commenced with a brief review of the methods for the "fixation" of the nitrogen of the air by previous experimenters, followed by a very clear account of the different forms which the alternating discharge in air can assume. The main part of the Paper contains full particulars of the results of a long series of experiments with a simple form of apparatus, undertaken to trace the influence of certain variables on the efficiency of the nitrogen fixation process, and finally the authors gave the theoretical conclusions drawn from their researches, and indicated the direction in which sufficiently improved results might be expected to enable electrically-produced nitrate to compete commercially with cyanamide for fertilising purposes. Only a few speakers took part in the London discussion. Mr. W. Duddell asked for some fuller information on certain points connected with the nature of the discharge, and one or two speakers mentioned processes as being omitted from the Paper, but did not advance much in the way of particulars. Mr. Cramp, in his reply, dealt satisfactorily with practically every point raised. The discussion at Manchester chiefly turned upon the physical side of the subject. (Page 810.)

A new form of liquid motor-starter is described in a short article. (Page 815.)

The effect of a new form of flame arc lamp is shown by a photograph taken of an actual installation. (Page 816.)

A Paper was read recently by Mr. S. R. Gibbon on "Electrical Heating and Cooking Apparatus," before the Liverpool and District Electrical Association, in which the features of the systems of construction of the leading designs of heating and cooking apparatus at present on the market were briefly described. (Page 816.)

In a Paper read before the Birmingham Local Section of the Institution of Electrical Engineers, Dr. J. D. Coales described a method of artificially saturating the iron of transformers by direct-current, so that when an alternating E.M.F. is applied to one of the windings, the magnetisation varies in a cycle high up on the saturation curve. The use of this arrangement in the testing of alternators on inductive loads with transformers instead of choking coils was explained, and comparative test results by the two methods were given. In the discussion on the Paper, the convenience of the method was emphasised, and the opinion was expressed that the possibility of excessive heating of the transformers due to the extra core losses was not of importance. (Page 817.)

A written communication to the discussion on the Paper dealing with generalisations in the design of electrical machinery, by Messrs. J. C. Macfarlane and H. Burge, has been received from Dr. R. Pohl, of the Phœnix Dynamo Manufacturing Co., of Bradford. While admiring much of the authors' work, Dr. Pohl does not agree with their conclusion that for the best economy the cost of the active material in the armature and magnetic circuits should be equal. (Page 819.)

Experiments with high candle-power Osram lamps for public lighting are being made in Birkdale.—Further conferences are being held by the West London local authorities concerning the condition of the track of the London United Tramways. It is suggested that Sir Clifton Robinson should personally inspect the track complained of with the respective borough surveyors.—The sum of £500 damages has been awarded against the Dublin United Tramways Co. in relation to an accident caused by a rut alongside the track.—Owing to the local opposition, the London County Council does not propose to promote the suggested tramway down Sutherland Avenue.—As the Middlesbrough Corporation and the local tramway company cannot come to terms concerning tramway extensions, it is suggested that the adoption of the trackless trolley system will solve the difficulty.—The Tramways Committee of the Wolverhampton Corporation have acquiesced in the suggestion of the tramway company that through running should be abandoned, and acknowledge the effort of the company to make this successful. (Page 819.)

The Fareham Council require three alternators and accessories, and the Leith Corporation a 600-kw. generator. Local Government Board inquiries have been or will be held as follows: Cleethorpes (£4,000); Epsom (£1,500). Loans have been sanctioned, for electrical extensions, as follows: Wednesbury (£600); Frome (£11,000); Marylebone (£4,426); Battersea (£2,868); Woolwich (£753). A new motor-generator will shortly be required at Southampton; electricity meters are required at Beckenham; overhead tramway material at Portsmouth, and arc lamps and posts at Middlesbrough. The London County Council has accepted an offer by Messrs. J. Cochrane & Sons to provide condensing water pipes at the Greenwich power-house at an estimated cost of £8,000. (Page 820.)

A scheme of rearrangement of the capital of the Anglo-Argentine Tramways Co. has been sanctioned by the shareholders, as also has a considerable increase of the capital of the United Electric Tramways Co. of Montevideo. At the annual meeting of the Shanghai Electric Construction Co. on Friday, it was stated that there are several matters in dispute between the company and the municipality. Sir Edgar Speyer stated at the annual meeting of the Underground Electric Railway Co. of London on Monday that the traffic on the District Railway and on all the tubes showed satisfactory increases. In future, half-yearly balance sheets will be prepared to June 30th and December 31st. Subscriptions have been invited to an issue of £100,000 5 per cent. first mortgage debenture stock by the South London Electric Supply Corporation. (Page 822.)

The specification for the "Davy" automatic switch for use with small auto-transformers supplying metal filament lamps has been published. Among the other specifications which were published on Thursday by the Patent Office, is one by J. Johnson for a hard insulating material composed of sulphur, mica, and lamp-black, and another for an induction motor with a double rotor by Crompton & Co., Ltd., J. C. Macfarlane, and H. Burge. In this machine a high-resistance rotor is used when starting up, and a low resistance rotor when running. Three specifications by C. Ruzicka relate to the composition of insulating material of high specific resistance for heating and cooking apparatus. An ingenious form of self-starting mercury vapour lamp, in which the mercury is forced out of the illuminating portion of the quartz tube by the pressure of the vapour, is described in a specification by H. A. Kent, H. G. Lacell, and the Silica Syndicate, and Messrs. Siemens Brothers' Dynamo Works, Ltd. and O. Kieffer have one for a method of ventilating the rotors of turbo-alternators by forcing air through passages in the rotor teeth. An application for the amendment of a specification relating to mariners' compasses has been made by the executors of the late Lord Kelvin, and H. Mosey wishes to entirely reword the

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claims in a specification for a gravity-fed arc-lamp with converging carbons. Short abstracts of the above specifications are given in our Patent Record. (Page 825.)

A Local Government Board inquiry, recently held at Radcliffe, a report of which appears on another page, brings into prominence a practice in connection with the supply of electric power that cannot be too seriously discouraged. There are cases in which certain portions of a power company's authorised area in which local authorities have their own electricity works are marked out, as it were, as the local authorities' own preserves. The power company is not debarred from supplying consumers in that area, but it must in the first instance obtain the consent of the local authority. Instances of such consent are now becoming fairly frequent, when, for instance, the power consumer is at the outskirts of an area and is more accessible to the company than from the local electricity works, or when the municipal works are built on too small a scale to deal with consumers requiring heavy power loads. There is a growing practice, however, of charging the power company a price for the local authority's consent, a practice certainly not contemplated when the power companies acts were passed by Parliament. It was elicited during the Local Government Board inquiry at Radcliffe that 2½ per cent. of the gross revenue from the power company's consumer in the local authority's area had to be handed over to the District Council. In Farnworth the same condition obtains, and in Salford and Bury a nominal fee is exacted. The theory that a consent which may be withheld by a local authority has to be bought, has done so much harm in the tramway industry that a vigorous protest must be made against its being adopted in the electric power industry. If a local authority is unable to supply a consumer itself, it is obviously to the benefit not only of the consumer and the power company, but also to the community at large, that free facilities should be given to the company which can step in and supply the demand.

The Paper by Messrs. Cramp and Hoyle, which has been discussed by London and Manchester meetings of the Institution of Electrical Engineers, described a valuable series of experimental researches in the domains of both physics and chemistry. Possibly, from an electrical engineering point of view, however, the subjects dealt with may influence the future rather than the present. From the nature of the matters treated, it is possible that these researches might have been better brought to the notice of those specially competent to discuss the subject, by the Paper being read before some more specialised body, such as the Faraday Society; yet doubtless wider publicity will be given to the authors' work through the Institution of Electrical Engineers, and, indeed, the rapidity with which electrochemistry is merging into electrical engineering quite justifies the choice of an engineering institution as the medium of publication. From a strictly industrial point of view, perhaps, the net result of the researches may be a little disappointing, for the Paper almost leaves an impression that, notwithstanding their vast amount of work, the authors have failed to prove any commercial superiority of their method of utilising electrical discharges for producing nitrogenous compounds over the cyanamide process. Incidentally, however, the experimenters have done a most interesting and valuable piece of work from the electro-physical point of view, apart from its relation to industrial chemistry, in distinguishing between the various forms taken by the high-tension discharge, and in defining the conditions under which they occur, work which cannot fail to bear ultimate fruit in other branches of electrical engineering.

Most electrical engineers have, at some period of their career, passed through that interesting and essential, yet often somewhat neglected, department of an engineering works, whether small or large, the test-room. Indeed, for those who do not in later years take up the management of electrical machinery, either in a generating station or other works, the surmounting of the practical difficulties met in the testing of all classes of electrical apparatus during this period is one of the most valuable parts of the engineer's training on the technical side. It is then that he becomes familiar with many of the little peculiarities and ills of electrical machinery, and becomes as expert and quick in his diagnosis as a practised physician. One of the chief difficulties confronting the engineer in the test-room is the lack of auxiliary apparatus, and any little devices or "kinks," whereby he is enabled to carry out tests, without the use of special apparatus and with a low consumption of energy, are always welcome to him. Only a few weeks ago, a Paper on the testing of large alternators was read at a Local Section meeting of the Institution, and now we have another. The first of these, by Mr. S. P. Smith, described a method of testing an alternator, which was an improvement of Behrend's short-circuit test, and enabled the machine to be run under full-load conditions, and to be tested for efficiency and temperature rise, without supplying any more than the total losses. This, though a very economical way of obtaining the necessary figures, had certain drawbacks, which prevented it from being readily accepted by practical engineers. The necessity of special connections of the field windings, and the uncertainty of the correctness of the iron losses, caused frequent difficulty. The Paper read by Dr. J. D. Coales before the Birmingham Local Section, and abstracted in this issue, also dealt with a means of testing large alternators without excessive power consumption, but more especially with a means of testing for pressure drop. To obtain a highly inductive load it has hitherto been necessary either to dismantle some of the test-room transformers, take off the yokes, and use the wound limbs as choking coils, or to obtain specially constructed choking coils similar to those described by Messrs. Morcom and Morris in their Paper before the Birmingham Local Section last session. Dr. Coales describes a method whereby the test-room transformers can be used for this purpose without dismantling them, by means of artificially saturating the iron, and under certain conditions this method will, no doubt, be of considerable use to the test engineer. Although primarily intended for a "pressure drop" test, the arrangement described by Dr. Coales could well be used for temperature and efficiency tests at varying power factors, as mentioned in the discussion, provided efficient means of cooling the overworked transformers were provided.

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POWER SUPPLY IN LANCASHIRE

AN interesting fight is in progress between the Urban District Council of Radcliffe (Lancs.) and the Lancashire Electric Power Co. with regard to power supply within the township of Radcliffe itself. Although the Lancashire Power Co. has its large generating station at Radcliffe, it is precluded from supplying power within Radcliffe itself without the consent of the District Council. The Council has its own generating station, with a capacity of 490 kw. (made up by two 120-kw. sets and one 250-kw. set, from which it supplies 62 consumers for lighting, 16 for power, and 12 for light and power combined. To these consumers 285,186 units were supplied during the past year. The chief consumer of the Radcliffe District Council, however, is the Corporation of Bury, whose trams run into Radcliffe, and who have to buy electrical energy for this portion of their tramway system from the Radcliffe District Council at 1⅜d. per unit; 488,063 units were supplied to the tramways last year, and it is stated that the Bury Corporation are losing about £1,000 a year on this part of their tramway system.

The Radcliffe District Council, while not absolutely refusing to let the Lancashire Power Co. supply consumers in Radcliffe, makes it a condition that the consumers shall first make an actual application for power to the District Council, and then if the demand is so great that the municipal works could not deal with it, the consumer is allowed to buy from the Lancashire Power Co. This, it is said, has resulted in the power company having failed to get more than one consumer who would otherwise have been a good customer to them, for a consumer who desires to buy electrical energy from the power company naturally objects to applying for a supply from the District Council first, even if he is assured that this application is merely a futile formality.

The power company has, however, found an opportunity to make a determined effort not only to improve on these conditions, but also to add the Radcliffe District Council itself to the number of large consumers who are supplied from the company's mains in various parts of South Lancashire. The municipal electricity works at Radcliffe desire to put down more plant—to the extent of a 300-kw. set—to meet the growing demand for electricity in their district, and applied to the Local Government Board in the ordinary course for sanction to a loan of £14,350. Part of this, viz., £3,500, is for over-expenditure already incurred without sanction, £5,035 is for plant at the generating station, including the 300-kw. set, one boiler and some auxiliary plant, and the remaining £5,815 is for mains extensions and for motors for hiring out. At the Local Government Board inquiry, held on November 18th and December 10th, the Lancashire Electric Power Co. opposed the loan, and were supported by a section of the Radcliffe ratepayers, including several large manufacturing firms, on the ground that the District Council would fare more economically if they bought their supply "in bulk" from the company. Mr. Hooper, the Local Government Board inspector, allowed the company's *locus standi*, and the whole question of the District Council's attitude with regard to the power company's prospective consumers was gone into.

It appeared that the company had already offered to supply the District Council "in bulk" at the Council's electricity works at 0·6d. per unit for A.C. and 0·75d. for D.C. supply, but that this offer had been refused. The lowest price at which the Council were supplying any power-user was 0·9d. per unit; the power company, on the other hand, are supplying a large bleach works in the district with about 300,000 units per year at 0·65d. per unit. In answer to this, Mr. H. Wilkinson, the Council's electrical engineer, stated that his total costs last year were 0·78d. per unit sold, and that interest and sinking fund came out to 0·41d. per unit, while at the price mentioned for bulk supply taken from the company the costs would work out to 1·11d. per unit sold.

Mr. Wolfenden said that in 1905, at which time he was vice-chairman of the British Aluminium Company, the company had proposed to erect new works at Radcliffe, and had entered into negotiations with the Lancashire Power Co. They had practically come to terms for a supply of a 24-hour load (Sundays included) of 1,500 kw., but owing to the uncertainty and delay with regard to obtaining the Council's consent, the negotiations were broken off, and the British Aluminium Company erected in Norway the new works they had in contemplation. The Council contended, however, that there had been no unnecessary delay, as the matter had only come up in August, 1905, and that they were ready with the draft agreement between the Council and the company in the following November.

In the evidence given by Mr. Mills, the Clerk to the Council, it was elicited that the power company have to pay the Council 2½ per cent. on the gross revenue for the one consumer (already referred to) which they have in the Radcliffe area. This consumer is Whittaker's bleach works at Mount Zion. In the draft agreement with regard to the supply to the British Aluminium Co., only 1 per cent. was arranged. It was subsequently stated that the power company pay a similar 2½ per cent. to the District Councils at Ramsbottom and Farnworth, but only nominal considerations in Salford and Bury, and none in Bolton.

The Chairman of the Radcliffe Electricity Committee (Mr. S. R. Walker) was called to give his version of the negotiations with the British Aluminium Company, and stated that the plans for building the new works were passed by the Council in October, and the draft agreement in November, and that the breaking off of the negotiations was entirely due to the Aluminium Company. Mr. Walker admitted that the Council desired to confine themselves to supplying small consumers only, and on the question of taking supply in bulk, said that they could also obtain this from the electricity works of the Bury Corporation, which were only 2½ to 3 miles distant. Mr. Lacey, consulting electrical engineer to the Radcliffe Urban District Council, explained that the Council's present station at Radcliffe would not admit of the erection of a high-tension plant, and that the question of buying of bulk supply would in any case be considered before the existing buildings were extended.

In addition to the bleach works already mentioned, a number of other works were alluded to during the inquiry, of which some took power from the company and others did not do so because of the Council's intervention. Among the latter was the East Lancashire Paper Mill, which had put down its own plant. Messrs. W. T. Wood and Co., who were proposing to build a weaving shed in Radcliffe, went outside the area, as they found the Council's price prohibitive and could not make arrangements with the power company owing to the trouble with the Council. A similar position was taken up by Andrew Greenhaigh's bleaching works, which are owned by the Bleachers' Association, who also own Whittaker's bleaching works, the company's only power consumer in Radcliffe. Mr. Young, the manager of a new colliery at Coney Green, also said that his colliery would like to be in a position to get cheap electrical energy.

Mr. C. D. Taite, the present engineer and manager of the Lancashire Power Co., spoke as to the unworkable nature of the present arrangement with the Radcliffe Council with regard to applications for power, and of the necessity of being allowed to canvass in the district. In Salford, he said, they had a canvasser whose sole duty it was to call on power and light users.

Mr. Taite also adduced figures to show that it would pay the Council to buy energy in bulk from the power company at 0·75d. per unit for D.C. current. This offer was contingent upon an arrangement being come to with the Council for the company to deal directly with large power users. Mr. R. B. Leach, electrical engineer to the Farnworth Council, said that they had found that it was cheaper to take power in bulk from the Lancashire Electric Power Company before they had completed the building of their own generating station. He admitted that in the case of power users in Farnworth supplied direct by the company, a commission of 2½ per cent. was paid, but, on the other hand, it was stated that the Bolton Corporation charged no commission in such cases, and that the Bury Corporation only charged a nominal consideration. In Salford, too, permission had been given to supply a consumer in Prestwich on payment of a fee of £1 per annum.

Another argument adduced by the company was that the Radcliffe Council's electricity undertaking was only enabled to pay its way because of the contract with the Bury Corporation to supply its trams at 1⅜d. per unit, and that this price was too high, and would certainly be reduced, as it was subject to a revision every five years.

To meet a suggestion by the Radcliffe Council that assurances were needed as to the financial stability of the Lancashire Electric Power Company, Sir Richard Hampson, a director of the company and an ex-Lord Mayor of Liverpool, and also Mr. H. F. Parshall, chairman of the company, gave assurances that there were ample funds available both for working capital and for extensions.

The decision of the Local Government Board will be announced in due course.

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ELECTRICITY SUPPLY AT ST. ALBANS

A Combined Refuse Destructor and Generating Plant

THE recently completed generating station at St. Albans, Herts, is in the almost unique position of being a steam generating station exclusively dependent on refuse for fuel. It forms one of the small separate stations owned by the North Metropolitan Electric Power Supply Co., which have been established in some of those isolated parts of its large area of supply (326 square miles), which it would not have been economical to reach by extensions of mains.

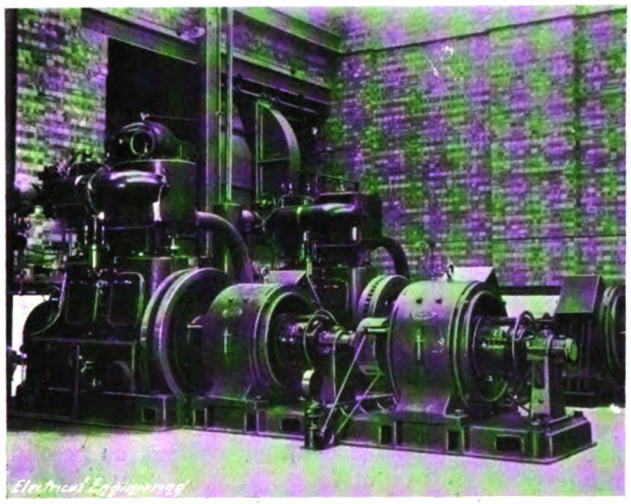

FIG. 1.—VIEW OF 150-KW. GENERATING SETS AND FORCED DRAUGHT PLANT.

The company also owns a station constructed for similar reasons at Hertford. By an arrangement with the Corporation of St. Albans, the company dispose of the whole of the town refuse which is dumped direct into a hopper delivering on to the floor of the destructor house, by the Corporation dust-carts. Before we describe the station itself, it may be of interest to give a few particulars of the history of the undertaking. As far back as in the year 1898, the St. Albans Corporation obtained a Provisional Order for the supply of electricity, but decided not to proceed with the construction of a station. Later, the Order was transferred to the St. Albans and District Electric Supply Company, Ltd., who, in 1905, obtained an Order for the supply of the surrounding district. An Amending Order in 1907 transferred both the above Orders to the North Metropolitan Electrical Power Distribution Company, Ltd., who now hold them, and the generating station has been built by, and is under the control of, the North Metropolitan Electric Power Supply Company.

The station is adjacent to a branch line of the Great Northern Railway within half a mile of the St. Albans station of the Midland Railway, and adjoins the works of Messrs. Arc Lamps, Ltd., which were described in ELECTRICAL ENGINEERING, Oct. 1st, 1908, page 489. At the time of that description, the works were run temporarily from a gas engine; but since then electric driving has been introduced, and power is supplied by means of overhead lines from the station now being described. As indicated in the ground plan of Fig. 5, an inclined roadway, laid with wooden sleepers in order to give the horses a firm footing, leads from the road to an elevated, covered in platform at the back of the station. Here the carts of refuse are first weighed on a Pooley weigh-bridge with ticket-printing attachment, and are then backed against the edge of a shoot which extends almost the whole width of the station as shown in Fig. 5. The refuse is dumped into this shoot and is delivered on to the destructor house floor below, from where it is fed by hand into the furnaces. Old iron is, of course, sorted out by the stokers, and any bulky objects, such as large mattresses or animal carcases, are cremated separately in one of the combustion chambers. The old iron is sold for about 15 shillings a ton. On either side of the main refuse hopper is a small coal-bunker, containing a small store of cheap coal of the class known as "yard sweepings." This is provided for the purpose of mixing with the refuse occasionally, when the material is very wet or contains a large proportion of garden refuse.

From the plan and elevation given in Fig. 5, it will be seen that the building is constructed in three main bays. The destructor furnaces, boilers, and pumping plant occupy the rear bay; the centre accommodates the generating sets and switchgear; and the front portion is devoted to the battery-room, test-room, and offices. A view of the generating plant, which comprises at present two 150-kw. sets, is given in Fig. 1. The arrangement of the boilers at right angles to the destructor furnaces, as shown in Figs. 4 and 5, has resulted in a very compact design for this portion of the plant. The end of the station from which the view of Fig. 1 was taken, is only temporary, and the site will permit of very considerable extensions. As can be seen from Figs. 1 and 5, the whole of the machinery and switchgear is quite shut off from the destructor plant, so that dust troubles are entirely obviated.

The destructor plant was supplied by Messrs. Heenan & Froude, Ltd., and consists of two units of three cells each. Each unit is capable of burning from 25 to 30 tons of refuse per day of 18 hours. The cells and combustion chambers are lined with 9 inches of fire-brick. Regulating valves for controlling the forced draught to each section of the grate independently are

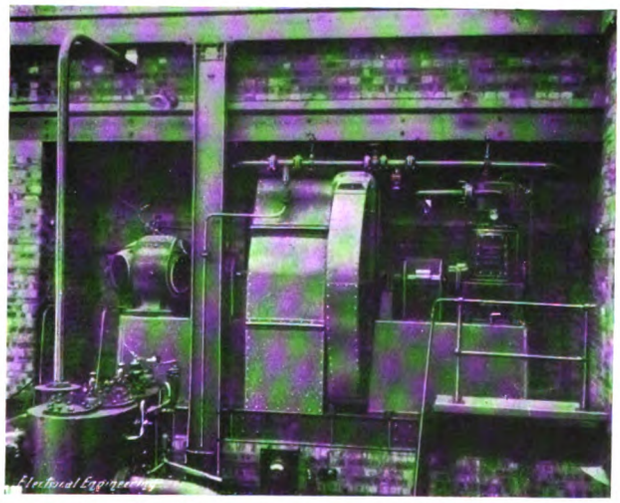

FIG. 2.—FAN FOR FORCED DRAUGHT WITH STEAM AND ELECTRIC DRIVE.

provided; and these are worked by means of small levers near the furnace doors. The latter are of the balanced sliding pattern. In order to permit of the destruction of mattresses, animal carcases, and other large articles, the doors of the combustion chambers, of which there are two, are 3 ft. wide by 4 ft. 6 in. high.

D

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The chimney, which was constructed by the Alphons Custodis Co., is 130 ft. in height, and has an internal diameter at the top of 5 ft. 6 in. To provide forced draught for the furnaces a "Heenan" centrifugal fan running at a speed of 450 r.p.m., is used. As shown in Fig. 2, this fan can be driven either electrically or by steam. On one side is a vertical steam engine of the totally enclosed type, fitted with forced lubrication; this engine is connected to the fan by means of an ordinary flange coupling.

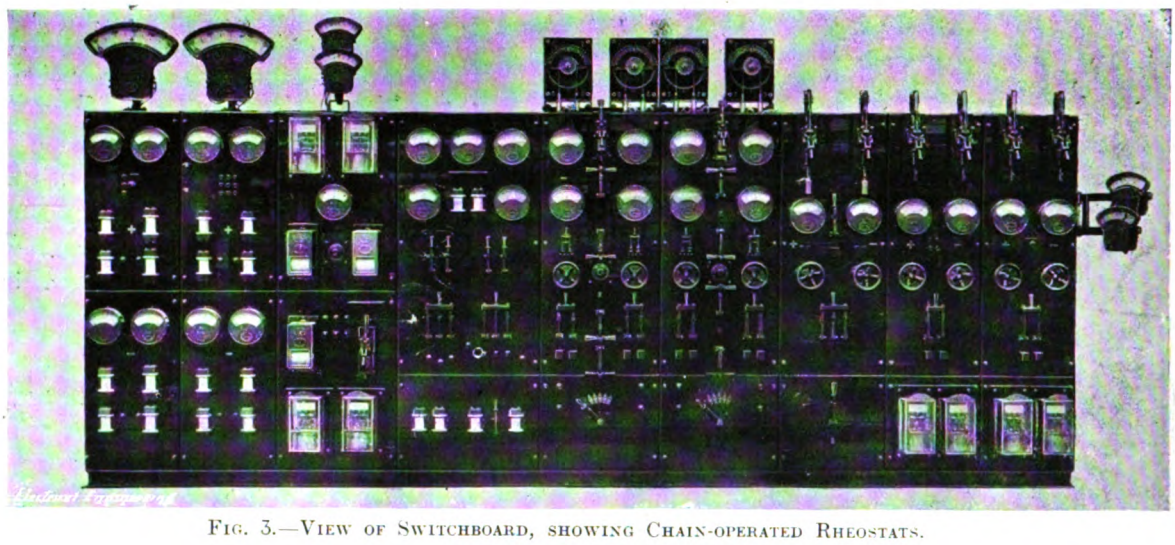

Fig. 3.—View of Switchboard, showing Chain-operated Rheostats.

On the other side is a 460-volt Rhodes ventilated type motor, which can be coupled to the fan by means of a sliding clutch when required. This motor is designed for a 50 per cent. speed variation by shunt regulation; the starting and regulating gear is attached to the wall just below the platform on which the forced draught plant is mounted. The platform is alongside the flue, projecting into the engine-room as shown in Fig. 1, but entirely separated by means of steel plates from the destructor house, so that no dust can reach either engine or motor. The air for the fan is taken in at the top of the destructor house, and after passing through the air-shaft and the fan, it is heated to a temperature of about 350° F. by being passed through an air-heater, which consists of a number of boiler tubes through which the flue gases pass, arranged in the flue in the position indicated in Fig. 4. The heated air is then passed through ducts to the front of the furnaces. Good ventilation of the destructor house is ensured, as fresh air is drawn in at the doorways and through special openings provided at the ground level, to replace that which is removed from the top of the building by the fan. This special feature of the Heenan destructor ensures that any smoke or fumes which may have collected in the destructor house pass through the furnaces a second time.

Each of the two Babcock and Wilcox boilers has a heating surface of nearly 2,000 square feet, and is composed of twelve sections of eight tubes each, and, as shown in Fig. 4, doors are provided in the side of the building, so that the tubes can readily be drawn when necessary. Each boiler is provided with a "Foster" superheater, capable of raising 7,000 lb. of steam per hour, at a pressure of 200 lb. per sq. in. to a temperature of 507° F., corresponding to a superheat of 120° F. These superheaters consist of a series of steel tubes fitted with annular gills or flanges not shown in the figure, to equalise the temperature. Each of these tubes has a centrally-supported core or closed tube, so that the steam, while receiving the superheat, passes along an annular space. The main and bye flues are provided with doors for access for cleaning. Two swivel dampers are fixed in the outlet to each boiler, and two balanced sliding dampers are provided in the bye flues; so that either destructor can be used when its boiler is shut down. There is also a sliding damper in the flue to the chimney. A guarantee was given by the makers of the destructor plant that 1·69 lb. of water from and at 212° F. would be evaporated per lb. of refuse burnt, at a pressure of 200 lbs. per sq. in., and at a temperature of 507° F. A pressure of 200 lb. per sq. in. was decided upon in order to take full advantage of the steam raised, so that blowing off would occur as seldom as possible. As a certain amount of blowing off is unavoidable, a relief valve is fitted at one end of the main steam range, and pipes are connected to it which allow

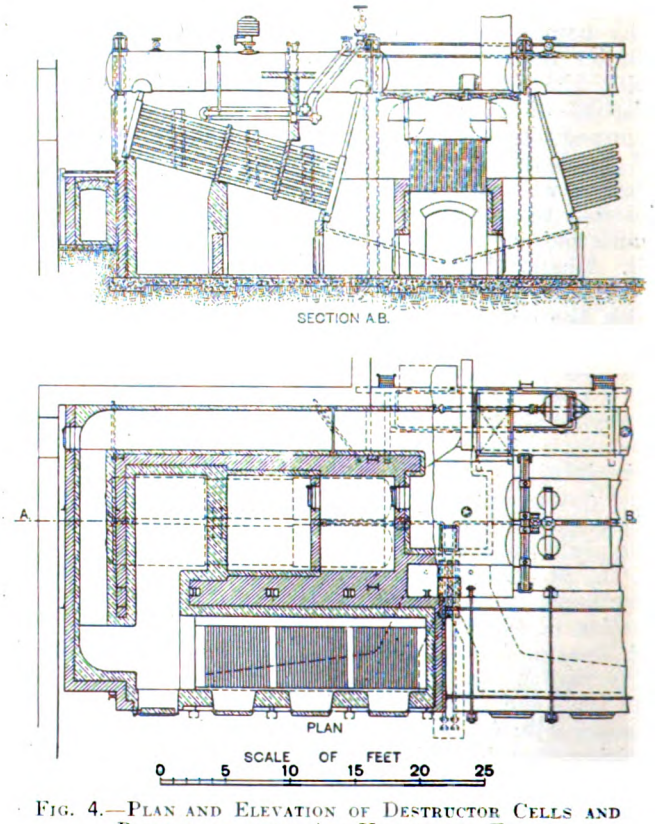

Fig. 4.—Plan and Elevation of Destructor Cells and Boilers, showing Air Heater and Fan.

the excess steam to pass to an injector heater in the feed tank, which not only increases the economy, but enables the water to be returned to the boilers. The amount of steam consumed by the engine for the forced

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draught set was specified as from 5 to 6 per cent. of the total amount generated. Refuse clinker is, of course, a useful bye-product, as is also the fine hard dust collected from the combustion chambers, which makes an excellent mortar.

The two engines are of the Brush-Falcon two-crank compound enclosed type running at 430 r.p.m., and are at present run non-condensing, although it is intended to put in condensing plant at a future date. It is possible, however, that the exhaust steam will be utilised for the heating of a large factory and printing works adjacent to the station. The guaranteed steam consumption is 28·5 lbs. per kw. hr. at full load, with 175 lbs. per sq. in. pressure at the stop-valve and atmospheric exhaust. The pump room is situated above the main flue adjacent to the chimney, and contains a Mather & Platt three-throw variable stroke electrically-driven pump and a Wier steam pump. A water softening plant is shortly to be installed.

Each engine drives two 75-kw. continuous-current generators in tandem. These are four-pole Brush machines generating at 230 volts, one on either side of the 460-volt three-wire system. One of the problems which confronted the engineer when designing the station was the fact that, whereas a pressure of 460 volts had been decided upon for the town, the large factory and printing works already mentioned, which it was also intended to supply, had already a 115-volt system with its own generating plant. In order to obtain a 115-volt supply, the generator armatures are fitted with two slip-rings connected to opposite points in the winding, and these are connected through double-pole switches mounted on the machine frames with compensators. A tapping is taken out from the neutral point of each compensator, so that the direct-current voltage between either terminal and the tapping is 115 volts if the total pressure across the machine in question is 230 volts. Connections from the tappings of the two compensators and from the common and outer terminals of the generators thus constitute a five-wire system, from which the supply to the adjacent factory can be given. As the declared pressure in the town is 460 volts, and the station pressure may be as high as 480 volts at full load, provision is made to supply the difference between this and the total generator pressure of about

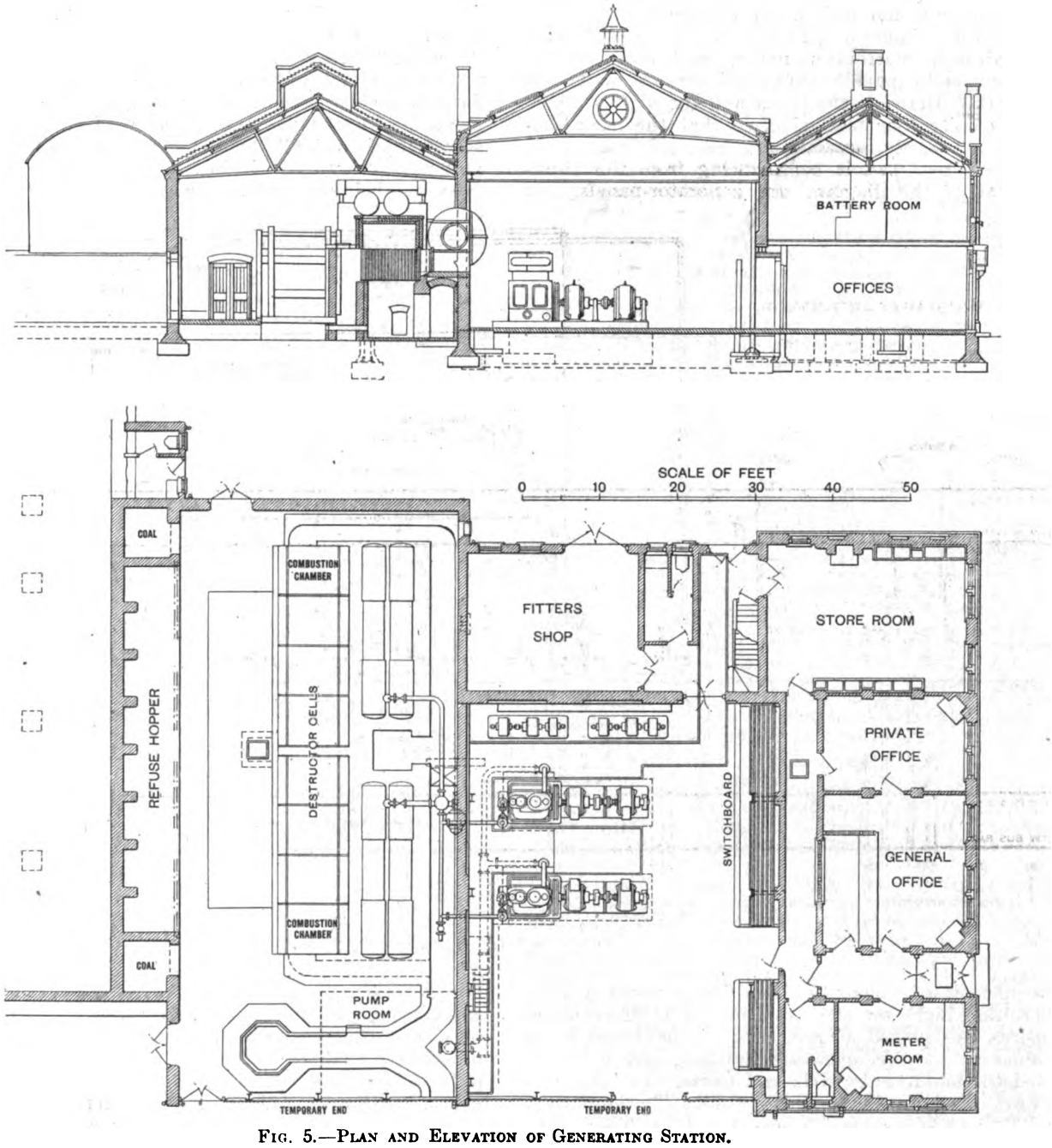

Fig. 5.—Plan and Elevation of Generating Station.

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460 volts by boosters. For this purpose the generators are connected to "low-pressure" bars on the switchboard and the outgoing cables to the "high-pressure" bars, and the boosters are connected between the two sets of bars. The 115-volt supply can be given by using a booster set as a motor-generator set, in which case the generators can be connected direct to the "high-pressure" bars, as shown in the diagram of connections given in Fig. 6. This diagram, which shows the whole of the station connections, has been prepared to correspond exactly with the arrangement of the instruments and switchgear on the main switchboard which is illustrated in Fig. 3. The board itself is of Messrs. Ferranti's make, and consists of enamelled slate panels supported on an angle-iron framework. Between the board and the wall is a passage-way quite four feet wide, so that the back connections are easily accessible.

The first two panels commencing from the right-hand side of the diagram are generator-panels, and panel, the usual earth or neutral wire panel, the recording earth-current ammeter is fixed. A resistance is put in series with this recording instrument directly the earth-current reaches the value of 15 amperes, and this prevents it from exceeding that amount. The next two panels are the main feeder-panels, from which the 460-volt three-wire supply for the town leaves the station, the cables are six-core, and consist of two outers and a neutral, and three pilot cables from the feeding points on the town distributing network. These feeders, which together with the cables for the whole of the distributing mains were supplied by British Insulated and Helsby Cables, Ltd., are taken to "Prescot" feeder pillars.

The two reversible booster-sets supplied by the Lancashire Dynamo & Motor Co., are arranged along one side of the engine-room as shown in Fig. 5. Each set comprises a 460-volt, 800-r.p.m. shunt-wound motor driving two 18-kw. generators, the three machines being mounted on a common bedplate. The

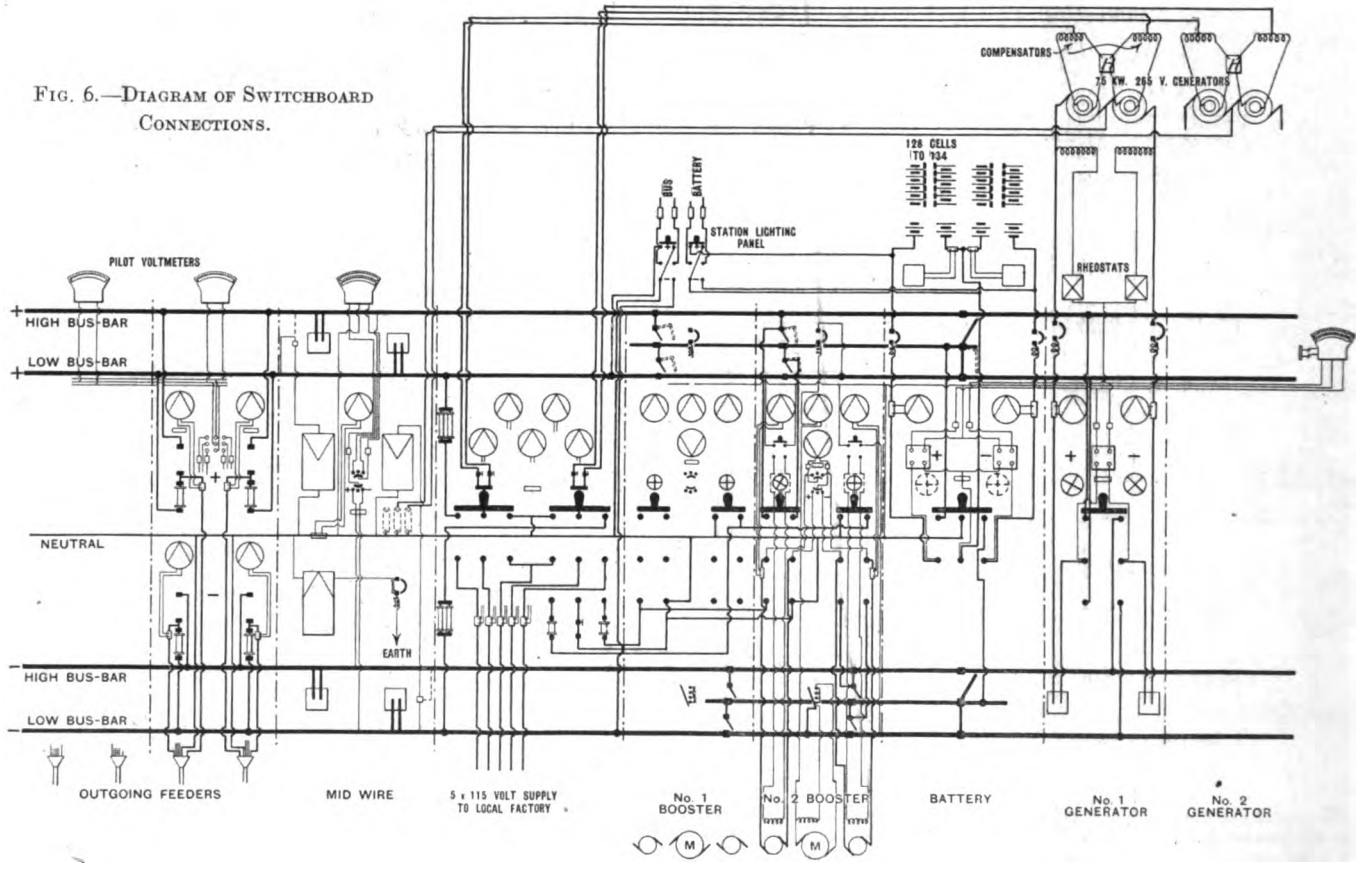

FIG. 6.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

these permit of the generators being connected to either the high or the low bus-bars. The shunt rheostats are placed at the back of the board some distance above the operating handles, and are connected to the latter by rods and universal joints. On the next panel are the handles for operating the battery regulating switches, which are described later. The next panels, the booster-panels, are necessarily somewhat complicated, in view of the many functions of the booster-sets, but, by a careful inspection of the diagram, the manner in which the various connections are made may be seen. At the top of the diagram, and connections from the generator slip-rings to the compensators are shown, and the latter are connected to the five-wire supply cable in the manner indicated on the diagram of the next panel. It may be mentioned that the compensators are designed to take an out-of-balance load of 50 amperes in any one of the intermediate wires. The method of supplying the 115-volt system direct from booster-sets acting as motor-generators is also clearly shown. On the next two generator fields are excited from the 230-volt circuit through rheostats of the reversing potentiometer pattern. These rheostats, which can be seen in the illustration of the switchboard, are chain-operated, the rods connecting the chains being enclosed in insulating-tubes, so that if a chain breaks, there is no danger of a rod falling and short-circuiting any terminals at the back of the board. The booster-sets are used for three distinct purposes:—In the first place they are used for battery charging, and for this work each generator is capable of boosting up to the extent of 25 volts with a current of 200 amperes at the beginning of a charge, or 120 volts with a current of 150 amperes at the end of a charge. The second purpose for which these sets are used is for boosting-up between the high and low-pressure bus-bars of the station, as explained above, in which case one generator adds the necessary 10–15 volts on each side of the three-wire system. Thirdly, as mentioned before, the booster-sets can be used to give a 2 × 115-volt supply to the adjoining factory, when the main generators are not

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running. By this arrangement, the supply to this special consumer from a portion of the battery only, and the consequent unequal discharge of the cells, are avoided. When performing this duty each set has a capacity of 150 amperes, at 2 × 120 volts, or 36 kw. The combined efficiency of one set when each booster is delivering 150 amperes at 120 volts is guaranteed to be over 80 per cent., and the consumption of the motor when the set is running light with the boosters unexcited is guaranteed to be less than 6 kw.

The battery room contains 268 cells arranged in one tier, but in two groups of 134 each. The cells, which are of the Tudor Company's make, have a capacity of somewhat over 1,000 ampere hours at a 10-hour discharge rate. Lead-lined wooden boxes are used, and these are supported on glass insulators, the whole being raised from the ground on a wooden stand. Some of the cells of each group are connected to the discharge regulating switches which, as indicated in the diagram of the switchboard connections given in Fig. 6, are operated by chaingear. Provision has been made for a bell connection, which will indicate when the switch arm is in an intermediate position. In order that the switchboard attendant may know in what position the switch arm of the regulating switch is, the shaft of the operating handle is provided with a screw-thread and a nut which travels along and indicates on an adjacent scale the number of cells in circuit. Ampere-hour meters to record the charge and discharge separately are provided. The station lighting is controlled from a small panel at the back of the main board as indicated in Fig. 6. All wiring is carried out with lead-covered twin wire.

In conclusion we wish to acknowledge our indebtedness to Mr. E. T. Ruthven-Murray, the Engineer-in-Chief to the North Metropolitan Electric Power Supply Co., who is responsible for the design of the station, for permission to visit and describe the station, and for kindly placing drawings and other information at our disposal. Our thanks are also due to Mr. T. E. Eachus, the resident engineer at St. Albans, who conducted our representative over the station.

SYSTEMS OF RECORDS FOR MAINS

Discussion at Sheffield

THE following is a report of the discussion on Mr. J. W. Beauchamp's Paper on "Plans and Records for Electrical Distribution Systems," read before the Leeds Local Section of the Institution of Electrical Engineers at Sheffield last week. An abstract of the Paper itself appeared in our last issue (p. 783).

Mr. J. E. Marsh (Sheffield Corporation Tramway), in opening the discussion, said that the subject was one which had been hitherto neglected by the members of the Institution, and congratulated the author on producing an eminently practical Paper. He was afraid that the keeping of complete detailed records of distribution systems did not always receive the careful attention by station engineers that was essential. He considered it very important to label cables to avoid mistakes on the spot. He was afraid, however, that the lead labels sometimes used were liable to be detached and then put back on the wrong cables.

Mr. J. W. Fawcett (Leeds) considered that the system described suffered from over elaboration. He maintained that a system of mains' records should be as simple as possible. The record was required for practical use and not compiled for academic consideration. Accuracy in detail was very important, and the speaker referred to a case where the records had failed—a particular cable having ultimately been found near the kerb, instead of being in the centre of the road, as shown. A system he found very satisfactory was to divide the network into from four to eight parts and make them into section maps. All services and extensions were kept in sketch books. He had tried both lead and leather labels with unsatisfactory results, and finally adopted aluminium labels punched in an automatic machine and attached by wires to the cables.

Mr. A. J. Cridge (Sheffield Corporation Electricity Supply Department) said that any system should be so arranged that a new man could easily understand it and find his way about without difficulty. He disagreed with a previous speaker, who had advocated recording the mains and service connections on the back of the meter card. The work should not be divided between two departments.

Mr. W. N. Y. King (Sheffield) emphasised the importance of keeping the records up to date, otherwise they were useless in an emergency and the system failed.

Mr. H. Dickinson (Chief Electrical Engineer, Leeds Corporation) explained in considerable detail the system adopted in Leeds, illustrating his remarks with copies of actual plans and cards in use. He had adopted a combination of ordnance maps and card systems. Every detail was shown on each section map and the cables were numbered, the numbers being carried forward to the end of the main. They worked absolutely to these maps. On the occurrence of a fault the particular map was referred to, a sketch made of the part required, and then worked to on the spot. They found no difficulty, as a rule, in getting all details on the maps. In some cases the maps were enlarged to twice the scale of the ordnance survey quite easily by means of a pantograph. All details referring to gas and water pipes, &c., met with were recorded, which information was frequently very useful. Photography was made use of extensively, and wherever an awkward place occurred it was photographed and properly indexed. He considered Mr. Beauchamp's system to be over elaborated, and was in favour of keeping a large part of the information in book form. All the plans were kept in a book and a duplicate set was preserved in the works, so that in case of fire there was no danger of the records being totally lost. In Leeds the card system only dealt with the consumers, feeders and sub-stations, from these they could easily turn to the proper book of plans, and in a few minutes every detail was before them. Photography was also used when laying mains for recording any peculiarity about walls, etc., which were then available as evidence at any future time.

Mr. W. F. Mylan (British Westinghouse Co., Sheffield) supported the previous speakers in advocating the importance of putting the working of a system into competent hands and keeping it strictly up to date. He preferred plenty of sketches and photographs to mere tabulated records; it was then so much easier to grasp a particular situation quickly.

Mr. Beauchamp, in reply, said the system advocated by him was intended to record where the cables were placed and not merely as a means of fault finding. It also gave a mass of detailed information useful for many other purposes besides cable laying. The automatic machine labels referred to by Mr. Fawcett were very useful for sub-station work and for switchboards. The use of photography advocated by Mr. Dickinson was valuable, especially if the records were carefully indexed. Referring to the remarks which had been made respecting keeping the records up to date, he agreed that the human element was a very serious one. Printing details on the cards served as a useful reminder of the information required. There was a liability in sketches to include only half of what should actually be recorded.

Somerset & District Electric Power Co.—Late notice is given of the intention of the Somerset & District Power Co. to introduce a Bill in the next session of Parliament for an amendment of their Act of 1903, including an extension of time for the commencement of works.

Northampton Institute.—In 1905 the Governors of the Northampton Institute applied to the Education Committee of the London County Council for a grant of £4,000 for the provision of electrical generating plant, but the Council recommended that a grant of £2,900 only should be made. The Governors of the Institute, however, were not able to put their plans into effect with this limited sum, and the amount was not spent. Application has now been made for a sum of £5,600, including the unexpended £2,900, for the provision of two 90 b.h.p. gas engines with suction gas producer plant, a 50-kw. continuous-current generator, a 50-k.v.a. three-phase alternator, a 25-kw. motor generator, and automatic reversible booster balancer set for a three-wire system; a 25-kw. rotary converter, four 10-k.v.a. static transformers, a battery of 250 cells, and two switchboards, one for continuous current and one for alternating current. The Education Committee recommend that this grant should be made, and the Finance Committee agree with this view.

Forthcoming Electrical Exhibition at Brescia.—Arrangements are being made for an international exhibition devoted to the application of electricity, to be held at Brescia next year. The province of Brescia is one particularly rich in water-power, and it is hoped that the exhibition will give an impetus to electrical power developments therefrom. The year 1909 has been chosen as the date for the exhibition as being the fiftieth anniversary of the inauguration of a monument to the famous Italian, Joseph Zanardelli. The exhibition will be also under the patronage of the municipality of Milan. The fourteen groups into which it is proposed to divide the exhibits cover a wide range of engineering and other applications of electricity and historical and statistical information relating thereto.

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THE PRODUCTION OF NITRIC ACID BY ELECTRIC DISCHARGES

A LONG Paper entitled "The Electric Discharge and the Production of Nitrogen," by Messrs. W. Cramp and B. Hoyle, was discussed at the London meeting of the Institution of Electrical Engineers last Thursday, and also before the Manchester Local Section on the preceding Tuesday. In their introductory remarks the authors referred to the importance of the subject on account of the fact that it had been calculated that the amount of fertiliser in the form of natural nitrates still available was less than that required for the world's food supply for the next twenty years, assuming that no new sources are discovered. Many inventors have attempted to fix the nitrogen of the air by really attempting to burn the nitrogen

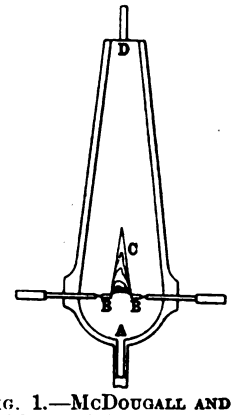

Fig. 1.—McDougall and Howles' Apparatus.

A. Air Inlet.
B. Electrodes.
C. Flame.
D. Outlet for Gases.

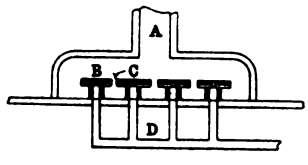

Fig. 2.—Naville and Guye's Apparatus.

A. Air Inlet.
B. Hollow Carbon Electrodes.
C. Gap across which the Discharge takes place.
D. Outlet for Gases.

in the presence of oxygen to NO and NO_2 by means of the electric arc. The apparatus proposed by McDougall and Howles, of Manchester, and shown in Fig. 1, is essentially a high-voltage machine working at from 8,000 to 16,000 volts. The results given by this were very poor, but it is only fair to say that the power used was very small. Naville and Guye's arrangement is shown in Fig. 2. The arcs set up are in series, and the air to be burned is taken from the outside through the centre of hollow electrodes, thus passing right through the section of the arc. Three gaps in series are used. The apparatus of Kowalski and Moscicki (Fig. 3) is essentially arranged for high voltage and high frequency (from 6,000 to 10,000 ~ per second), and entails difficulties of insulation. These inventors

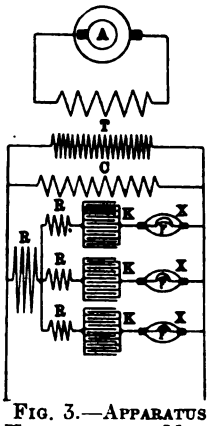

Fig. 3.—Apparatus of Kowalski and Moscicki.

A. Alternator.
T. Transformer.
C. Choking Coil.
K. Condensers.
F. Discharge.
R. Resistances.

Complete apparatus consists of twenty-four discharge chambers *X*. The air supply is not shown.

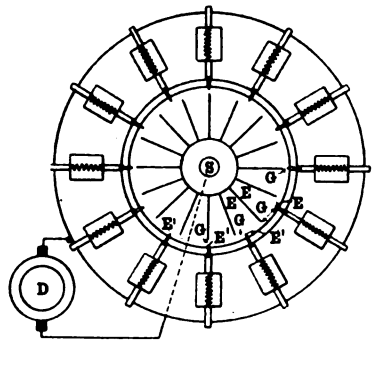

Fig. 4.—Apparatus of Bradley and Lovejoy.

D is a Direct Current Generator for 10,000 Volts.
E are the Platinum-tipped Moving Electrodes, setting up Discharges across the Gaps *G* to the stationary Electrodes *E'*.

The complete apparatus has fifteen such rotating wheels running on Shaft *S*.

have also used direct current at 1,500 volts, giving 525 kg. per kilowatt-year. Bradley and Lovejoy combine a large number of small arcs (as in the last apparatus) with great length, obtained by drawing the arc out. The machine consists of a series of rotating electrodes which set up arcs and draw them out from fixed electrodes surrounding them, as shown in Fig. 4. The apparatus of Pauling is sufficiently clear from Fig. 5. It is really the reverse of the system used by Naville and Guye. The principle of Werner's apparatus is obvious from Fig. 6.

Birkeland and Eyde's arrangement is shown in Fig. 7. The machine consists of a pair of water-cooled copper tubes 15 mm. diameter employed as electrodes. These electrodes are suitable for flames up to 750 kw. at 3,500 volts, with a gap of 1 cm., and are placed in a magnetic field of about 4,000 to 5,000 lines of force per square centimetre in the centre. This field blows the arcs into the form of a large circular fan, the maximum diameter of the flame being about 140 cms. Fig. 8 shows the form of flame employed and the connections used. The object of the magnetic blow-out arrangement is to increase the rate of cutting of the flame and the air, which is also assisted by the air blast supplied. In the method adopted by E. Rossi, air at a high pressure (50 to 90 atmospheres) is heated by being brought into contact with a Nernst glower. Frank and Caro's process consists in forming first, in an electrical furnace, calcium car-

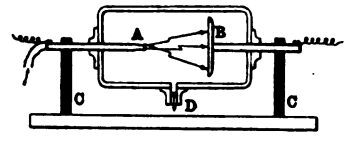

Fig. 5.—Pauling's Apparatus.

A and *B*. Electrodes. *A* being hollow and supplying the Discharge with Air at the Centre.
C. Insulating Columns.
D. Outlet for Gases Produced.

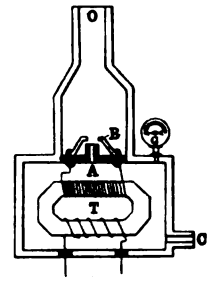

Fig. 6.—Werner's Apparatus.

C. Air Inlet.
T. Transformer.
A. Air Jet.
B. Discharge Electrodes
O. Outlet for Gases.

bide, and then passing nitrogen over this material when at a red heat, the result being that the nitrogen combines with the calcium carbide, forming cyanamide. It is essential for this process that the nitrogen should be free from oxygen, and this is obtained by fractional distillation of the air, so that oxygen is given off as a by-product.

In all the processes named above, except the last, the object is to produce NO_2+NO, which, when combined with water, gives a mixture of nitric and nitrous acids. From these is then usually produced nitrate of calcium, which is the fertiliser sold. In the last process the cyanamide is sold direct, and decomposes slowly in the presence of water, giving off ammonia, which is absorbed by the soil or taken up by the plants. Of the above methods, the last at present appears to yield the best result per horse-power expended, and from the point of view of cost is certainly better than Chili saltpetre already. Examination of records of outputs of the first seven processes shows us that the best results have always been obtained with very large

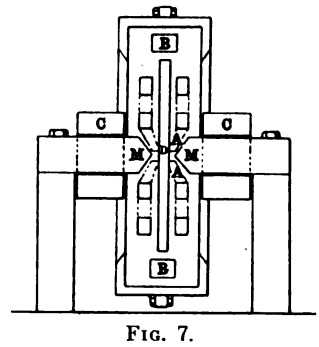

Fig. 7.

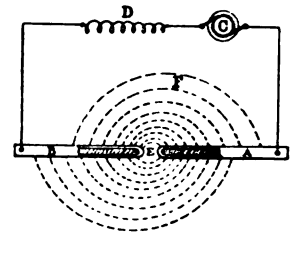

Fig. 8.

Apparatus of Birkeland and Eyde.

A. Air Inlet to centre of Disc of Flame.
B. Gas Outlet at Periphery.
D. Discharge Chamber lined with Firebrick.
C. Exciting Coils.
M. Electromagnet.
Electrodes not shown.

A and *B*. Hollow Copper Water-cooled Electrodes.
C. Alternator.
D. Choking Coil.
E. Gap from 0·75 to 1 cm. long.
F. Disc of Flame up to 140 cms. Diameter.

powers. Excellent results have been obtained by Bradley and Lovejoy from their multitude of small long direct-current arcs, and this result is to some extent verified by Moscicki's high yield obtained by the use of very high frequency discharges. The results of McDougall and Howles are poor. Little better is to be expected from either Naville and Guye or Pauling, and if there is one lesson more than another which can be learnt from these attempts, it is that an arc is never successful unless made use of to heat a very large quantity of air. The best results appear only to be obtained by the use of thin flames with very rapidly moving arc-threads used to heat suddenly quanti-

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ties of air which are as quickly as possible cooled again. For this reason the apparatus selected for experimental results was a modification of that suggested by Werner.

The apparatus used in the authors' long series of experiments consisted of a high-tension transformer excited by means of an alternator and used to feed on its high-tension side a pair of phosphor-bronze ribbon electrodes shaped almost like the well-known horn lightning arresters. The nozzle *A* was supplied with air from an air-pump and receiver, so that the air had time to cool after being compressed before issuing from the nozzle. The alternator was a "Cramp self-excited" machine with a drooping characteristic and a frequency of 160. The

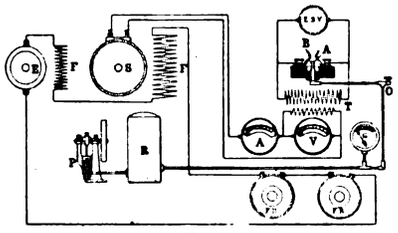

Fig. 9.

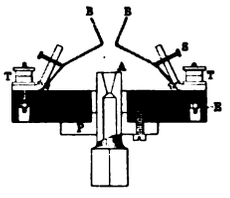

Fig. 10.

The Authors' own Apparatus.

A. Laval-shaped Glass Nozzle.
B. Electrodes.
T. Transformer. Ratio 100 to 1.
E.S.V. Electrostatic Voltmeter.
A and *V.* Low-tension Ammeter and Voltmeter.
G. Air-pressure Gauge.
O. Air Outlet.
P. Air Pump.
R. Air Receiver.
FR. Field Rheostats.
F_1 F_2. Exciter and Alternator Field Coils.
E. Exciter.
S. Statoe of Alternator.

A. Aluminium Laval Nozzle.
B. Phosphor Bronze Sparking Ribbons
P. Aluminium Plate, carrying Ebonite base *E* and adjustable on *A*.
T. Terminals.
S. Screw Adjustment for Gap-length.

transformer had a ratio of transformation of 100 to 1. The details of the sparking electrodes will be seen from Fig. 10. After a short examination of various types, however, it was decided that a shape like that known as the "Laval" nozzle would be best as a general type.

The Paper then passed on to a general consideration of the various forms which electric discharges assume, and classified these as follows :—Glow, brush, spark, nitrogen flame (high-tension), and arc (low-tension). Experiments have shown that, by gradual increase of the current supplied to the low-tension side of a transformer, a spark between points on the high-tension side can certainly be caused to pass through every form successively in the order—glow, brush, oscillatory spark, nitrogen flame, and flaming arc. A curve for a discharge regulated in this way is shown in Fig. 11, where, with gradual increase of pressure across a pair of points, a glow is formed between

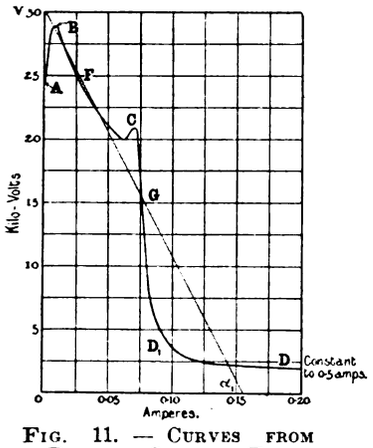

Fig. 11. — Curves from Primary Side of Transformer.

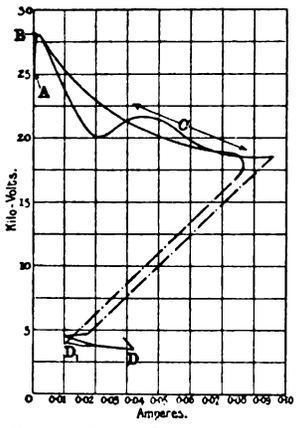

Fig. 12. — Curves from Secondary Side of Transformer.

the limits *A* and *B*. At *B* a brush discharge is set up, which gradually passes between *B* and *C* into the oscillatory discharge or spark. At *C* the latter breaks down into the high-tension arc or nitrogen flame, which continues to exist with great fall of pressure to the point *D*, after which the discharge is of the character of the ordinary low-tension arc. These characteristics and curves are correct so long as measurements are made on the low-tension side of the transformer, but if the readings of pressure and current be taken on the high-tension side, it is found that the transformer itself has considerable influence on the form of discharge. In order to test this, readings were taken using the 30-kw. 100,000-volt core-type transformer of the Municipal School of Technology. One series of results obtained is plotted in Fig. 12, where the letters used agree with those in Fig. 11. The great difference between Figs. 11 and 12 lies in the fact that the line *B C* is so much longer and so much more horizontal, and that *C D* has a negative slope in Fig. 12.

An elaborate study of this and other experiments has led the authors to the following conclusions :—(1) That each particular form of discharge is distinct from the others in having a different ratio $\frac{\delta V}{\delta A}$. (2) The glow discharge is the only one that, throughout its range, shows no negative ratio. (3) All the other forms have first a negative ratio, and then, usually, a positive ratio, as the current is steadily increased. (4) The form of discharge with the biggest negative ratio is the third form, the high-tension arc or nitrogen flame.

The authors, therefore, propose the following definitions :—The silent discharge, or glow, shall mean the first discharge taking place between the electrodes in air, whose characteristic $\frac{\delta V}{\delta A}$ is all positive. The brush discharge shall mean that discharge taking place with a hissing noise accompanied by light purple-coloured streamers projecting from the electrodes but not joining them. In this form of discharge the characteristic $\frac{\delta V}{\delta A}$ is nearly all negative. The spark discharge shall mean that discharge which succeeds the brush discharge, and whose characteristic $\frac{\delta V}{\delta A}$ is first negative (advanced brush discharge) and then usually positive. The high-tension discharge, or nitrogen flame, shall mean that discharge which, as the pressure is further increased, follows the sparking discharge, and whose characteristic $\frac{\delta V}{\delta A}$ is first negative, then positive. The low-tension arc shall mean that discharge which exists when the current is carried by the vapour of the electrodes and the spectrum is predominantly that of the material of the electrodes. Its characteristic is first negative and then positive.

The chemical characteristics of the five forms are fairly clearly marked. The glow and the brush discharges produce mainly ozone. The disruptive or spark discharge also produces a large proportion of ozone with a sensible proportion of oxides of nitrogen. The arcing flame is made up of arc-threads carried into this shape by the action of the heated air to which it gives rise, has a temperature far greater than the above, and is composed mainly of burning nitrogen, as is evident from the fact that a bottle inverted over the flame collects the well-known brown fumes of NO_2. There is no smell of ozone with this discharge. The well-known low-tension alternating-current arc differs from it in the fact that the conducting part is mainly composed of the vapours of the material of which the terminals are composed.

The effects on the steadiness, &c., of the various forms of discharge of variations in the resistance and reactances is briefly discussed.

The effects both of a current of air blowing on the discharge or of a magnetic field across it are the same effect so far as the form of discharge is concerned, for they tend to cause any small arc set up to travel rapidly at right angles to the field or along the line of the air stream. Consequently, the instant an arc is formed it travels away from the point of formation, under the influence of the air stream or the field, getting longer as it proceeds, and probably smaller in cross-section. This continues until it becomes of a length such as the terminal pressure will no longer support, when it is suddenly extinguished, and another starts from the points. Across the points themselves with this form of discharge there always exists the blue line of the oscillating spark, which continually renews the arc-thread. The effect of the travelling of the threads is to increase the mean length of the discharge so that the pressure across it likewise rises for a given current. To maintain such a discharge does not necessitate anything like the same amount of external resistance or reactance as is the case with a discharge of similar type without the air current.

The effect of an increase in the capacity of the circuit was found to be somewhat similar to an increase in the blast pressure and tended to increase the oscillatory current flowing across the air-gap, and to make the discharge yield ozone if it does not already do so, or increases the output of ozone if it was already being given off.

Results are given in the Paper of a long series of experiments with a view to determining the effects on the chemical results of the use of nozzles of different diameter, of change of current, of change of air velocity, of alteration of spark-gap length, and of change of capacity of the circuit.

The comparison of these variables was carried out as follows :—One variable having been decided upon, everything else in the circuit was kept constant. The air which passed through the discharge had a free exit, and a known portion of it was drawn off at a known rate by means of an aspirator through a flask con-

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taining a weak solution of caustic soda of a known strength. This solution contained a little "Phenol-Thalene" as a colour indicator. As the gas was bubbled slowly through the flask the absorption of the oxides of nitrogen caused the indicator to lose its colour. The time taken for the colour to disappear completely was taken as a measure of the amount of acid produced in that time.

Regarding the size of the jet, it was found that the greater the amount of air passed by the jet for a given pressure, the greater is the maximum acid output, and the greater the amount of air passed by any given jet, the less is the maximum acid concentration. From this it follows that with increased quantity of air the amount of acid produced increases faster than the concentration diminishes, and therefore for a large yield per kilowatt-year with such an apparatus, a nozzle giving low concentration will probably be necessary.

Experiments with variations of current, air-gap length, and quantity of air passed indicated that increase of current gives an increased yield up to a certain maximum for each length of gap, and that the greater the quantity of air passed through the gap the higher is this maximum for each gap. In the course of these experiments the influence of the capacity of the electrostatic voltmeter on the secondary side was incidentally shown to be very marked.

The effect of frequency was much complicated by the presence of sharp peaks on some of the curves due to resonance effects. In this connection it was noticed that the higher the blast pressure, the more pronounced is resonance at certain currents, and that the higher the blast pressure, the higher is the value of the current at which oscillations are set up, and the more prominent they are.

The authors, while unable to give definite conclusions as to the effect of variations of frequency, think that it must also be allowed that the presence of a high frequency, in so far as it admits of large capacity currents across the arc and probable production of ozone, is to be considered on the whole as likely to increase the yield of peroxide. Consequently, they conclude that Kowalski and Moscicki are probably right in their statement, but that the reason for the increase in the output is not to be found in the actual increase of frequency, but rather in the increase of ozone due to this frequency as shown below. On the appearance of the discharge the effect of the voltmeter capacity, already alluded to in another connection, is very marked. It causes the blue oscillatory discharge, which always exists across the points, to be much enlarged in thickness and brilliancy, though the area of nitrogen flame is hardly increased. This would agree with the theory that part of the peroxide is due to the splitting up of ozone. Photographs of the discharge were shown which estimated the effect of adding the voltmeter very clearly. Since the ozone given off in the lower portion of the discharge is more active than ordinary oxygen, it is reasonable to suppose that more nitrogen will combine than before to form nitrous products.

Further confirmation of this view was obtained from a spectroscopic examination of the discharge, and a glass tube of small diameter was inserted into the high-frequency oscillatory portion of the discharge. Gas was then drawn off and tested, and was found to be rich in ozone. By suitably placing the tube in the discharge, air mixed with ozone could be obtained, whilst higher up in the same discharge air mixed with nitrogen oxides was obtained.

Some experiments were also tried with reference to the ionisation of the gases after formation. In the first place, it was found that the output could be sensibly improved by sudden cooling of the gases after leaving the apparatus, and a Tesla coil was connected to metal plates, between which the gases had to pass on their way to the testing apparatus, which showed that an increased output may be expected of from 5 to 20 per cent., depending upon the conditions existing. The authors' explanation was that when ionised molecules of oxygen and nitrogen pass through an electrostatic field, some of the uncombined elements may be forced together with such a velocity that chemical combination takes place between them. In this way an additional amount of peroxide is formed.

In the concluding portion of the Paper the authors endeavoured to show that the whole of the electrochemical phenomena discussed may be explained on recognised ionisation and electrochemical hypotheses. When first the potential difference is applied across the points, the electric field is very strong near them, and very weak near the centre. As a result, any ions produced near the points never reach the centre of the field; and since they are acted on by an alternating field, they are alternately driven out some distance and recalled. An increase in the pressure results in the motion at either pole getting more intense, so that with increased movement of the ions a glow appears at either pole. With further increased pressure the glow extends across from point to point as a double luminous cone, and at this time the velocity of the corpuscles is probably nearly enough to produce ionisation by collision. Further increase in the strength of the field results in not only the production of more ions from either side, but in the more rapid and complete interchange of the ions as they pass from one pole to the other. So soon as the stage is reached when free interchange can take place and when the kinetic energy of the ions exceeds the critical value necessary for ionisation by collision, there must be a corresponding reduction of the apparent resistance of the path. This leads to a formation of brush discharge with the first negative value of $\frac{\delta V}{\delta A}$. The heat of the terminals and consequent increase of corpuscles, with their production in turn of more ions by collision, leads to further reduction in the resistance of the path, so that the current is further increased. At this point further ionisation is assisted by the heat produced, until the terminals themselves probably supply the whole of the necessary corpuscles. When this happens the spectrum shows the character of the material of which the terminals are made, and we call it "the low-tension arc."

Now Töpler has, from facts similar to these for a continuous-current discharge, derived certain theoretical curves which agree very fairly with the experimental curves given in Figs. 11 and 12. Sir J. J. Thomson has shown that if the ionisation of air be taken as unity, then for oxygen it is 1·2 and for nitrogen it is 0·95. We may, therefore, assume that when electric stress first occurs across an air-gap, the oxygen is ionised before, or to a greater extent than, the nitrogen; and the smaller currents at this periods are probably carried by the oxygen ions alone. This leads to the formation of ozone, or to the burning or oxidation of oxygen itself. Thus when the air velocity through the air-gap is high, so that the glow or the brush only exist, the current is probably carried exclusively by oxygen ions, and hence the oxygen and ozone spectra only appear, and the gas smells strongly of ozone. As the field becomes stronger and ionisation by collision ensues, the nitrogen is ionised, and the brush gradually gives way first to the spark (which shows little nitrogen peroxide spectrum), and finally to the nitrogen flame. The temperature is undoubtedly far greater for this form than for the preceding, and the "body" is greater, for a draught of air hardly effects the ozone discharge, but blows the nitrogen flame about easily. This is explicable both on the ground of the oscillatory nature of the ozone discharge and also from the relatively small proportion of oxygen to nitrogen present.

The agreement of the quantity of gas actually formed with that which theoretically might be ionised under given conditions is very poor. Nor with the present state of knowledge could it be otherwise, for the data available as to the number of ions which may be formed in a cubic centimetre of air have been ascertained for limited temperatures probably of the order of 2,000° C. and with enormous pressures.

Further consideration of the above and other facts and theories, and the view of some thermo-chemists hold that the action whereby the peroxide is produced is neither a purely electric nor a chemical phenomenon, but only a thermal action, has led the authors to conclude that peroxide is formed in the arc by the combined agency of great temperature, great pressure, and great temperature gradient; that temperature and pressure may be interchanged, and that it is practically useless to attempt to set a limit to the maximum efficiency attainable till these relationships are better understood.

As regards practical deductions, attention was called to the great importance of adapting gap, current, and air blast to one another; for it is evident that changes of yield to the extent of 50 per cent. or more may be obtained by slight variations of either factor from the best obtainable. Again, it may be noticed that as regards quantity of air forced through the flame the maximum acid yield does not for a given current occur at the same point as the maximum acid strength; consequently there is reason to doubt the value of using a magnetic field (as does Birkeland) to spread out the flame. It would appear from rough estimations made on the Birkeland-Eyde process as if the efficiency of this system was such as to lead to the belief that a very good proportion of the maximum possible yield was being obtained. This is a most important point, for if this be true then it is hardly possible to compete with the cyanamide process in point of view of cost. If, on the other hand, by making use of the most favourable velocity, the most favourable gap-length, the introduction of ozone, the instantaneous cooling of whatever gas is produced, and fixing by subsequent ionisation, much better yields may be expected, then it is well worth while proceeding on these lines in a large plant with the object of rendering the production of NO more economical.

Appended to the Paper was a valuable bibliography of the subject.

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DISCUSSION IN LONDON.

The SECRETARY read a communication from Dr. SILVANUS P. THOMPSON as follows :—

Messrs. Cramp and Hayle's Paper gives a very interesting *résumé* of the various suggestions that have been made for the production of nitrates from the air by electric discharges. Their own experiments are also extremely suggestive and valuable as throwing light on the molecular processes at work. I think the authors have hardly appreciated the importance of the spontaneous further oxidations of the gases which are formed in the passage of air through the flaming arcs used in the process of Birkeland and Eyde. The gases after leaving the furnace are not treated with water or lime until they have been allowed to remain (and cool) a considerable time in large oxidation chambers. If this were not done a very large proportion of the liquid formed in the water towers would be nitrous acid instead of nitric. It seems to me that the figure 900 kilogrammes of nitric acid per kilowatt year is too high a figure for the average commercial yield of this process. If I remember rightly, 900 was an exceptional figure, not an average one, the average being nearer 600. It is well that there should be no exaggeration, and I happen to know that in calculating the commercial project for the new and enlarged factories in Norway the experts expressly took a lower figure so as to have a margin of safety in their calculations. The large scale working of the new factory at Notodden has certainly shown a higher economical yield than that assumed in the estimates. The authors mention the cyanamide process, though this does not produce nitrates. There is no doubt that the two successful processes to-day are the nitrate of lime process and the cyanamide process, but though both of these take nitrogen from the air, the products are of different character, and nitrate of lime proves to be just as satisfactory for agricultural purposes as nitrate of soda, and in the case of heavy clay soils the lime in it gives a preference. Cyanamide on the other hand is akin to sulphate of ammonia rather than to nitrate of soda, and competes with the former rather than with the latter. Moreover, nitrate of lime has certain important applications in the coal-tar colour industry, for which cyanamide will not serve. A recent result of careful observations in Norway is that nitrites, hitherto regarded in agriculture as deleterious, are just as useful to vegetation as nitrates. This will enable a cheaper product of the electric oxidation furnace to be put into commerce. All electricians will do well to study the authors' discussion of the five types of electric discharge. Much vague and loose use is often made of the terms "brush" discharge and "glow" discharge; and often the production by sparks in the air of nitrous gases is confused with ozone. In fact, it is quite common to find any smell produced by electric discharges described as the smell of ozone.

Mr. BERTRAM BLOUNT, although called upon, declined to discuss the Paper seriously, as it was too physical in its nature for him. As regards the chemistry of the Paper, all he had to say was that it was of the most "guessy" description.

Mr. W. DUDDELL, F.R.S., referring to Fig. 12, said that he could not see how the discharge could very well have two stable conditions, corresponding to one definite current value. They had first 0·02 amperes for a stable condition of 3 kw. and another stable condition at about 20 kw., and he was led to suspect that there must be some other variable beyond the current, and that therefore really the figure should be drawn in three dimensions and not in two. With regard to the electrostatic voltmeter, he rather thought the thing was not so simple as it looked, and that they did not know what was meant by 0·02 amperes. He took it that the 0·02 was a root mean square value, but they did not know the maximum. In fact he thought they wanted to know a little more of the wave form of the current through these discharges before they could be quite clear as to what was meant by the curve. With regard to the effect of a current of air blowing upon the discharge, he wanted to know whether it was a fact that if the discharge was blown with a higher air pressure, they got less volts across the discharge. His impression of the arc in the past had been that if it were blown it always required a higher voltage to maintain it, and he was not at all clear as to what had occurred in these curves. In the same connection, the following sentence appeared in the Paper:— "Across the points themselves with this form of discharge, there always exists the blue line of the oscillating spark which continually renews the arc thread." It was not customary, he said, in wireless telegraphy to look upon the blue spark as being the oscillating spark, and he would like to know how the authors arrived at the conclusion that this was the oscillating part of the discharge. Further, when the authors stated that the discharge was oscillating, did they really mean oscillating in the ordinary sense. With regard to the effect of resonance in some of the experiments, he would like to know exactly what frequency that corresponded to. Was it the frequency of the alternating supply, or was it the frequency of the interruptions with which the sparking across the gaps took place? Sparks could take place, of course, across the gap between electrodes more than once per half-wave. Multiple sparking, for instance, was well known in wireless telegraphy where they got four, five, or six discharges across the electrodes in a half-wave. He would have been very interested to have seen the wave forms of some of these discharges, because he thought some of them must be extremely complicated, and that therefore the root square values of the quantities did not convey very much information as to what was going on. Some of the curves of output of acid shown had been plotted, so far as he could remember, in terms of the amperes in the primary. Now the amperes in the primary in a transformer of the type Mr. Cramp was using depended very little on the power that was being taken out of the secondary. It was purely a matter of the relation between the self induction of the secondary and the capacity of the secondary as to what amperes he was able to put through his primary. Therefore, it would have been of great interest if Mr. Cramp had given them the watts used, because in the commercial application of this system they would want to know how much power they were going to use. The effect of the putting in of an electrostatic voltmeter had really suggested this to him, for if this was an ordinary high tension transformer with a considerable self induction in the secondary winding, the putting in of the electrostatic voltmeter would considerably improve its power factor, and therefore the real reason that the output was greater might be that they were using more power.

Mr. G. N. HUNTLEY, in criticising the Paper from the chemical point of view, complained that nitric acid was not properly defined in the Paper. Nitric acid ordinarily had two meanings in commerce; there was 100 per cent. acid, but this was not the ordinary commercial article of 70 per cent. strength, and he rather thought the authors had worked upon the 70 per cent. basis, but the actual definition given in the Paper stated that commercial nitric acid was a mixture of nitrates and nitric acid. This was quite new to him, and it was not commercial nitric acid. If the figures in the Paper were worked out on the 100 per cent. basis, they would require considerable modification. He did not think the method used by the authors for estimating the nitric acid produced was a very satisfactory one. The measurement of the volume was very indirect, but leaving that on one side, the actual measurement of the acid was by simply measuring the volume of the gases produced, but from his experience with absorption plants, he was of the opinion that the quantities given by the authors were not reliable. In fact, the authors themselves had almost hinted as much in apologising for their method. Another source of error was that there was always moisture present in the air. There was one point he would like to see developed. All the workers on this subject seemed to have directed their attention to the output of nitric acid per kilowatt year, but the actual strength of the gas was also an important point. If this gas was passed through water they could get nitric acid at a perfectly definite strength, say 20 to 25 per cent., but the strength likely to be arrived at depended upon the concentration of the gases in the nitric oxide. He believed that in the apparatus of Birkeland there was ¾ per cent. nitric oxide, but in various modifications that had been introduced later this had gone up as high as 2 to 2½ per cent. This was of practical importance, because the cost of the energy might not be the chief consideration. The capital outlay upon the absorption plant had also to be considered, and the richer the gas the larger the plant had to be for a given quantity.

Dr. H. BORNS pointed out that the list of literature appended to the Paper appeared to him very defective. Whilst quoting Werner very largely in the Paper, there was no reference to his literature. Brode, some years ago, described the nature of the arc flame by means of a diagram similar to one given in the Paper. He referred to the greenish-blue flame over which there was an envelope of yellowish hue. The electric discharge of the chemical reaction took place chiefly in the blue flame. If a glass rod were put in this, the current and the potential at once altered, but when a glass rod was put in the other two zones there were no alterations; they were merely flame phenomena. This applied to a gas mixture, but if they burned the arc in a pure gas, then there was only one flame which was perfectly homogeneous, and his impression was that before the authors could say much about ionisation they should try to repeat their experiments as far as possible in pure gas. The arrangement of Moscicki's, described by the authors, was now no longer used. Concentric cylindrical anodes were used, in which the magnetic field was so arranged that the arc flame turned between the two, around the inner electrode, and up the annular air space. Moscicki worked with direct current. In fact, several investigators had proved that direct current and alternating current were equally efficient as regards yield when reduced to watts. This was an important point. Rosche, some years ago, used electrodes made of metallic oxides, and according to Clement, when an arc was formed between such electrodes, no resonance was formed at all. The use of metallic oxides for electrodes had been referred to in a remarkable Paper by Haber and Koenig, which was not mentioned by the authors at all. According to Nernst, the combustion of nitrogen was merely a thermal phenomenon, but according to others it was not. They knew that nitrogen and oxygen combined had a very high temperature, but that the resulting NO was decomposed at that temperature. Therefore, the object was to remove the NO as fast as possible out of the arc. It had also been

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pointed out that as long as the decomposition and combination rates are equal then the electrical features predominate, and the reaction became essentially electrical. When, however, the decomposition was very rapid, relatively to the combination of the N.O., then the electrical features were of little influence. Experiments must then be considered on lines to permit of decomposition as fast as possible, keeping the arc as cold as possible. In any case, he thought they must start with pure gas first. In conclusion, Dr. Borns complained that the authors had mixed their system of measurement up in a most deplorable manner, cubic feet, inches, millimetres, and C.G.S. units all being made use of.

Mr. H. M. SAYERS said he had expected to find the Paper treat this subject a little more quantitatively as regards the possible efficiency of the process. The heat of formation of these oxides of nitrogen, he supposed, was known, and if the specific heat of the combining gases be also known for the best combining temperature, he took it that it could be worked out in watts or other energy equivalent per gramme, so that, given a certain amount of energy in the secondary circuit, they ought to be able to get the efficiency of the different processes just as it was possible to get the efficiency of a motor by measuring the input and the output. He did not find this in the Paper, however, and he would like to know whether the reason was that there was some uncertainty as to the actual heat of formation at the temperature of formation, or some other relation in the thermo-chemical application. Following the example of Mr. Duddell, he would like to ask a question as to the relation between the primary amperes in the different curves and tables, and the secondary amperes. He noticed that the current was measured in the electrostatic voltmeter, but he took it that the current through the discharge was not measured. If it was, perhaps the authors knew the actual ratio between the primary and the secondary currents in the different conditions on the curves. It occurred to him that this oxidation of nitrates was carried on by nature on a pretty large scale. Many of the higher plants did it, and they knew that there were some very remarkable microscopic plants which did it, and the properties of these plants could be used in a commercial way, and he believed they were used to a commercial extent. Was it not possible to measure the heat of formation of oxides of nitrogen by these microbes? If they had a number of these nitric acid or nitrate-forming microbes in a test tube with a proper thermo-electric arrangement, or one of Mr. Duddell's devices for these things, it should be possible to test the rise of temperature and find out the actual heat of formation and actual temperatures.

Mr. C. WEISS said that Dr. Borns had referred to the process for the working of which he understood that the Birkeland and Eyde Co. and the Badische Anilin und Soda Fabrik were now building large works conjointly. The patents, of course, of this latter company had been before the public for some years, and were extremely interesting, and he suggested that perhaps the authors could add this as a tenth example of previous work done in connection with the fixation of nitrogen. It was a matter which was coming before the public largely, and he understood that there were negotiations pending now for the adoption of it in this country.

Mr. W. CRAMP, in reply, said that when an electrical engineer took up a work in which chemistry, physics and electrical engineering were all mixed, he was likely to get into trouble, and it required a certain amount of courage to set about it. they had had many misgivings before writing the Paper, and the results would not have been published now except for the fact that they were unable to continue the work further. Many of the statements that had been made in the discussion were, he thought, a little hasty, inasmuch as he had only given a summary of the Paper, and some of the questions put to him were distinctly answered in the Paper itself. On the other hand, the authors had carefully left out certain important tests in their part to make the Paper short and concise. For instance, Dr. Thompson had referred to the spontaneous formation of N_2O_4, after the gases had left the flames. As a matter of fact, they had taken very great care over that. They had an apparatus covered with a large dome with the large contents compared with the amount of air blown through, thus giving ample chances of oxidation of NO, NO_2, N_2O_2, and N_2O_4, and they thought they had taken ample precautions to prevent NO escaping without being oxidised. They had also dealt with the difference in the cyanamide and nitrates and had compared them, as fertilisers, from the point of view of cost to the farmer, with the result that the cyanamide process was cheaper for the amount of fertilision produced for a given amount of energy. Mr. Blount had referred to the chemistry of the paper, and they admitted that it was rather guessy in this respect. They did not pretend to give absolute figures of output for the process, but comparative figures for the different conditions used. The idea was to enable someone now to produce a discharge as they had produced it, and, with the conditions which they thought they could lay down, start with the most economical process which they could suggest to work on in order to get a better result. They had given their explanation of the chemistry of the subject in the form in which it was given in order that there might be no mistake about what they were trying to consider. With regard to Mr. Huntley's remarks, if his figures were correct, he only brought their (the authors') figures out higher, but did not alter the proportional figures in any way, and, consequently, the comparative shapes of the curves, which were the things they laid stress upon, were still of importance, or, at least, they hoped of use. With regard to the measurement of absorption of these gases he thought he could fairly say that they had had in Manchester a good deal of experience in absorbing minute quantities of oxide of nitrogen. The chemist who helped them in this—namely, Mr. Peachy—had worked for a long time on the subject, and he advised this method of comparison because he had found that in testing the gases going through there was practically no peroxide escaping, and, again, it was not liable to error from the presence of ozone. Mr. Duddell's contribution to the discussion was, as usual, exceedingly interesting and valuable. He first referred to the stable conditions apparently shewn on the current curve, and he (Mr. Cramp) would like to remove any misunderstanding about Figures 11 and 12. In Figue 11 the measurements had been taken on the low tension side and were multiplied by the ratio of transformation in order to get an idea of the voltage appearing on the high tension side, and it must be clearly understood that no high tension voltmeter was on, except where it was definitely stated in the Paper. In Figure 12, the measurements were taken on the high tension side direct, and they were obliged to have a high tension voltmeter on. With regard to what they were resonating with, he thought the resonance was really with the multiple sparking, as Mr. Duddell suggested. They could not get an oscillograph that would give the shape of such rapid oscillations as they were using. A most important point was the question of power. They could not get a wattmeter that would give the readings of the power on the high tension side and their attempts to measure the power on the low tension side had not met with success. Consequently they could say very little about the change of power factor; undoubtedly it was changed, but to what extent he did not know. With regard to the measurement of volume and the relationship of volume and pressure they did not take these quite so roughly as some of the speakers seemed to think. They had a large air meter specially calibrated for the job, and every nozzle used was very carefully calibrated by means of that meter, together with a carefully calibrated pressure meter, so that they knew exactly the relationship between the volume and the pressure on each nozzle. With regard to Dr. Borns' remarks, they were glad to have his additions to the list of literature on the subject, which they knew was not complete. He had not given Werner credit for any writings, because he did not believe Werner had ever written anything at all. They quite agreed with Dr. Borns that all these experiments ought to be started with pure gases, but that was chemical-physical work, and could not be undertaken in a commercial warehouse where they had had to carry out their experiments. Dr. Borns had also mentioned Moscicki's new continuous current process, which, as a matter of fact, the authors had referred to in the Paper. Mr. Sayers had made some very interesting remarks about the theoretical heats of formation, but he did not think it was possible to get the efficiency of the flame as Mr. Sayers had suggested until they knew something more about the heats of formation. They could not measure the temperature of the flame and they did not know the exact energy dissipated in it, and he knew of no figures published on this subject.

DISCUSSION IN MANCHESTER.

The discussion was opened by Dr. E. W. MARCHANT (Liverpool University), who asked for some further information as to the effect of the character of the circuit on the curves given in the Paper, and gathered from some of the results that the transformer employed was one with rather bad regulating qualities. Another small detail that he wished to refer to was the initial spark mentioned as occurring before all discharges took place. He had noticed the same thing in connection with an oscillating discharge with a frequency of about 10,000 per second. The pilot spark occurred before there was any sign of oscillation, and he took it to be due to the discharge terminals, and thought that had been rather borne out to-night by the author, who had shown that the initial spark was largely increased if they had a voltmeter of some capacity connected across their terminals. He was interested in the theory of ozone helping to produce nitric acid, and mentioned the corrosion which occurred of these fittings of large influence machines, which might be due to nitric acid formed by the agency of the ozone produced by brush discharges.

Mr. C. F. SMITH considered that a good deal of importance attached to the effect of the nature of the circuit, especially at high frequencies, and referred to the great irregularities in the distribution of the voltage drop in different parts of the circuit in the case of high oscillation frequencies. Referring to a photograph of the discharge from a "horn" arrester which Mr. Cramp had shown, he was inclined to think that a larger proportion of the effect was due rather to the magnetic field of the current than

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the air current, and this would be shown by putting the horns upside down.

Prof. W. H. Haldane Gee (Manchester Municipal School of Technology) emphasised the necessity for a very cheap supply of current for such processes to be commercially practicable. There were certain great principles that might be applied in studying the combination of nitrogen and oxygen. First of all, we knew that it was endothermic, and that the resulting compound would be decomposed by heat. Nernst, by passing air through an iridium tube, had been able to measure the percentage of N_2O_2 at various temperatures up to about 2,000° C., and his formulæ might be extended to higher temperatures. Birkeland and Eyde had shown that, taking the best available data, the output of their furnace was somewhere about what would be expected from Nernst's formula. This was a very important matter, because, unless the yield could be increased very largely, the nitrogen-oxygen process did not seem to compare favourably with the cyanamide process. Now, Mr. Cramp had shown that, by the use of the Tesla coil, the introduction of ozone, and so on, that we not only got a thermal action, but also ionic changes that would give a greater yield of the nitrogen dioxide. Two Russian Professors (Gorbey and Mitkievitch) had been experimenting on the combination of nitrogen and oxygen. They used a simple type of furnace. Air was passed over two electric flames, using electrodes of carbon or metal, and then they cool the resulting gas. It was said that the yield of a 12-kw. plant was as good as the large plant used in Norway. He asked for further particulars as to how the sparks pressure was calculated.

Mr. J. Lustgarten, referring to Mr. Cramp's ionisation theory, wished to ask how the ions in the first place were produced. The way he took the ionisation theory to explain the manner in which the glow first starts, and, consequently, the brush discharge, and the other various forms of discharge, was somewhat as follows: Free ions were always present in atmospheric air. As soon as the pressure was applied between the two points, the ions started to move, and their velocity increased with the strength of field. With the increase of velocity, collision took place between these free ions and the molecules of the gas, with the result that further negative and positive ions were produced. Now this went on until the kinetic energy of the ions due to the increase in field that was applied between the two points became large enough, and the glow appeared.

Mr. E. A. Watson wished to add yet another explanation of the glow brush and spark discharge. Consider two sharp points placed in an insulating medium with a difference of potential between them. From the principles of electrostatics, the dielectric stress in the medium at the points would, if the points were perfectly sharp, and if the medium were not disrupted, be infinitely great. This was, of course, impossible, and what actually happened was that the point surrounded itself with a zone of disrupted medium, in this case air, roughly spherical in shape. The dielectric stress at the surface of such a sphere can easily be shown to be finite, and less than the previous stress at the point, so that the effect of the disruption was to relieve the dielectric stress on the air, and to enable a stable condition of affairs to be maintained, irrespective of the characteristics of the circuit employed. When the voltage was increased, the zone of disrupted air would grow in size until it reached a certain critical value, at which any further increase in its diameter would increase the dielectric stress in the remainder of the air. The condition then became unstable, and the brush discharge took place. This, unlike the glow discharge, was affected by the resistance, reactance, &c., in circuit. If the transformer and alternator used were of large capacity, it could not be obtained, but the discharge passed straight from the glow to the spark.

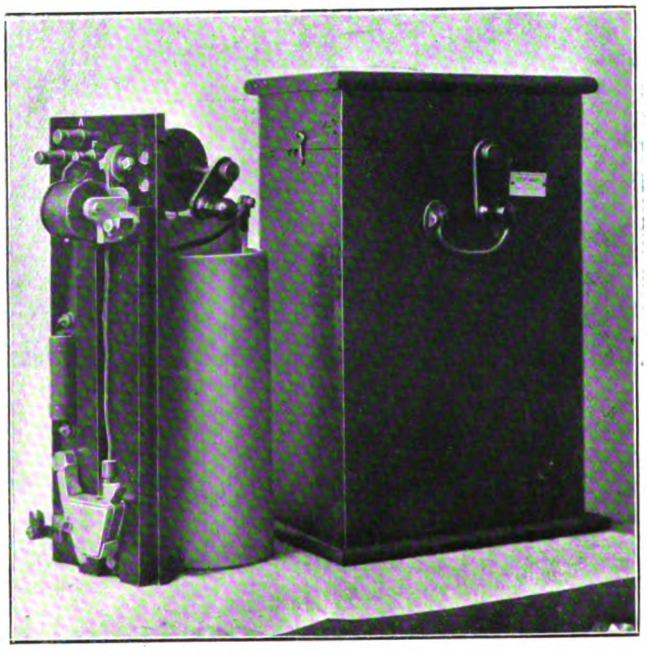
Mr. P. Kemp said that it was interesting to compare Figs. 11 and 12 with ordinary curves of current and voltage. At first the current and volts increased in agreement with Ohm's law, and then the current remained practically constant for a large increase in voltage. This corresponded to the part marked *A B* in the curve, where the current was very nearly constant, whilst the voltage increased largely. At the point corresponding to *B*, the curve for parallel plates bent sharply upwards, this being the stage when fresh ions were produced, and a large increase of current was produced by a comparatively small increase of pressure. If, now, the air-gap were decreased, even a reduced pressure would be sufficient to cause a substantial increase of current. This corresponded to the section *B C* during during which the brush discharge took place, and the layers of air nearest the electrode became broken down. In this way the effective length of the air-gap was reduced, and the cases were seen to be analogous; but at this point a peculiar rise in pressure is observed which was difficult of satisfactory explanation. The section *C D* was evidently due to the C R drop produced in the H.T. spark and nitrogen flame, to say nothing of the drop in the transformer. Since the pressure was high at the instant the pilot spark passed, a considerable load was put on the transformer, thus producing the sudden drop in pressure. The low-tension arc was now established, and the ions were torn off from the surface of the electrodes, practically forming a flexible conductor of the arc. It is not essential that a discharge should go through all the five stages enumerated by Mr. Cramp. The spark may take place before the brush discharge appears.

Mr. W. A. Stephens objected to the authors' conclusion that in a glow or brush discharge with high air velocity, the current was carried exclusively by the oxygen ions on account of the relative velocities of the nitrogen and oxygen ions.

Mr. Cramp, in reply to Dr. Marchant, explained the difficulties in obtaining the exact circuit conditions. With regard to the necessity for cheap power mentioned by Prof. Gee, in Norway they were able to produce it at a very low price, and at the present time, to his certain knowledge, in Ireland there was a waterfall of at least 30,000 h.p. with men there ready to put in a plant to harness that power, but it was almost impossible in this country to raise capital for the use of it. Mr. Lustgarten's remarks with regard to glow ionisation were interesting, but they did not agree with his ideas. It had been clearly shown by Sir J. J. Thomson that ionisation took place due to an electrostatic field, and that was all that was wanted to start the action. With regard to Mr. Kemp's remarks as to the first spark that passed, he thought the effect was of the nature of a surge, and could not be maintained; consequently, with the gradual increase in pressure, the five stages were always passed through.

A NEW LIQUID STARTER

THE accompanying illustration represents a new pattern of liquid motor starter, which is being put on the market by the O.S. Liquid Starter and Dimmer Co., of Leigh, Lancashire, under the Olive and Swarbrick patents, and is standardised up to 50 h.p. The firm have given a good deal of attention to the choice of a suitable electrolyte, and are able to supply material for a solution which gives no trouble through creeping, spraying, or evaporation. An efficient no-voltage release is provided, and the starter falls to the off position by gravity, as soon as there is any appreciable diminution of voltage across the armature.



O.S. Liquid Motor Starter.

When the starter is full on the electrodes are short circuited, and a good point in the arrangement is that the resistance is never in series with the field circuit. Special care is taken in the selection of the jars, which are of the best non-absorbent Doulton ware, without joints. The whole of the mechanism can be taken to pieces for inspection or repair in an instant. Two connections only need disconnecting, and the whole of the working parts can be simply lifted out.

Telegraphic Traffic.—The Hanekin route, and the cable between Dakar and Consky, Africa, have been restored to working order again, and there are no interruptions to record.

Electrolytic Disinfectant.—The *Standard* states that a company is being floated in Durban, which will in all probability erect a factory there, for working an electrolytic process for the production of disinfectant from sea-water. The company in question is said to have acquired all the rights for South Africa and Rhodesia.

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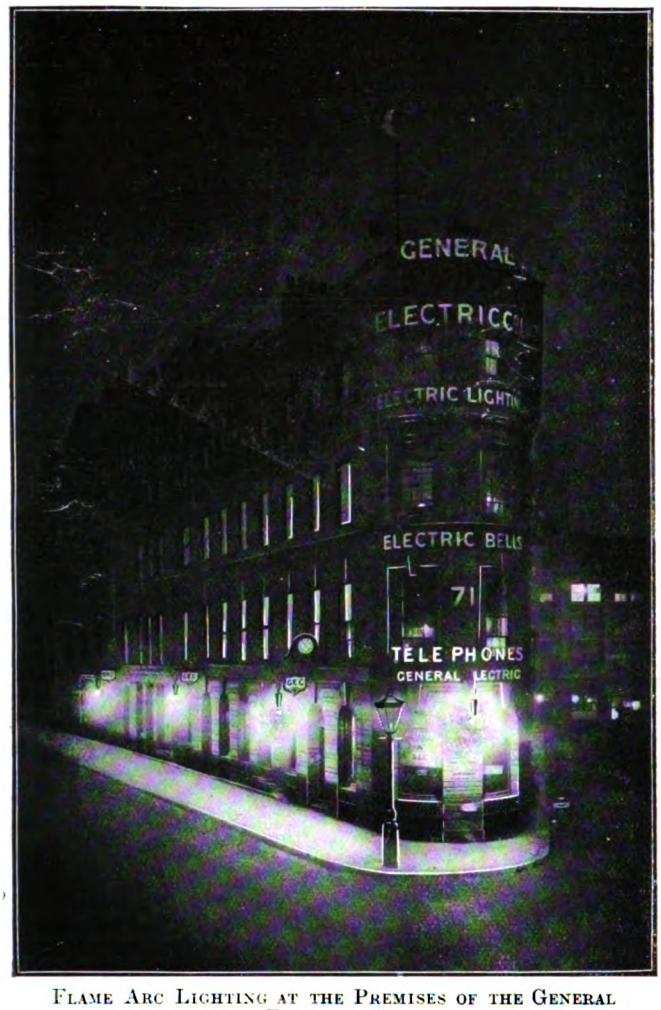
STREET ILLUMINATION BY FLAME ARC LAMPS

THE question of long burning flame arc lamps for street lighting is attracting a good deal of attention at the present time, and interest will attach in this connection to the display of lamps of this nature, which is now being made outside the premises of the General Electric Co., in Queen Victoria Street. The effect produced is shown in the accompanying illustration.



Flame Arc Lighting at the Premises of the General Electric Co.

which is reproduced from a photograph taken recently between five and six o'clock on a slightly foggy afternoon. The four lamps in question are examples of the latest pattern of Angold magazine flame arc lamp, which the company have developed specially for street lighting purposes. These lamps, although of very moderate size, are constructed to run for 55 hours without trimming.

London Electric Power Bills.—The House of Lords has accepted the Commons' amendments to the London Electric Supply Bill and the London (Westminster and Kensington) Electric Supply Bill, which we gave at length in our last issue. The Bills received Royal assent on Monday.

The Mile End-road Tramway.—In answer to a question by Sir John Benn in the House of Commons last week, Mr. Winston Churchill stated that accidents to two persons and five horses had been reported to the Board of Trade as occurring upon the G.B. surface contact line in the Mile End-road through contact with live studs. The service in question was withdrawn in July last and the period covered by the Board of Trade certificate expired last Wednesday.

The Brighton Railway Electrification.—A good deal of progress has been made with the equipment upon the single-phase system of the Victoria-London Bridge suburban section of the London, Brighton and South Coast Railway. It is stated that the overhead equipment is already complete from Battersea to Denmark Hill, and its completion as far as Peckham Rye will enable experimental running on this section to be commenced early in January. On the rest of the line, except in the termini, practically all the overhead steel work is up, but the catenary construction is not yet installed. The feeder cables are, however, all laid, and the switch cabins are complete. Eight complete three-car trains are also ready for trial.

ELECTRICAL HEATING AND COOKING APPARATUS

A PAPER was read recently by Mr. S. R. Gibbon, before the Liverpool and District Electrical Association, on electricity as applied to heating and cooking. After a few historical notes, the author classified heating systems as electrolytic and hot wire, further subdividing the latter into incandescent lamps, hot wire coils, hot wire coils in enamel, hot films, and hot iron plates (transformer method).

The only commercial example of the electrolytic method was the Fuller Geyser, which gives a continuous stream of two pints per minute of hot water with 1·5 kw., and the use of the incandescent lamp as a heater was limited to radiator and medical appliances. In the hot-wire system as developed by the Phœnix Electric Co., there is no form of insulation round the wire, as they contend that this hinders the radiation and conduction of the heat generated. Further, there is every care taken to allow of perfect expansion and contraction of the wire, which is of special alloy. It is enclosed in a specially constructed case giving rapid and highly efficient conduction.

The enamel method in use is the General Electric Co.'s "Archer" system for the smaller appliances. A bottom layer of semi-refractory material is first fused on to the metal base. On this coating are laid wires of a special composition, crimped in such a way as to render them non-inductive, and embedded in a further layer of enamel, and covered by another layer. In this way the whole forms one solid mass. In this system the conductor can be brought within 0·036 in. of the object to be heated, and an efficiency as high as 90 to 97 per cent. is obtained.

The enamel system is not, however, employed in the ovens manufactured by the General Electric Co., but spiral coils of special wire are wound cylindrically round porcelain insulators. The elements are of comparatively small dimensions, and are easily replaceable. A valuable feature to some of the General Electric Co.'s water-heater, &c., is a fusible plug which protects the appliance from overheating by cutting the current off, should the vessel be left dry with the current on.

The Prometheus system consists, primarily, of resistances composed of metallic films deposited on insulating bases. For the latter, thin mica strips are employed, and the film is protected from mechanical injury by enclosure in a metal case, from which it is efficiently insulated. Electrical continuity is established by means of flat metal terminals held in close contact with the two ends of the film. A number of different forms of these resistances or "elements" are used, each suited to the particular conditions under which it has to work, and the size and shape of the apparatus on which it is employed.

Finally, as an example of the transformer method, the author mentioned the "Tricity" cooker of the Berry Construction Co., in which the part of the apparatus representing the stove is formed by a transformer, the top of which forms a hot plate, and which induces currents in windings embedded in the actual cooking vessels laid on the plate, so that flexible wires are entirely avoided.

The author, in conclusion, described the "Electroyl Radiator" of Messrs. Purcell & Nobbs, in which a high efficiency from the air-warming point of view is obtained by the heating to a moderate temperature of a considerable body of oil contained in a vessel with large surface by immersed wires. This apparatus was described and illustrated in Electrical Engineering, October 29th, page 586.

Electric Head Lamps.—It is announced in the *Electrical Review and Western Electrician*, that the street sweepers who have to work at night in the "boulevards and parkways" of Chicago, are to be provided with small electric lamps to their caps, in order to prevent risk of their being run down by rapid traffic. Two-volt tungsten lamps are used, supplied from a pocket one-cell accumulator.

Electrification of the Pennsylvania Railroad.—It is announced in the *Electric Railway Journal* (New York), that a decision has been arrived at to adopt the continuous-current, third-rail system for the North and East River tunnels and lines in connection therewith. The conclusion has only been reached after extensive experimental observations with both this and single-phase methods. Extensive comparative tests of locomotives have been in progress for the last two years on the West Jersey and Seashore Railway, and a special test line was erected in Long Island with short lengths of no less than ten different patterns of overhead construction, including dummy tunnels, for the study of single-phase working. The experimental rolling stock included a special 11,000-volt 15-cycle locomotive, and other vehicles, from which complete trains were made up.

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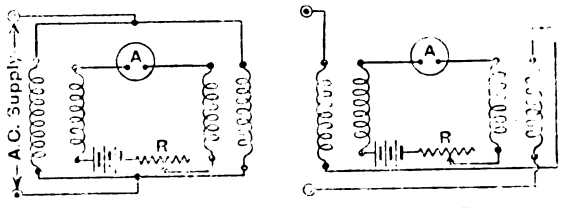
THE USE OF TRANSFORMERS AS CHOKING COILS FOR THE TESTING OF ALTERNATORS

In his Paper, read on Wednesday, December 16th, before the Birmingham Local Section of the Institution of Electrical Engineers, Dr. J. D. Coales, of Birmingham University, described a method whereby ordinary transformers could be used as choking coils for the purpose of testing alternators on inductive loads. In attempting to separate the inductive and resistance components of the "drop" in alternators on load, it is necessary to apply an inductive load about equal to the full-load current of the alternator under test. The smallness of the no-load current renders a transformer useless as an inductive load at the voltage for which it is designed unless by some special means the no-load current can be increased to a reasonably large value. In core transformers with butt joints this may be accomplished by temporarily opening the joints between the limbs and yoke, and inserting distance-pieces of non-magnetic material, but this is not always convenient. To provide choking coils for such a purpose is generally too costly, especially in the case of large alternators. If, however, the alternator is provided with transformers either for stepping its voltage up or down or both, the test may be easily carried out by the method described in the Paper, which permits of a reduction of the permeability of the core of a transformer (thereby increasing its magnetising current), without any interference with its construction. Briefly, the method consists in bringing the flux density of the core to a high value, by means of direct current sent through the secondary winding; so that when an alternating electromotive force is applied to the primary, the flux density undergoes variations about a mean flux density corresponding to low permeability, instead of about zero flux density corresponding to high permeability as is ordinarily the case.

In the use of this method it is evident that something must be done to prevent the secondary electromotive force from driving an alternating current through the source of direct current. Two ways of doing this are shown in Figs. 1 and 2. In Fig. 1 the primaries of two similar transformers are connected in parallel, and the secondaries in opposition as in the Kapp-Sumpner circulation of power test, the source of direct current being inserted as shown. In Fig. 2 the primaries are in series, and the secondaries in opposition as before. The inductance of the second arrangement is double that of the first, and by use of both a wide range of inductances may be obtained. In the absence of a specially designed choking coil, it is thus necessary to use two transformers for single-phase working. For testing a three-phase alternator, at least three transformers are necessary. If two sets—that is, six transformers—are available, then an inductive load may be obtained by making up three single-phase pairs connected as in Figs. 1 and 2, and combining these in star or mesh groupings with the direct current sent through the six secondary windings in series; or each three-phase set may be star connected, and the two sets connected in parallel with the secondaries opposing each other as in the Kapp-Sumpner test applied to three-phase transformers. The source of direct current is then connected between the neutral junctions of the two sets of secondary windings.

If the high-tension windings are used for the direct-current



Figs. 1 and 2.—Alternative Arrangements of Transformers.

circuit, the strength of the direct-current required is proportionately reduced. There are several methods of arranging the direct-current circuit in star- and mesh-connected transformers, and it is possible to superpose the direct current upon the alternating current in the primary windings in such a way as to avoid any circulation of direct current through the alternator circuits. This is equally true both for full inductive and partially inductive loads.

In the tests described by the author, only three transformers were available, and mesh connection was adopted for both the primary and secondary windings of the transformers. The direct current was caused to circulate round the secondary mesh consisting of the high-tension windings, by opening the mesh at one corner and inserting a battery, carbon rheostat, and ammeter. As there is no alternating electromotive force round such a mesh under ordinary circumstances, the direct-current circuit would experience no alternating current of any magnitude. However, should such circulating currents occur through dissymmetry produced by the artificial saturation of the cores, it may be reduced to a negligible amount by means of an ordinary choking coil inserted in the direct-current leads. The connections for taking a full inductive load test on an alternator in this manner are given in Fig. 3. The results of tests made by the author, according to the above method, and also with three ordinary choking coils connected in mesh, were given in the Paper, and a comparison of these results shows that with full-load current the transformers caused a drop of 46 per cent. and the choking coils a drop of 47·5 per cent.—that is, a difference of 1·5 per cent. In other words, the error by using the transformers was 3·1 per cent. If six transformers had been available, so that in each phase the windings could have been connected as in Figs. 1 or 2, the author concludes that the results would have been exactly the same by the two methods. By connecting a variable lamp load in parallel with each of the H.T. windings of the secondary mesh, the pressure drop on any desired power factor can be determined. In order to prevent

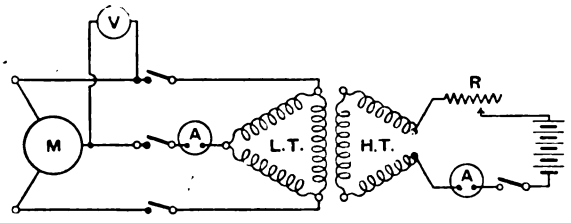


Fig. 3.—Diagram of Connections for Inductive Load Test on a Three-phase Alternator.

any portion of the lamp load current from passing through the battery in this case, the open corner of the mesh is bridged by a carbon rheostat to the middle plate of which one lamp load lead is connected.

In testing alternators for "drop" on inductive loads, it is necessary to take into consideration the wave-form of the current employed for the purpose; for the distribution of the armature reaction over the cycle depends upon this, and it is possible that the "drop," to some extent, depends on this distribution of the armature reaction as well as upon its mean value. A large number of tests were carried out by the author to determine the effect of the above arrangements on the wave forms of both current and E.M.F. of the alternator, and the results of these, as expressed by oscillograph records, were given in the Paper. The conclusion was arrived at that the wave forms were not distorted to a serious degree so long as the currents in the transformer windings were above 25 per cent. of the full-load values for the transformers used. In the case of the test on the three-phase alternator with three transformers, the wave forms were somewhat distorted, but, as shown by the results obtained, this did not appear to have much effect. One of the interesting facts brought out by the oscillograph was that the direct current is thrown into ripples by the superposition upon it of an induced alternating current having twice the frequency of the applied voltage. Another interesting point is that the core losses in the transformers are over four times the full-load loss under normal conditions, so that, as the copper losses are about the same and equal to the normal iron losses, the total losses are about 2·7 times those under normal conditions.

In order to combine the two transformers into one and so save labour in construction, it is suggested that a double magnetic circuit be used, having three parallel cores, of which the middle core has double the section of the outer cores. The primary winding should consist of two equal coils placed upon the outer cores and connected so as to magnetise the rectangle formed by the outer cores and yoke in the same sense. The direct-current winding or secondary should then be placed on the middle core, so that when excited it magnetises the two outer cores in parallel, while it is itself uninfluenced by the alternating magnetic flux produced by the primary windings. By this means half the copper required for the direct-current windings, when two transformers are used, is saved.

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DISCUSSION.

DR. W. E. SUMPNER (Birmingham Municipal Technical School), who opened the discussion, considered that the method described by the author was a very convenient one for obtaining low power factors. Methods previously available were the Ayrton copper rings, Swinburne Hedgehog transformer, and the choking coils recently described by Messrs. Morcom and Morris (*see* ELECTRICAL ENGINEERING, Vol. III., p. 427). Some trouble would probably occur in applying the author's method to large machines in view of the fact that the core losses were so great. The temperature rises would be very rapid, and some means would have to be adopted to keep the transformers cool.

MR. S. P. SMITH (Siemens Bros. Dynamo Works, Ltd.) pointed out that the distortion of the current waves disappeared as the current increased, owing probably to the saturation of the core diminishing the effect on the iron. The ripples in the direct-current wave, he said, were probably due to the superposition of harmonics, something on the lines of the action in the case of a machine with a rotating field, where the current in the rotor reacted on that in the stator to produce third or fourth harmonics.

DR. D. K. MORRIS said the test would be most valuable to the engine builder, as no special apparatus would be required. The question of heating due to excessive core losses was not a serious objection, as a quarter of an hour would suffice to take all the measurements necessary to determine the regulation of an alternator on inductive load. One drawback was the need of direct current of very low voltage. An important advantage was the easy adjustment of the power factor with constant voltage; with his type of choking coil it was necessary to put a resistance in series.

MR. A. R. EVEREST (British Thomson-Houston Co.) said that in connection with experiments on the rectification of alternating currents by means of a mercury arc, he had used a high degree of saturation in the core of the transformer, but, as far as he could see, this did not have the effect of largely increasing the core losses and heating. The author in his Paper, on the contrary, showed the losses with high saturation to be much greater than when working round zero flux.

PROF. G. KAPP (Birmingham University) stated that the expense involved in testing an alternator by this method would be nothing like what the use of choking coils entailed. With regard to the heating of the transformer, it should be borne in mind that the hysteresis loss was due rather to the differences in the induction than to the maximum values of the same. It was possible, however, that hysteresis increased with a high degree of saturation of the core. The time taken to raise the temperature of a large oil-cooled transformer was very considerable, even when no allowance was made for the heat radiated or conducted away. Where the heat capacity of such a transformer was very large, he anticipated it would take at least two hours to reach a dangerous temperature. This period would be sufficiently long to determine the voltage regulation, and also form a good idea of the temperature rise of the alternator, which would probably reach its maximum temperature in six hours.

DR. J. D. COALES, in reply, said that Dr. Sumpner's objection to the use of this method for testing large machines had been practically dealt with by Dr. Kapp. Unfortunately, he had only small machines at his disposal, and was unable to carry out the tests on a large scale. His method was capable of being applied to the over-compounding of rotary converters, and this arrangement had, he believed, been patented by someone in America.

CATALOGUES AND PAMPHLETS RECEIVED

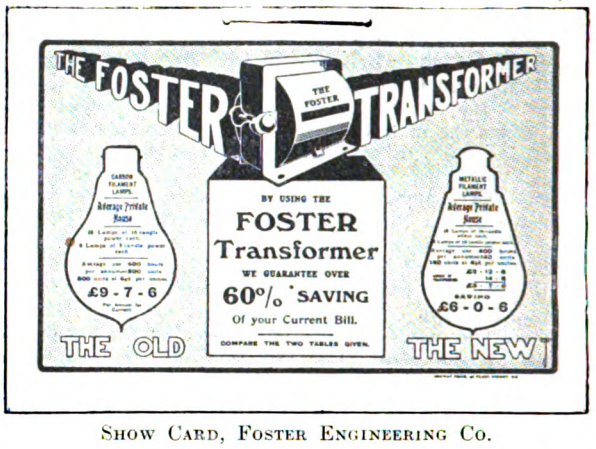
[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

HOISTING APPARATUS, ELECTRIC DRILLS, &c.—Some leaflets from Messrs. Kramos, Ltd., of Bath, illustrate a series of compactly designed electric hoists, transporters, &c., and a special design of lifting magnet, which can be used in connection with this apparatus and also with cranes of larger size. Another leaflet gives prices and particulars of the firm's well-known British-made portable electric drills in sizes suitable for drilling holes from 1/4 in. to 2½ in.

PORTABLE & IGNITION ACCUMULATORS.—A neat illustrated pamphlet is to hand from the Chloride Electrical Storage Co., Ltd., of Clifton Junction, Manchester. In this pamphlet the various sizes of "Exide" accumulators for ignition purposes and for portable lamps are listed. The ignition capacity is reckoned to be twice the capacity on a 10-hour discharge rate; this method of estimating the ignition capacity gives values in accordance with the rating proposed by the Society of Motor Manufacturers and Traders. The cells are fitted with prepared wood separators and have celluloid boxes. Acid-proof carriers of rubber, metal cases, and wooden crates are included in this pamphlet, and hand-lamps with 4-volt 4-c.p. metal filament lamps, and with capacities ranging from 12 to 70 lighting hours on one charge are also listed.

ELECTRIC CRANES.—A handsome catalogue from Messrs. Babcock & Wilcox, Ltd., contains illustrations and particulars of a large range of designs of electric cranes. It will be remembered that the company acquired the business of Messrs. Wimshurst, Hollick & Co., whose electric cranes were well-known, some three years ago, which, while retaining the technical staff of the latter firm, they transferred entirely to their works at Renfrew. Some of the cranes illustrated are of the single-motor type, employing the Hollick patent balanced friction gear, but the largest patterns of multiple-motor crane are also represented. A number of orders are in course of execution for British and Colonial Government Departments, &c.

TRANSFORMERS FOR METAL FILAMENT LAMPS.—The accompanying illustration is a miniature reproduction of an



SHOW CARD, FOSTER ENGINEERING CO.

effective show card, which is being used by the Foster Engineering Co., who were one of the earliest British firms to standardise the manufacture of small transformers for metal filament lamps.

TESTING SETS.—A pamphlet from the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., describes the latest pattern of the small form of the "Silvertown" portable testing set. This consists of a small portable Wheatstone's bridge, together with a suitable galvanometer, mounted on an ebonite slab and fitted into a polished teak case with brass carrying handle. The adjustable resistance contains coils from 1 to 400 ohms, giving a total of 1,110 ohms. The ratio coils are so arranged as to require only two plugs, and by their means ratios of ten times, equality, and one-tenth are obtainable. The range which the instrument can measure is therefore from 0·1 to 11,100 ohms, but by means of galvanometer deflections suitable resistances may be measured to hundredths of an ohm. The galvanometer is fitted with a spring plunger lifting arrangement, so that the pivot and jewel may not get unduly worn or damaged when the instrument is being carried. The galvanometer is calibrated in divisions, which are proportional to the current strengths, and a mirror to prevent parallax error is provided.

POCKET-BOOKS, DIARIES, &c., for 1909.

A clearly printed office wall calendar for 1909, with monthly tear-off sheets, to hand from Messrs. Nalder Brothers & Thompson, Ltd., reminds us of the approach of the close of the present year.

Messrs. Simplex Conduits, Ltd., are sending to some of their friends a very neatly designed circular brass wall thermometer.

Messrs. Siemens Brothers and Co., Ltd., conjointly with Messrs. Siemens Brothers' Dynamo Works, Ltd., are issuing the 1909 edition of their well-known Morocco leather covered pocket book and diary. This season's issue is even more complete than the last, and contains a fund of useful information and a new set of interesting illustrations indicating the wide range of the sphere of action of these two companies.

Our Editor has been much pleased to receive from the Electrical Standardising, Testing, and Training Institution, Faraday House, a compact and convenient "Memory Tickler" in the form of a case containing a card index outfit arranged with guide cards under days of the months.

Accident on the Liverpool Overhead Railway.—A regrettable accident occurred on the Liverpool Overhead Railway on Saturday. The 11.20 p.m. train from Dingle, due to arrive at Seaforth Sands Station at 11.44 p.m. (and arriving eight minutes late), ran with undue speed into the station and came into contact with the hydraulic buffers at the end of the platform. The rails were greasy, owing to the moist weather, and evidently the driver had not applied his brakes soon enough. The front carriage and its occupants were uninjured, the second carriage had some of the windows broken and some of the fittings displaced. One of the passengers unfortunately had her legs broken; all the others escaped injuries. Some complained of being shaken, but were able to walk home. There was no electrical fault, and no interruption of the traffic on the line.

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SOME GENERALISATIONS ON THE DESIGN OF ELECTRICAL MACHINERY

THE following communication to the discussion on the Paper with the above title, by Messrs. J. C. Macfarlane and H. Burge (see page 785 of ELECTRICAL ENGINEERING of December 17th), has been received from Dr. R. Pohl, of the Phœnix Dynamo Manufacturing Co., of Bradford:—

This Paper sets out in a very interesting manner the factors that limit the output obtainable from electric machines, and indicates clearly and correctly the present state of design. In so far, however, as it contributes to the theory of the design of electric machines for minimum cost, I do not think that all the conclusions arrived at are correct. A few years ago, in conjunction with H. Bohle, I published such a theory for static transformers, in the design of which the number of variables is, of course, much smaller than in rotating machines, and the problem could be easily solved without any undue assumptions being made. The principle that the total cost for the material of the electric circuit should be equal to the total cost for the material of the magnetic circuit of a transformer was established, and used as the basis of calculation.

The authors of the present Paper go a step further, and apply the same principle to the design of rotating machines and particularly to D.C. machines, and they conclude that the cost of the material in the electric circuit, *i.e.*, of the armature and inter-pole copper, should be equal to the cost of the material in the electric circuit—*i.e.*, of the total iron and the shunt copper. This result is entirely different from present-day practice, and, in my opinion, also far from being correct for the design theoretically most favourable. It is arrived at chiefly by the assumption that the material in the magnetic circuit—that is, the iron and shunt copper—varies directly with the total magnetic loading, which I do not think is really the case. It will easily be seen that with an increase of the magnetic loading the amount of shunt copper by no means rises in proportion to the increase, and as it forms an important part of the total cost, this fact greatly affects the result. Furthermore, even in inter-pole machines a certain relation should be maintained between the field ampere-turns for gap and teeth, and the armature ampere-turns beneath the pole arc, in order to keep the field distortion within permissible limits. As a result, with an increase of the magnetic loading and consequent decrease of the armature ampere turns, the shunt ampere-turns, and also the weight of shunt copper, may sometimes even be made to decrease.

Some years ago, when with the introduction of inter-poles a theory of design for minimum cost without regard to sparking became of practical interest, I worked out a suitable method from which I concluded that in the most favourable machines the ratio of the cost for armature and inter-pole copper to the cost for iron and shunt copper is not constant for all sizes, and is generally between $\frac{1}{4}$ and $\frac{1}{3}$. Another conclusion was that the length of the armature core should be considerably greater than the pole arc, and not equal to it, as the authors assume. The curves are, however, very flat, and one may depart very considerably from the point theoretically most favourable without adding appreciably to the cost of the active material. Such departure is generally desirable, because, after all, the cost of the active material is not the only point to be kept in mind in the design of a machine. Though differing from the authors in some of the points cited above, I have read the Paper with the greatest interest, and cannot refrain from congratulating them on the clear manner in which they have given so much detailed information of real practical utility in, comparatively, so short a Paper.

LOCAL NOTES

ALTRINCHAM: *Tramway Lease.*—Notice is given of the intention of the Council to lease to the Manchester Corporation, for 23 years, five authorised tramways, the lease to be reckoned as from May 10th, 1907.

BIRKDALE: *Public Lighting.*—A number of high candle-power Osram lamps are being fitted in the streets as an experiment in public lighting, owing to the number of breakages when carbon filament lamps were used. Trials are also to be carried out with arc lamps in the more important thoroughfares. These experiments are being carried out by the Birkdale Electric Supply Co. at the instance of the Council.

BIRMINGHAM: *Tramwaymen's Hours.*—The Tramways Committee have adopted the report by Mr. A. Baker, the Tramways Manager, by which a 54 hour week has been adopted for the whole of the present tramway staff, without a reduction in pay, instead of the 60 hour week at present in force. New members of the staff, however, will commence at a slightly reduced wage and reach the maximum in six years instead of four as at present.

BRENTFORD: *Condition of Tramway Track.*—At the last meeting of the Council the chairman reported that he had attended the conference at Hounslow with respect to the condition of the tracks of the London United Tramways Co., at which Sir Clifton Robinson attended and spoke. The chairman stated that the representatives of the various districts were determined to keep Sir Clifton Robinson up to the mark, and with that object in view a resolution was passed at the conference that the surveyors of the different districts should meet Sir Clifton Robinson and go over the tracks in the respective districts and to submit detailed reports to a further conference at which Sir Clifton Robinson is again to be invited to attend.

CHELTENHAM: *Cost of Public Lighting.*—In his annual report the District Auditor calls attention to the charge for public lighting, viz., 3d. per unit, which he considers excessive.

DUBLIN: *Damages Against Tramway Co.*—The sum of £500 damages has been awarded against the Dublin United Tramways Co. in connection with the death of a painter who was thrown out of a cart through a wheel catching in a rut next to the tramline. It was argued that this was due to the negligence of the tramway company to maintain their track in proper condition.

DUNDEE: *Stair Lighting.*—A proposal that the electricity department should bear the cost of the wiring and fitting of common stairs, in order to induce the proprietors to take current, has been referred back.

Gift of Electric Light Installation.—Sir William Dalgleish, Bart., has borne the complete cost of an electric light installation at the Dundee Sailors' Home.

FALMOUTH: *Overhead Wires.*—The Electric Supply Corporation have been granted permission to erect some overhead wires to supply the district where the possible load does not justify the laying of a cable.

GLASGOW: *Tramway Receipts.*—Since the commencement of the financial year on June 1st, 1908, the number of passengers carried upon the Corporation Tramways has amounted to 119,964,000 against 121,631,946 in the corresponding period of last year, the respective receipts being £480,766 and £489,322.

GOVAN: *Plant Extensions.*—A sub-committee has been appointed to enquire into a report upon the extensions to the Electricity Works. The Borough Electrical Engineer has drafted two schemes involving respective expenditures of £14,000 and £11,000.

HENDON: *Public Office Lighting.*—The Hendon Electric Supply Co. offered to supply the necessary fittings for lighting the Council offices with electricity. The surveyor is to furnish a report giving particulars of the present cost of lighting the premises and the saving which would be effected by adopting the electric light.

LEEDS: *Tramway Receipts.*—The total receipts upon the Corporation tramways for the year to date amount to £244,543, compared with £241,070 for the corresponding period of 1907.

LONDON: *London County Council Tramways.*—In consequence of the opposition to the proposed tramway along Sutherland-avenue, Paddington, the Highways Committee recommend that this route be struck out of the list of proposed tramways for the session 1909.

The arrangement between the County Council and the Metropolitan Electric Tramways, Ltd., providing for the Council's tramway in Archway Road between the Archway Tavern and the county boundary to be worked by the company has terminated, and the Highways Committee recommend that the arrangement be extended up to and including March 31st, 1909. The rent to be paid to the Council by the company is at the rate of £2,500 per annum.

It is proposed to deal with an additional 52 cars during the current financial year in connection with the alteration from the "reversed" staircase to the "direct" type, in order to bring them into conformity with the bye-law made by the Council for the purpose of requiring an uninterrupted side view for drivers of vehicles in London. The expenditure is estimated at about £370.

The Board of Trade inspection of the new line at Forest Hill was made last week.

Marylebone Consulting Engineer's Fees.—In a report by the Electric Supply Committee, it is stated that the total commission paid to Mr. Arthur Wright for his services as consulting electrical engineer now amounts to £25,209.

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LYME REGIS: *Electric Lighting.*—A proposal to form a Lyme Regis Electric Light and Power Co. is now before the Council.

MACCLESFIELD: *Electric Supply.*—After consideration, the Corporation has decided to retain its electric lighting order, and to refuse its consent to an application by the Macclesfield Electric Lighting and Power Co., for a substituted order.

MIDDLESBROUGH: *Trackless Trolley System.*—Some difficulties are being experienced between the Corporation and the Middlesbrough, Stockton and Thornaby Tramways Co., as to certain extensions, and as a way out of the difficulty the trackless trolley system has been suggested. The Electrical Engineer to the Corporation has been instructed to obtain comparative particulars of the cost of the trackless trolley system and an extension of the tramways for the information of the General Purposes Committee who have the matter in hand.

MIDDLESEX: *Tramways.*—It was reported at the meeting of the County Council on December 17th that the Metropolitan Electric Tramways, Ltd., are negotiating with the London County Council for a continuance for a further period of the agreement under which the Spring Gardens authority at present leases the short length of tramway from the Archway Tavern to Highgate Archway to the company.

ROCHESTER: *Public Electric Lighting.*—An estimate has been submitted to the Works Committee of the cost of substituting electric lighting in the High-street for the present gas lamps. It is calculated that 54 arc lamps should take the place of the present 52 gas lamps. The figures of cost, however, show that if "Excello" 3,000 c.p. lamps are fixed the total annual cost, including repayment of principal and interest, would be £763 against £163 of the present gas lighting, whilst if "Excello" 2,500 c.p. lamps are fixed the cost would be £712. If "Oriflamme" 3,000 c.p. lamps are fixed the cost would be £564. In view of the great disparity between these figures and the present cost of gas lighting, the Council has decided to abandon the idea of the change for the present.

SOUTH AFRICA: *Electric Lighting.*—We read in *South Africa* that the Town Council of Uitenhage has accepted provisionally the electric lighting scheme of the General Electric Co., of London. The matter has still to come before the ratepayers for approval.

TEWKESBURY: *Electric Supply.*—The plans of the electric supply works have been passed.

TOTTENHAM: *Electric Lighting.*—It has been agreed between the Council and the North Metropolitan Electric Power Supply Co., to defer the electric lighting in the district, in order to save the expenditure this half-year. Under the agreement of January 15th, 1907, the Council agreed to light 110 arc lamps for a period of eleven years from the date thereof, and as the company were about to commence the supply they agreed to defer it until the end of March, in consideration of the Council extending the lighting period for a further three months at the expiration of the above term. The company now asked the Council to pass a resolution to this effect, and the Committee recommended the Council to accede to the request. This was agreed to.

WELLS: *Electric Lighting.*—A discussion took place at the last monthly meeting of the Council relative to the application of the local gas company for electric lighting powers. After a proposal to oppose had been moved, the matter was referred back to the General Purposes Committee.

WISHAW: *Tramway Extensions.*—Plans of the proposed extension of the Lanarkshire tramways to Wishaw are now in the hands of the Council, and it is expected the work will be started during the next few weeks, and that it will be completed by the end of March next.

WOLVERHAMPTON: *Tramway Inter-communication.*—The Tramway Committee have reported in reference to the letter from the Tramway Co., notifying their intention of discontinuing the through service upon their trolley tramways and the Corporation surface contact tramways. The report points out that the Committee have no suggestions by which the matter can be re-opened, and acknowledges the effort which the Company has made to make the arrangement a success.

WORSBOROUGH: *Tramway Rating.*—Under the recent decision that light railways are to be treated as railways for rating purposes, *i.e.*, should be rated upon one-fourth the assessment. The undertaking of the Barnsley Electric Traction Co. in Worsborough is now dealt with in this manner. An application, however, has been made to the Council for the return of the sum of £55 10s., which the company claim to have been overcharged in the past. The Town Clerk has expressed the opinion that, from the legal point of view, the company cannot recover, but that there was some obligation on the Council, from the moral point of view, to return the money. The Local Government Board is to be asked whether it will give permission for this to be done.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ALGERIA.—The Municipality of Bone has postponed the date for receipt of tenders for an electric tramway and lighting concession until February 15th, 1909. We gave particulars of this in our issue for December 3rd

CLEETHORPES.—The Council has applied to the Local Government Board for sanction to borrow £4,000 for cables in connection with their electric lighting order.

CROYDON.—It has been decided to lay a two-way conduit to carry the new feeder cable from the power-house to the Swan feeder pillar at a cost of £1,321.

EPSOM.—A Local Government inquiry was held last week into the application by the Corporation to borrow £1,500 for purposes of electric lighting. The inquiry was adjourned for the preparation of certain information for the inspector.

FAREHAM.—The Council invite tenders for (1) three alternators and exciters; (2) high- and low-pressure switchboard; (3) overhead travelling crane. Particulars from the Consulting Engineers, Messrs. May & Hawes, Caxton House, Westminster, London, and tenders to the Town Clerk, by January 20th.

FROME. The Local Government Board has sanctioned the expenditure of £11,000 upon electric lighting extensions.

GRAVESEND.—The Local Government Board held an enquiry last week into an application by the Corporation for sanction to borrow £6,000 for the purposes of the electric lighting undertaking.

INDIA.—*Commercial Intelligence* states that the British Eastern Electric Power Co.'s concession for the introduction of electric light and traction in Lucknow having expired, the Municipality of Lucknow have decided to invite tenders by public advertisement for the lighting of the town by electricity, and by gas. The Municipality has asked the Government whether it could undertake the management of a municipal plant.

We read in *Commercial Intelligence* the United Provinces Government have granted a licence to the Municipal Board of Mussoorie for the general supply of electrical energy in respect of the area comprised within the Municipal limits of Mussoorie.

LEITH.—A 600-kw. steam dynamo is required by the Corporation. Particulars from the Borough Electrical Engineer, and tenders by January 6th.

LONDON: *Battersea.*—The Finance Committee of the London County Council recommend loans as follows:—Mains £2,090, repayable in 30 years; house services £778, repayable in 12 years.

Marylebone.—The Finance Committee of the London County Council recommend sanction to a loan of £4,426, repayable in 50 years, for alterations to the Aybrook Street sub-station.

Woolwich.—The Finance Committee of the London County Council recommend sanction to the borrowing of £753, repayable in 20 years, for the construction of a cooling pond in connection with the electric lighting undertaking.

SOUTHAMPTON.—The three alternating machines in use at the works being nearly fully loaded with the existing demand, the electrical engineer points out in a report on the matter that a new motor alternator would cost £700, which could be operated from the existing generator, and would be the most economical method of dealing with the day load machines. The Council has decided to adopt the engineer's advice.

SPAIN.—The Castro del Rio Municipality invites tenders for an electric lighting concession during a period of 20 years. The annual rent asked is £214.

WEDNESBURY.—The Local Government Board has sanctioned a loan of £600 for an overhead feeder to the King's Hill District.

Miscellaneous

ARGENTINE.—The *Review of the River Plate* states that the Santa Fé municipality will shortly call for tenders for the electrification of the tramways. The basis of the contract will be the sale of the present municipal lines.

BECKENHAM.—Tenders are invited for electricity meters. Particulars from the Resident Engineer, and tenders to the Town Clerk, by January 4th.

BELFAST.—Tenders are invited by the Belfast Harbour Commissioners for the supply of 100 tons of best rolled steel girder tramway rails, with fish plates and bolts. Particulars from the Harbour Engineers, and tenders by December 30th.

MEXICO.—A contract has been concluded between the Mexican Government and the Cia de Tranvias de Mexico, S.A., for the construction of tramways in Mexico.

MIDDLESBROUGH.—Tenders are invited for the supply, delivery, and erection of 20 flame arc lamps, posts, brackets, and incandescent fittings for same. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk, by December 30th.

PORTSMOUTH.—Tenders are invited for overhead line material, &c., in connection with the construction of the Gold-

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smith Avenue Tramway. Particulars from the Tramways Engineer, and tenders to the Town Clerk, by January 4th.

RUSSIA.—Conditions relating to the Baku electric tramway concession, which was noticed in our issue for December 3rd, may be seen at the Commercial Intelligence Branch of the Board of Trade.

The *Financial News* St. Petersburg correspondent states that there is a great future for electrical enterprise in Russia. The satisfactory results obtained by the electrical undertakings in St. Petersburg, Moscow, and other towns have stimulated a number of municipalities to substitute electrical for horse tramways. Odessa, Kharkov, Vilna, Baku, and Astrakan, especially, are pushing forward in the matter.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Adaptation of St. Cecilia's House, Commercial Road, as a domestic economy centre (£260). T. J. Bailey, Architect to the L.C.C. Education Committee.

E.C.—Addition to *Times* printing offices, 162 Queen Victoria Street. Architect, H. O. Ellis, 46 Fenchurch Street, E.C.

Alterations for additional office accommodation for L.C.C. tramways department at Evelyn House, Finsbury Pavement (£250). W. E. Riley, architect.

Rebuilding Bell's Buildings (£21,800). Architect, F. W. Forster, 41 Bedford Row, W.C.; builder, J. S. Minter, High Street, Putney.

N.—Adapting disused Fire Brigade station at 38 Seven Sisters Road, for commercial purposes. Surveyors, Gilbert & How, 5 Crouch Hill, Hornsey, N.

N.E.—Assembly Hall, Stanboroughs Yark, rear of High Street, Kingsland. Builders, G. E. Wallis & Sons, Ltd., West Street, Bethnal Green.

N.W.—Proposed new infirmary and phthisis wards, &c., Hendon. Clerk to Hendon Board of Guardians.

Club room, Town Square, Hendon, Hampstead Garden Suburb Architect, E. L. Lutyens, 29 Bloomsbury Square, W.C.

S.E.—Fire station in Foxley Road, Camberwell New Road (£7,450). Contractors, John Barker & Co., Ltd., 83 Kensington High Street, W.

S.W.—Photographic studio at 298 Streatham High Road. Builders, A. J. and C. Hocking, 56 Great Queen Street, W.C.

W.—Extension to Technical Institute, Paddington (£8,200). Contractors, E. Lawrance and Sons, Wharf Road, City Road.

PROVINCES.

ABERDARE (GLAM.).—School. Architect, T. Roderick, 23 Clifton Street.

BARNSTAPLE (DEVON).—New Infant School. G. W. F. Brown. Clerk to the Education Committee, Barnstaple.

BRISTOL.—Mission Church, School, etc., Kingswood (£4,000). Architect, J. Mackay, Kimberley Road, Kingswood, Bristol.

CANTERBURY.—Extension to City School of Art. A. C. Turley, Surveyor to Town Council.

CHISLEHURST.—Enlargement of Council Chambers. W. J. Winter, Surveyor to Urban District Council.

CHRISTCHURCH (HANTS).—Proposed addition to workhouse. Architect, c/o Clerk to the Guardians.

CROYDON.—Additions to Stanley Hall, South Norwood Hill, for W. F. Stanley, Optical Works, South Norwood.

Entertainment hall, North End. Architect, A. Broad, 22 George Street.

Isolation hospital (£7,370). J. S. Killick, Surveyor to Rural District Council.

EPSOM.—Enlargement of technical institute. Ramsay Nares, Secretary, Surrey Education Committee, Kingston.

GLASGOW.—Development of Cardonald estate. A. B. M'Donald, Engineer to Glasgow Corporation.

HARROGATE.—Infant school at Bilton School (300 places). J. Turner Taylor, Clerk to the Education Committee.

LEYTON.—School, Sybourn Street (£10,650). Builder, F. J. Coxhead, Bulmer Road, E.

Additions to municipal offices (£8,500). Builder, North Bros., Stratford, E.

LUTON.—Free library. S. F. L. Fox, Borough Surveyor, Luton.

NEATH (GLAM.).—Swimming baths. Mr. Jenkins, architect, Guildhall, Neath.

NORTHALLERTON.—Proposed isolation hospital. W. Watson, Surveyor to the Urban District Council.

NORTHAMPTON.—Additions to hospital (£7,000). Architect, F. Dorman, 5 Mercers' Row.

PENNYCROSS (PLYMOUTH).—Church of St. Martin. Architect, W. D. Caröe, 3 Great College Street, S.W.

PLYMOUTH.—Swimming and Turkish baths (£6,000). Architect, E. Coath Adams, 20 Bedford Street.

RUGBY.—Opera House. Architect, H. Percival, 47 Mortimer Street, London, W.

SHIPLEY.—By the casting vote of the Mayor, the Saltaire Institution is to be lighted electrically.

SHREWSBURY.—Proposed "Walsham How Mission House" (estimated cost, £3,000). Secretary, the Rev. A. E. Ll. Kenyon, rector of Ludlow.

SOUTHAMPTON.—Chapel and lodge. J. A. Crowther, Engineer, Southampton Town Council.

SWANSEA.—Infants' school, Brynmill, and school at Glanmor. Architect, G. E. T. Laurence, c/o Town Clerk.

Gymnasium, cookery class-room, &c., for Higher Girls' School. A. W. Halden, secretary, Swansea Education Committee.

Asylum. Engineer, R. H. Wyrill, Swansea Town Council.

Rebuilding Masonic Hall, Caer Street.

Art Gallery (£12,000). Architect, Glendenning Moxham, Castle Street.

TAUNTON.—Post Office. H.M. Office of Works, Storey's Gate, S.W.

WATFORD.—New Baptist Church, Leavesden Road, for the Trustees, Leavesden Road Baptist Church.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The New South Wales Postmaster-General's Department has accepted the tender of the Western Electric Co. (Australia) Ltd., for the supply, delivery, and erection of a branching metallic multiple magneto switchboard, at Mosman, at £3,346, with additional cabling to the extent of £58, and apparatus for twenty-seven incoming junction lines, at 24s. 6d. each, and for forty outgoing junction lines, at 11s. 6d. each.

BELFAST.—The tender of the British Insulated & Helsby Cables, Ltd., has been accepted for trolley wire.

CARDIFF.—The tender of Mr. C. Pullan, of Bradford, has been accepted for the installation of electric lighting in the Cardiff Museum at £76.

CROYDON.—The Corporation have accepted the tender of W. J. Bishop & Co., Croydon, at £59, for electric wiring and fitting at the department's inquiry office and store (3 Park Lane). The maintenance contract with the Tudor Accumulator Co. for one battery has lapsed, and the contract for the second will lapse in the spring. The amount paid per annum for the two batteries is £58. It was resolved to extend the contract for five years at the increased rate of £65 per annum.

DARLINGTON.—An order has been placed with Messrs. Cox-Walkers, of Darlington, for an electrically-driven pump.

LONDON: *London County Council.*—The following tenders have been received for the electric lighting of the Clapham Secondary Schools:—G. E. Taylor & Co. (recommended), £699; W. J. Fryer & Co., £747; Aland & Co., £783; Comyn Ching & Co., £786; W. G. Cannon & Sons, £789; G. Weston & Sons, £803; Tredegar & Co., £923; G. N. Haden & Sons, £971; S. J. Suter & Wood, £987; Lund Brothers & Co., £990; F. C. Hoskins & Co., £1,084; C. Pullan, £1,116. The original estimate of the chief engineer, amounting to £1,055, was based on the use of carbon filament lamps, whereas the scheme on which tenders were invited provides for the use of metallic filament lamps, which enables a reduction to be made in the number of points to be provided and an improvement to be effected in the lighting, together with economy in the consumption of energy.

The Highways Committee recommend that the contract with Messrs. W. T. Henley's Telegraph Works Co., Ltd., for the supply of low-tension cables for the central car repair depôt, shall be extended to include the telephone installation at a cost not exceeding £125.

The offer by Messrs. Hadfields' Steel Foundry Co. to supply a right-hand standard junction, consisting of points, track, and slot crossing, yokes, &c., at the Hackney car-shed, at £262, less 2½ per cent., has been accepted.

An offer by Messrs. John Cochrane & Sons for the provision of additional condensing water-pipes at the Greenwich power house at cost price, plus 10 per cent., is recommended for acceptance. The estimated cost is £8,000.

Chelsea.—The Council have accepted the tender of Messrs. Wright Bros. & Co., at £23 17s. 6d., for putting the electrical installation in the old portion of the Town Hall in repair. They have further accepted the tender, at £35 7s. 6d., of the same firm for alterations to the electrical installation at the new portion of the Town Hall. The work consists of supplying and fixing six distributing fuse boards, altering the position of the main cable in the basement, and connecting same to new main distributing fuse board.

Marylebone.—The Council received tenders for the supply of paper-insulated, lead-covered, and armoured cable from the following firms, viz.:—Aubert, Grenier & Co., Union Cable Co., Ltd., Siemens, Bros., Ltd., Western Electric Co., Johnson & Phillips, Ltd., St. Helens' Cable Co., Ltd., Callenders' Cable Co., Ltd., W. T. Glover & Co., Ltd., Blackwell & Co., Henley's

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Telegraph Works Co., Ltd., British Insulated & Helsby Cables, Ltd., and Lahmayer Electric Co. It was explained that tenders from foreign firms had been invited owing to a combination among British firms to keep up prices. Upon the recommendation of the Electric Supply Committee the Council accepted the lowest prices in the tenders of Messrs. Aubert, Grenier & Co. and the Union Cable Co., subject to the samples proving up to specification standard, these prices amounting to £500 less than the lowest prices of the British firms. The detailed prices per 220 yards of the successful firms were as follows:—Union Cable Co., S.W.G., single, 7/18, £4 5s. 4d.; 7/16, £7 5s. 3d.; twin 3/20, £7 11s.; armoured, 7/20 five-core, £18 6s. 9d.; 0·50 sq. in. concentric, £26 5s. 1d.; triple concentric, 0·025 by 0·025 by 0·025, £27 17s. 10d.; 0·050 by 0·050 by 0·035, £37 19s. 6d.; 0·4 by 0·4 by 0·15, £162 15s. 7d.; 0·5 by 0·5 concentric, £149 13s. 10d. Aubert, Grenier & Co., S.W.G., 7/20, five-core, £13 12s. 5·8d.; concentric, 0·025 sq. in. £10 9s. 2d.; 0·050 sq. in., £21 3s 8d.; 0·5 by 0·5, £135 18s. 6d.; triple concentric, 0·025 by 0·025 by 0·025, £20 12s. 8d.; 0·050 by 0·050 by 0·050, £30 5s. 10d.; 0·1 by 0·1 by 0·05, £46 5s. 6d.; 0·15 by 0·15 by 0·075, £64 4s. 10d.; 0·25 by 0·25 by 0·125, £94 2s.; 0·4 by 0·4 by 0·15, £142 2s.; 1 sq. in., single, £131 15s. 6d.; armoured, 7/20, five-core, £17 3s. 2d.; triple concentric, 0·1 by 0·1 by 0·05, £57 5s. 6d.; 0·15 by 0·15 by 0·075, £76 4s. 10d.; 0·25 by 0·25 by 0·125, £108 2s.; 1 sq. in., single, £144 15s. 6d. The tenders of Messrs. Doulton & Co., Ltd., and the Albion Clay Co., Ltd., have been accepted for ducts and troughing.

Poplar.—The tender of Messrs. W. G. and J. H. Nash has been accepted for carrying for ventilating purposes the two existing openings in the battery room floor of the engine room through the roof of the building by means of galvanised iron shafts with louvre and cowl at a cost of £25.

WOLVERHAMPTON.—The Electricity Committee has accepted the tender of the Electric Construction Co. for switchgear and accessories at £120, and the fittings for forced ventilation to two turbo-alternators at £250.

COMPANIES' MEETINGS AND REPORTS

ADELAIDE ELECTRIC SUPPLY CO.—The report for the year ended August 31st, 1908, states that with the sanction of the holders of the preference and ordinary shares, a further 6,000 preference shares of £5 each were issued in April and May last, the whole of which were again applied for by and allotted to the public in Adelaide. The profit and loss account shows a credit balance for the year of £12,962. After payment of the dividend on the preference shares for the half-year ended February 28th, 1908, writing £606 off suspense account (consisting of the cost of the various issues of preference shares), and placing a sum of £1,000 to depreciation account, there remains, including the amount carried forward from the previous year, an available balance of £9,330, which the directors recommend should be applied as follows:—Dividend on six per cent. preference shares for the half-year ended August 31st, 1908; 3½ per cent. dividend on ordinary shares for the year ended August 31st, 1908; balance carried forward, £879.

ANGLO-ARGENTINE TRAMWAYS CO.—At a special meeting of share and debenture holders on Friday, the resolutions were passed dealing with the re-arrangement of the company as follows:—To exchange the existing £266,600 of 6 per cent. debenture stock for 4 per cent. debenture stock, ranking *pari passu* with the 4 per cent. debenture stock already issued, at the rate of £155 of 4 per cent. stock for £100 of 6 per cent. stock; to exchange the £1,300,035 of 6 per cent. cumulative first preference shares for a new issue of 4½ per cent. debenture stock, redeemable in 75 years, and ranking immediately after the 4 per cent. debenture stock, at the rate of £6 13s. 4d. of 4½ per cent. stock for each £5 first preference share, thus giving the holder the present rate of interest—namely, 6 per cent. per annum; to increase the authorised amount of the 10 per cent. non-cumulative second preference shares of £5 each by £400,000, and to convert each of the existing and new second preference shares of £5 each into two 5 per cent. cumulative first preference shares of £5 each, entitled to one vote per share. After the second preference shares have become first preference shares, to convert the existing third preference shares into second preference shares, with the same rights as at present. It was pointed out at the meeting that the Corporation of Buenos Ayres has granted its permission to the fusion of the various tramway interests in the City upon certain conditions, including the handing over of the whole of the undertaking at the termination of the concession, gratuitously, and the construction of 20 kilometres of new lines within the next 20 years.

COSTA RICA ELECTRIC LIGHT & TRACTION CO.—For the year ended June 30th, 1908, the revenue amounted to £14,402 against £14,303 for the previous year. After meeting expenses and debenture interest, there is a net profit of £4,490, compared with £3,961 last year. This surplus is to be applied to the sinking fund and the reduction of discount on debenture issue account.

ELECTRIC CONVERSION SYNDICATE.—The report for the year to September 30th states that during that period the Board has been principally engaged in liquidating the amounts due to secured creditors, the amount of whose debts on September 30th amounted to £7,642. This amount, however, has been further reduced since the closing of the books.

PROVINCIAL TRAMWAYS CO.—The report for the year ended September 30th states that the net revenue received from the local companies has been £33,084, against £38,049 last year, £30,993 in 1906, and £24,050 in 1905. Adding amount brought forward and transfer fees, there is a balance available of £36,749. From this has to be deducted: Administration expenses, vote to directors at last meeting, income tax—balance of account, interest, interest to debenture holders paid and accrued, preference dividend, interim dividend on ordinary shares, £20,206, leaving £16,543. From this sum the directors have set aside for reserve and depreciation the sum of £8,000, and have also written off £500 from the expenses of the issue of the debenture stock (making, with £3,000 reserved last year, the sum of £3,500 written off), and after these deductions the amount at the disposal of the directors will be £8,042. The directors recommend that a dividend be paid upon the ordinary shares of 4s. per share, making, with 3s. per share paid in June last, 7s. per share, free of income tax, for the year. There will then be a balance to be carried forward of £3,060. In common with other tramway concerns, the traffic receipts have been reduced by general depression in trade and bad weather during the best months of the financial year. This has caused a decrease in the net revenue of the local companies. At the meeting on Friday the report and accounts were adopted.

SHANGHAI ELECTRIC CONSTRUCTION CO.—At the annual meeting, on Friday, the report and accounts were adopted. Sir A. Dent, K.C.M.G., who presided, referred at some length to the negotiations with the municipality of Shanghai for the purchase of the undertaking which had been rejected by the ratepayers in 1907. No further progress had, he said, been made in this direction, the negotiations having been practically suspended pending the solution of other more important matters appertaining to the administration of the company. Amongst these, the question of fares taking a leading position, the company having demonstrated by their experience that they could not earn an adequate profit upon the present basis of fares. A new table of fares and distances was now before the Council, and he hoped it would meet with their approval. At the same time, he thought greater latitude should be left to the company in this direction subject to interference by the Council should the requirements of the public not be adequately met.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—At the annual general meeting on Monday, the report and accounts given in our last issue, were adopted. The chairman, Sir Edgar Speyer, said that hitherto the accounts of the company had been made up annually to the end of June and the general meeting had been held in the autumn. In future, however, the revenue account would be made up half-yearly to June 30th and December 31st, and in the opinion of the directors it would be convenient to hold the meetings in February and August, and in February next the proprietors would have submitted to them a balance-sheet made up to December 31st next, with a revenue account from the close of the liquidation to the end of the year. The conversion scheme had been carried through without a hitch, and the Prior Lien bonds had been successfully issued. The increase in traffics had been satisfactory, both on the District Railway and on the tubes.

UNITED ELECTRIC TRAMWAYS OF MONTEVIDEO.—At an extraordinary general meeting on Monday, resolutions were passed increasing the capital from £800,000 to £1,000,000 by the creation of 20,000 further 6 per cent. cumulative preference shares of £5 each, ranking *pari passu* with the existing preference shares, and 20,000 further ordinary shares of £5 each, ranking *pari passu* with the existing ordinary shares. Resolutions were also submitted to a meeting of the debenture-holders for an issue of £200,000 further 5 per cent. debenture stock.

Mr. George A. Touche, the chairman of the company, who presided, stated that the need for extra capital was the extraordinary rapidity with which their business had been expanding. They had estimated traffic receipts of £255,000 during the first complete year of electrification, but, as a matter of fact, although a year's electric working had not yet been completed, their receipts had amounted to £252,758. In addition to 77¼ miles of track at present in operation, a further 3¾ miles was expected to be finished during the next few months. Their early financial requirements amounted to something like £107,900. Orders had been placed for additional plant for the power-house to the extent of £52,200, and there were very considerable prospective requirements for rolling stock, permanent way, and paving.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Son, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., port of arrival, quoted on Tuesday night, was £65 to £65 10s. per ton (last week £65 10s. to £66 per ton).

DISSOLUTIONS OF PARTNERSHIP.—The partnership between T. H. Satchwell and A. E. Gibbings, trading as Satchwell and Gibbings, Tantarra Electrical Works, Tantarra Street, Walsall, has been dissolved.

The partnership between J. W. Revy and P. F. Besch, trading as electrical engineers under the title of Revy, Phillips and Co., at 181, Queen Victoria Street, London, E.C., has been dissolved.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of creditors in the bankruptcy of Thomas Ward, late director of Electric Instruments Manufacturers, Ltd., Freezywater, Waltham Cross, Herts, was held last week for considering a proposal for the payment of a composition of 7s. 6d. in the pound within six months. The proposition has been accepted.

Mr. L. B. Linnett, 42, Poultry, London, E.C., has been appointed trustee in the bankruptcy of W. J. Aubert, electrical and gas engineer, late of 16, Harp Alley, London, E.C.

A meeting of creditors of the Aluminium Corporation, Ltd. (in liquidation) was held yesterday.

A second and final dividend of 7½d. in the £ will be paid on December 29th at the Official Receiver's office, 13 Winckley Street, Preston, in the bankruptcy of R. S. Blackburn, electrical engineer and contractor, of Hebden Bridge, Yorkshire.

SOME RECENT B.T.H. MINING CONTRACTS.—The extent to which electricity is being applied for mining and for power purposes generally, is well exemplified in the following list of the more important motor installation contracts which were secured by the power and mining department of the British Thomson-Houston Co., during 1908:- Carlin How Mines, Durham: 5 three-phase motors, 6½ to 175 h.p., aggregating 321½ h.p., together with controllers, switchgear, mechanical gearing, emergency brake and three-throw ram pump. Sheffield Coal Co.: 1 250-kw. A.C. generator, 7 three-phase motors, 30-80 h.p.; total, 320 h.p.; controllers, resistances, transformers, and switchgear. Joshua Whiteley and Co., Ltd., Albion Mills, Huddersfield: 23 three-phase motors, 6-55 h.p., totalling 928 h.p., together with switchboards, control panels, necessary wiring, etc. J. and P. Coats, Ltd., Glasgow: 8 three-phase motors, 300-325 h.p., total 2,600 h.p., with controlling gear, panels, etc. Pease and Partners, Darlington (for Esh Colliery): 1 125-kva generator, 1 45 h.p. and 1 70-h.p. motors (total 115 h.p.), with switchboard, controllers and resistances, also two 15-25-h.p. motors, total, 40 h.p.; control panels, etc.; also 2 25-120-h.p., 145-h.p. motors, 1 130-kw. transformer, controllers, resistances and switchgear. Fife Coal Co., Leven: 19 three-phase motors, 25-50 h.p. = 660 h.p., with controlling gear. Aveling and Porter, Ltd., Rochester: 8 three-phase motors, 2¼-16 h.p. = 105¾ h.p., with stg. rheostats, wiring, etc. London Corporation (for Central Criminal Court): 8 8-h.p. = 64 h.p. D.C. motors, with starters and panels. Gwynnes, Ltd.: Testing plant for Borough of Hammersmith—1 120-kv. motor generator set, 1 110-kva. type A.B.T. generator, 1 146-h.p. motor, 1 10-kw. exciter, 1 140-kw. transformer, with switchgear. Greeves, Ltd., J. and T. M., Fort River Mills, Pelfast: 8 three-phase motors, 2-60 h.p. = 92 h.p., with switchgear. Glenboig Union Fire Clay Co., Ltd., Glenboig, N.B.: 20 three-phase motors, = 1,225 h.p., with controllers, resistances, panels, etc.

APPOINTMENTS AND PERSONAL NOTES

The South Indian Railway Co. require an electrical engineer to take charge of the electric lighting and electric driving installation in the company's locomotive shops. Candidates must be between 25 and 35 years of age, and must have had an electrical and mechanical engineering training. The salary is Rs.500 per month, rising annually by Rs.50 to Rs.700 per month. The engagement is for five years. Applications to Mr. R. White, consulting engineer to the company, 3 Victoria Street, London, S.W.

The *Review of the River Plate* states that Mr. P. W. Beatty, chief electrical engineer to the Pacific Railway Co., has returned to Buenos Ayres from a business trip to England.

Lieut.-General Sir Richard H. Sankey, K.C.B., who was a director of the Cleveland and Durham County Electric Power Co., and Deputy-Chairman of the South Wales Electrical Power Distribution Co., and who died in November, left estate of the gross value of £2,447.

The Institution of Civil Engineers: Students' Meeting.—At the students' meeting, held at the Institution on Friday, December 18th, at 8 p.m., Mr. E. P. Hill, M.Inst.C.E., in the chair, the Paper read was "High-power Water Turbines on Moderate Falls," by R. Woldenden, M.Sc. The Paper, which was illustrated by lantern-slides, described briefly the various types of impulse and reaction turbines and their regulation, and discussed mathematically the design of mixed flow and radial inward-flow turbines.

MISCELLANEOUS CITY NOTES

AMERICAN TELEPHONE & TELEGRAPH CO.—The regular quarterly dividend of $2 per share has been declared.

COMPANY TO BE STRUCK OFF REGISTER.—Notice is given in the *London Gazette* that the name of the British Blaknik Arc Light Co., Ltd., will be struck off the register of Joint Stock Companies within three months, unless cause is shown to the contrary.

GALLOWAYS.—At the last board meeting, resolutions were passed authorising the postponement of the payment of the balance of preference dividends for this or any future year until after the general meeting.

LIVERPOOL ELECTRIC CABLE CO.—At the ordinary general meeting, held in Liverpool on December 22nd, a dividend of 5 per cent., making with the dividend of 2½ per cent. paid in June, a total dividend of 7½ per cent., and a further bonus of 2½ per cent., making 10 per cent. for the year.

MIDLAND ELECTRIC CORPORATION FOR POWER DISTRIBUTION.—The debenture transfer books will be closed from the 25th to the 31st inst. inclusive, for the preparation of debenture interest warrants.

ORIENTAL TELEPHONE & ELECTRIC CO.—The register of transfers of 4 per cent. redeemable debenture stock will be closed from December 18th to 31st inst., both days inclusive, for the preparation of warrants for the half-yearly interest due January 1st, 1909.

PUEBLA TRAMWAY LIGHT & POWER CO.—Coupon No. 4, on the five per cent. thirty year first mortgage gold bonds, due January 1st, 1909, will be paid on and after that date at the Bank of Montreal, 47 Threadneedle Street, London.

SOUTH LONDON ELECTRIC SUPPLY CORPORATION.—Subscriptions have been invited during the week by the National Provincial Bank of England, Ltd., on behalf of the South London Electric Supply Corporation to an issue of £100,000 5 per cent. first mortgage debenture stock, having a first charge upon the whole of the company's undertaking. The prospectus states that the company has now about 121 miles of mains laid, and that the capital expenditure to December 31st, 1907, amounted to £300,000.

THE TELEPHONE CO. OF EGYPT.—The register of transfers of 4½ per cent. redeemable debenture stock will be closed from December 18th to 31st inst., both days inclusive, for the preparation of warrants for the half-yearly interest due January 1st, 1909.

COMPANY MORTGAGES

The following are among the mortgages and charges recently filed:—

ADAMS MANUFACTURING CO.—A charge dated November 2nd, 1908, to secure £700 (supplemental to an indenture dated December 19th, 1904), charged on certain hereditaments in Bedford, has been registered. Holders—M. E. Stephens, 11 Mount Street, Berkeley Square, W.; and F. S. Pelissier, 63 Berwick Street, London.

BUENOS AYRES NEW TRAMWAYS CO.—A trust deed, dated October 29th, 1908, to secure £100,000 conversion debenture stock (supplemental to a trust deed, dated December 1st, 1904, securing £500,000), has been registered. Property charged—The company's undertaking and property, present and future, including uncalled capital. Trustees—J. G. le Marchant, 13 Thurloe Square, and J. Head, 40 Lowndes Square, W.

BUENOS AYRES GRAND NATIONAL TRAMWAYS CO.—Trust deed, dated October 29th, 1908, to secure £200,000 conversion debenture stock (supplemental to trust deeds, dated February 16th, 1900, December 9th, 1904, and April 6th, 1906, securing £700,000 similar stock), making a total of £900,000, has been registered. Property charged—A certain concession, lands, property, undertaking, and rights. Trustees—Trustees, Executors and Securities Insurance Corporation, Ltd., Winchester House, E.C.

DAVIS ELECTRICAL CO.—Particulars of £2,000 debentures, created by resolution of October 12th, 1908, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £1,500. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

COATBRIDGE & AIRDRIE ELECTRIC SUPPLY CO.—A further charge, dated November 26th, 1908, to secure £2,500, charged on the company's undertaking and property, present and future, including uncalled capital and the Coatbridge and Airdrie undertakings, has been registered. Holders, County of London Electric Supply Co., Ltd., Moorgate Street, E.C.

HARPER ELECTRIC PIANO CO.—Issue on November 4th of £500 debentures, part of a series of which particulars have already been filed. (Amount now issued, £1,900.)

Electrical Standardising, Testing and Training Institution. At the recent scholarship examinations, held at Faraday House, Mr. W. B. Cushion of Gresham's School, Holt, Norfolk, was awarded an entrance exhibition of twenty-five guineas a year, tenable for three years.

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NEW COMPANIES

BRUCE, PEEBLES & CO.—This company was registered in Edinburgh, on December 5th, with a capital of £250,000 in £1 shares, to acquire the business carried on by Bruce, Peebles & Co., Ltd. (in liquidation), at East Pilton, Edinburgh, and to carry on in the United Kingdom, or elsewhere, the business of electricians, mechanical engineers, suppliers of electricity for the purposes of light, heat, or motive power, brass founders, gas meter manufacturers, tube makers, metal workers, wire-drawers, rope makers, garage, store and warehouse keepers, &c. The subscribers are J. Shields, 141 George Street, Edinburgh; J. Watt, 28 Charlotte Square, Edinburgh; A. Blair, 28 Charlotte Square, Edinburgh; A. W. Watson, 28 Charlotte Square, Edinburgh; W. Blair, 28 Charlotte Square, Edinburgh; D. Porter, 28 Charlotte Square, Edinburgh; J. Gowans, 33 Charlotte Square, Edinburgh. The number of directors is not to be less than three nor more than seven; the first are C. H. McEuen, M. B. Mountain, A. Mackenzie, F. E. Andrews, J. Shields, and A. W. Tait. Qualification, 250 shares. Remuneration, £100 each per annum (chairman £200). Registered office, East Pilton, Edinburgh.

BURMEISTER & WAIN.—Registered in Copenhagen with a capital of Kr.10,000,000 in shares of Kr.2,000 each. Addresses in the United Kingdom, 12 Coleman Street, E.C., and 105 Middle Abbey Street, Dublin.

GRAVITY FLAME ARC LAMPS.—This company was registered on December 17th, with a capital of £5,000 in £1 shares, to acquire from F. Blankensee and others certain patents for inventions relating to Gravity Flame Arc Lamps, and to carry on the business of manufacturers of electric lamps and electrical apparatus, electricians, mechanical engineers, suppliers of electricity, &c. Minimum cash subscription, £100. The number of directors is not to be less than two, nor more than seven; the subscribers are to appoint the first. Remuneration (except managing director), £50 per annum, and 10 per cent. of the net profits available for distribution, divisible. Registered by W. T. Hick, 2 Church Court, Clements Lane, E.C.

LANGWITH PARK ESTATE CO.—This company was registered on December 15th, with a capital of £1,500 in £1 shares, to carry on business as land agents, to plan and erect power stations for the generation of electricity for light or power, to erect plant for the manufacture of coal, acetylene and petrol gas or other luminant for the use of residents of Langwith Park, Collingham, to act as builders, &c., and to acquire and take over the benefit of an agreement for the purchase of the said estate at Collingham, Yorks, made between Mrs. H. E. Reid and W. Walker. Private company. The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first. Qualification, £50. Remuneration for first year, one guinea each per meeting attended; afterwards, £75 per annum, divisible. Registered office, North British & Mercantile Buildings, East Parade, Leeds.

OMEGA ELECTRIC LAMP CO.—This company was registered on December 14th, with a capital of £1,000 in £1 shares, to carry on the business of manufacturers of and dealers in incandescent, electric, and other lamps, electric dynamos, motors, accumulators, batteries, cells, apparatus, fittings, and plant, &c. The subscribers are R. E. Haywood, 8 Cottesmore Gardens, Kensington, W., engineer; J. A. Scoular, 23 Normanton Avenue, Wimbledon Park, S.W., electric lamp manufacturer. Private company. The number of directors is not to be less than two, nor more than five; the first are R. E. Haywood and J. A. Scoular. Remuneration as fixed by the company. Registered by Walls, Stallard & Newton, 27 Old Jewry, E.C.

PROVINCIAL ELECTRIC THEATRES.—This company was registered on December 11th, with a capital of £20,000 in £1 shares, to carry on the business of cinematograph and film manufacturers, theatre proprietors, entertainers, cinematograph exhibitors, &c., and to adopt an agreement with R. G. Hill and J. J. Bamberger. Private company. The number of directors is not to be less than 2 nor more than 5: the first are R. G. Hill, F. C. A. Mouillot, S. G. Vernham, and J. J. Bamberger. Qualification, £100. Remuneration, £100 each per annum (chairman £50 extra). Registered office: 20, Bedford Street, W.C.

SALISBURY PUBLICATIONS CO.—This company was registered on December 1st, with a capital of £1,000 in £1 shares, to acquire the paper known as "Biggs & Sons' Contractors' Record and Municipal Engineering," and to carry on the business of publishers, printers, &c. The subscribers are Miss B Biggs, Glebe Lodge, Champion Hill, S.E.; C. H. Biggs, Coombe House, Stanmore Road, Richmond, Surrey, journalist; E. J. Biggs, Glebe Lodge, Champion Hill, S.E., journalist; A. Anson, 18 Eastcombe Avenue, Charlton, Kent, bank clerk; R. W. Weeks, 65 Hayes Road, Bromley, Kent, consulting electrical engineer. Private company. The number of directors is not to be less than two nor more than five; the first are A. Anson and R. W. Weekes. Qualification, 10 shares. Registered office, 139-140 Salisbury Court, Fleet Street, E.C.

TENNESSEE & ALABAMA SYNDICATE.—This company was registered on December 11th, with a capital of £15,000 in £1 shares, to adopt an agreement with J. Weil, and to carry on the business of owners of land, railways, tramways, bridges, iron and coalfields, oil wells, pipe lines, refineries, mines and mining and other rights, railway contractors, machinists, chemical, electrical and mechanical engineers, chemical manufacturers, distillers, druggists, dye-makers, metallurgists, founders, &c. Private company. The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first. Qualification, £5. Remuneration (except managing director), 5 per cent. of the distributed profits, divisible. Registered office, 1 Gresham Buildings, Basinghall Street, E.C.

NEW PUBLICATIONS

Lecture-Notes on the Theory of Electrical Measurements. By William A. Anthony. Third edition, revised by Albert Ball. (London: Chapman & Hall.) 4s. 6d.

"The Life Story of Sir Charles Tilston Bright." By Charles Bright. (London: Archibald Constable & Co.) Price 12s. 6d.

A Scheme for the Promotion of Scientific Research. By Walter B. Priest. Second Edition. (London: Stevens & Sons, Ltd.) 3s.

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Electric Motors for driving above complete with starters, switches and fuses.

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THE INSTITUTION OF ELECTRICAL ENGINEERS. The Council is prepared to consider applications for the appointment of Secretary of the Institution from candidates of good standing only, and of not more than 45 years of age. In making the selection, importance will be attached to the following qualifications:—

Administrative experience.
Tact and business capacity.
Acquaintance with the profession.
Knowledge of modern languages.
Technical knowledge.

Applications stating salary required and addressed to "The President of the Institution of Electrical Engineers, 92, Victoria Street, London, S.W.," must be delivered on or before Tuesday, January 12th, 1909.

CABLE JOINTER wanted for Valencia. Must be good worker, under 30, and have thorough knowledge of high tension sleeve jointing. If satisfactory, permanency as foreman. State salary required and past experience to Box A 68, ELECTRICAL ENGINEERING, 203, Temple Chambers, London, E.C.

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John E. Raworth,
Queen Anne's Chambers, 30, Broadway, Westminster, London, S.W.
Chartered Patent Agent.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Dec. 17th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1907 Patents

25,878, **Automatic Transformer Switch.** W. J. DAVY. An automatic switch for breaking the primary circuit of a transformer when the secondary circuit is open, and for closing it when current is required, is the subject of this specification. This switch was fully described in ELECTRICAL ENGINEERING, July 2nd, 1908, page 40. Six claims, six figures.

27,060, **Insulating Material.** J. JOHNSON. This specification describes a hard material suitable for base-blocks for switches and other purposes. It consists of about 40 per cent. sulphur, and 40 per cent. of either lamp black or mica, or a mixture of both. Various earths or colouring matter may be added, or the material may consist solely of the above substances. One claim.

1908 Patents

892, **Double Rotor Induction Motor.** CROMPTON AND CO., LTD., J. C. MACFARLANE, AND H. BURGE. In order to obtain a good starting torque with induction motors, it is necessary to have a high resistance in the rotor at starting, but this must be cut out when the motor is running at full speed, or the efficiency will be low. According to this invention two rotors, one with a high and the other with a low resistance, are mounted on the same shaft, and provision is made to move the low resistance rotor into the stator field automatically as the speed increases. Either a screw thread of fast pitch on the hub and spindle, or an arrangement of weights acting centrifugally can be used for this purpose. Two claims, two figures.

4,657, **High-Resistance Materials.** C. RUZICKA. A resistance composition consisting of 60 parts coal tar, 12 parts quartz, 24 parts potassium felspar, and 10 parts potassium tetraborate, is described in this specification. A moulded rod of this mixture 1 sq. cm. in section and 10 cm. in length, after being heated to a temperature of above 1,000° C., has a resistance of about 10,000 ohms. Instead of coal-tar, resin may be the chief component. In the specification numbered No. 9,762, resistance materials of much lower specific resistance, and suitable for use in heating and cooking apparatus are described. One of these consists of 20 parts iron oxide, 33 parts nickel oxide, 26 parts calcium felspar, and 18 parts bauxite. A material of still lower specific resistance is obtained if iron and nickel nitrites are substituted for the iron and nickel oxides respectively in the above composition. The mixtures are moulded and baked at a high temperature as in the first case. In a further specification, No. 9,763, a resistance material containing carbonised petroleum residue, potassium felspar, and quartz; and another consisting mainly of silicium carbide and potassium felspar, are described. The chief feature in these compositions is the employment of metallic compounds or salts as fluxing or welding agents. In all, nine claims.

5,596, **Self-Starting Mercury Vapour Lamp.** H. A. KENT, H. G. LACELL, AND THE SILICA SYNDICATE. This specification describes a mercury vapour lamp in which the quartz glass containing tube is full of mercury when cold, and has a coil of resistance wire round its centre, which is in series with the mercury in the tube. When the lamp is turned on, the mercury in the centre of the tube is vaporised, and an arc is formed. The pressure of the vapour causes the mercury to flow gradually through narrow necks into chambers provided at either end of the tube, until the arc extends the full length of the tube. When all the mercury has left the tube, the heating coil is automatically short-circuited. The tube is slowly filled with mercury again when the lamp is switched off. Two claims, four figures.

17,414, **Ventilation of Rotors of Turbo-Alternators.** SIEMENS BROS., DYNAMO WORKS, LTD., AND O. KIEFFER. According to this invention, the rotors of turbo-alternators and other electrical machines are ventilated by providing air passages along the tops of the rotor teeth, and drawing air through them. The tops of the passages which are slotted out of the core discs are closed by wedges. Three claims, three figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

10,560, BROWNE. Electrically-controlled railway block signalling.

19,708, WHITE. Contacts for controllers.

26,048, WINDRATH. Commutating devices.

26,354, RYAN. Electric chain-welding machines.

26,420, BECK FLAME LAMP LTD. (*Deutsche Beck Bogenlampen-Ges.*). Method of extinguishing arc lamps.

26,787, BRITISH INSULATED & HELSBY CABLES, Ltd., & NISBETT. Covering of wires and strips with metal.

26,911, FYNN. Commutating dynamo-electric machines.

27,132, BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitäts-Ges.*). Arc lamps.

27,164, NIX, HARPER, & LANE. Induction apparatus.

1908 Patents

155, RENNERT. Electromagnetic regulating apparatus.

241, WEIGHT. Brakes of automobiles.

1,019, GOLDSTONE, WARD, & GOLDSTONE. Electric cycle lamps.

1,299, EPPENSTEIN. Coincidence telemeters.

1,723, MOORHOUSE & ELLIS. Tramway track brakes.

1,751, STEWART, KILLEN, & HARRIS. Vehicles propelled by electro-mechanical means.

2,985, JUSTICE (*Otis Elevator Co. (Incorporated)*). Electrically-operated ammunition hoist.

4,482, THEMKE. Electrical alarm clocks.

4,550, HILL & MANN. Electric ignition of gas lamps.

5,199, GRAY. Electric cables.

5,415, BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). Filaments containing zirconium, for incandescent lamps and heaters.

6,644, ECCLES & MAKOWER. Generating electrical oscillations.

6,960, BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). Alternating-current commutator motors.

7,923, NATHUSIUS, & WESTDEUTSCHE THOMAS-PHOSPHATWERKE-GES. Electric furnaces.

8,018, MEYERLING. Ampere-hour meters.

8,255, DICKINSON. Tramway brake.

10,041, SCHNEEWEIS. Dry cell with ventilating channels.

10,171, SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*). Means for reducing the reflex action at the points of connection of electrical conductors.

10,317, MERSHON. Insulating supports for high-tension conductors.

10,632, PATERSON & DARK. Clamping device for electric contacts or brushes.

12,411, MOZINGO. Electric mail railway system.

12,468, SAHULKA. Wireless telegraphy.

12,834, STENTON. Signalling apparatus.

13,095, KEARNEY. Tube railway system.

15,273, HEDIN. Apparatus for indicating temperature.

16,849, HALL. Safety devices for ignition systems.

17,410, LUNDBERG, LUNDBERG, & LUNDBERG. Switches.

17,417, SIEMENS BROS. DYNAMO WORKS, Ltd. (*Siemens Schuckertwerke-Ges.*). Commutators.

17,772, MACKENZIE (*Telephon Disinfectoren-Ges.*). Apparatus to disinfect telephone mouthpieces.

17,841, PAGE (*Telegraph Transmitting Instrument Co.*). Keyboard telegraphic transmitters.

18,579, RATEAU. System of governing low-pressure turbines driving generators coupled in parallel.

18,713, S.P. (SUCHOSTAWER PATENTS) SYNDICATE LTD., & SAYERS. Electric traction on the surface contact system.

19,388, EBNER. Interruptor for electric ignition.

20,179, SERAGNOLI. Electro-pneumatic device to indicate attempts to tamper with articles to be protected.

20,352, HANKIN & WOLFF. Resistances for electric circuits.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

10,885, WOLFRAM-LAMPEN AKT.-GES. Manufacture of metal filaments.

10,889, CHAUDET. Carbon holders for arc lamps.

25,535, BLAGBURN. Process of obtaining nitrogen from the air.

25,537, ALLMANNA SVENSKA ELECTRISKA AKTIE-BOLAGET. Starting and regulating compensated repulsion motors.

26,053, EGNÉR & FREDRIKSSON. Aerial electric cables.

Applications for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of Dec. 16th, 1908.

22,031, of 1902. **Mariners' Compass.** The Executors of the late LORD KELVIN, F. W. CLARK, and KELVIN & JAMES WHITE, LTD., seek leave to revise the wording of the second claim in this specification.

24,950, of 1906. **Arc Lamp.** H. MOSEY seeks leave to amend this specification, which relates to a gravity-fed arc lamp with converging carbons. The amendment consists in substituting five new claims for the existing ones, to limit the scope of the invention.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ld.	10	7	5½*	10¼—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10	
Do. 6% Cum. Second Pref.	10	6	6	10¼—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	102—106	
Bromley (Kent) E. L. & Power Co., Ld.	5	5½	4¾*	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co., Ld.	5	10	5½*	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	98—101	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	4⅜—4⅝	+⅛
Do. 4½% Cum. Pref.	5	4½	4½	4⅝—4⅞	
Do. 4% Deb. Red	Stock	4	4	97½—99½	+½
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½	3⅞—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3⅜—4¼	
Do. 4½% Deb. Red	Stock	4½	4½	101—103	
City of London Elec. Lt. Co., Ltd.	10	6	6	10½—10¾	+⅛
Do. 6% Cum. Pref.	10	6	6	12½—13	
Do. 5% Deb. Red	Stock	5	5	123—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—103	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5	3½—4	
County of London Elect. Sup. Co. Ld.	10	5	—	8¼—9½	
Do. 6% Cum. Pref.	10	6	6	10⅝—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	98—101	
Edmunson's Electricity Corp., Ltd.	5	—	—	1⅞—2	
Do. 6% Cum. Pref.	5	—	—	⅝—⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	62—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4⅜—5¼	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6¾—7	+⅛
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	88—91	
Kensington & Knightsbridge E. L. Co.	5	10	4½*	7¾—8¼	
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N'ting Hill E. L. Cos. Db. Rd.	Stock	4	4	98—101	+1
London Electric Supply Corporation	3	2½	—	1⅜—1⅝	−⅛
Do. 6% Pref.	5	6	6	4⅞—5⅛	+⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4	89—93 xd	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	5¼—5⅝	+⅛
Do. 4½% Cum. Pref.	5	4½	4½	4⅝—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	88—92	
Newcastle-upon-Tyne Elec. Supply.	5	5	2½	4⅜—5⅛	
Do. (fully paid)	5	8	2½	4¾—5⅛	
Do. 5% Pref. Do.	5	5	2½	5⅛—5⅜	
Do. Do.	5	5	2½	5—5⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½*	5¾—6⅜	+⅛
Do. 4% Deb. Red.	Stock	4	4	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5½*	8⅝—9⅛	+⅛
Do. 7% Non-Cum. Pref.	5	7	7	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½	87—91	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	1⅛—1¼	
Do. 4% Deb. Red	Stock	4	4	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—3	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—½	
Do. 7% Cum. Pref.	1	7	7	1 3/32—1 7/32	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100 –103	
Urban Elec. Supply Co., Ltd.	5	5	5	⅝—1	
Do. 5% Cum. Pref.	5	5	5	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—83	
Victoria Falls Power Co. Pref.	1	—	—	7—1⅛	
Westminster Elec. Sup. Corp., Ltd.	5	10	5½*	8⅜—8⅝	+⅛
Do. 4½% Cum. Pref.	5	4½	4½	5—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	94—96	+1
Central London	Stock	3	3½*	64—66	
Do. 4% Preferred	Stock	4	4	84—86	
Do. Deferred	Stock	2	—	50—52	
Do. 4% Debentures	Stock	4	4	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	86—88	
City and South London Cons.	Stock	4½	1½	27½—28½	−2
Do. 4% Perp. Deb.	Stock	4	4	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	106—109	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—¾	
Gt. Northern, Piccadilly & Brompton	10	4	3½*	7¼—7¾	−¼
Do. 4% Perp. Deb.	Stock	4	4	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	½	35—36	−1⅛
Do. 3½% Preference	Stock	3½	3½	85—87	
Do. 3½% "A" Pref.	Stock	3½	3½	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½	74—77	
Metropolitan District	Stock	—	—	13¼—13¾	
Do. 6% Perp. Deb.	Stock	6	6	124—127	+1
Do. 4% Deb.	Stock	4	4	80—83	
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—27	
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	93—94	
Whitechapel and Bow 4% Deb.	Stock	4	4	101—104	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	⅞—1⅛	
Do. 4½% Deb. Red.	Stock	4½	4½	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93—96	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅜	
Do. 6% Cum. Pref.	10	6	6	3½—4½	−⅛
Do. 5% Perp. Deb.	Stock	5	5	92—97	+2
Do. 4½% 2nd Deb.	Stock	4½	4½	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4	96—100	

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%	%		
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅜—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Electrobus Co. Ord. Shares.	1	—	—	1/32—3/32	
London Street Tramways Co.	4	4/6	2½%	1 1/32—1 1/16	
London United Trs., Ld., Cm. Pf.	10	5	—	4½—5	−¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	68—72	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. % Cum. Pref.	1	5	5%	⅛—⅜	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	3/32—5/32	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	3/32—5/32	
Do. 3½% Mort. Deb.	100	3½	3½%	95—100	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—½	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	1½%*	4¼—4⅝	−⅛
Do. 6% Cum. Pref.	10	6	6%	9½—10½	−½
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	81—85	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	2⅜—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	56—59	−1
Do. 6% Pref. Ord.	Stock	6	6%*	98—100	−2½
Do. Def. Ord.	Stock	1	—	16½—16¾	−¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	87—89	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—103	
Direct United States Cable Co. Ltd.	20	4½	4½%	12¾—13⅜	−⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	101—103	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	100—102	
Do. do. (Mauritius Sub.)	25	4	4%	99½—101½	
Eastern Ext. Australasia & China	10	7	5%	11⅜—11⅝	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½%*	128—133	−1
Do. 3½% Pref.	Stock	3½	3½%*	82—85	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	−1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅛—⅜	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6%*	116—118	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5 1/16—5 1/16	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100½—102½	−⅜
Western Telegraph Co., Ltd.	10	7	6½*	12½—13	−⅛
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	3/32—5/32	
Do. 6% Cum. Pref.	1	6	3%*	1/32—3/32 xd	
Babcock & Wilcox, Ord.	1	20	16%*	3⅝—4	−1/16
Do. 6% Pref.	1	6	6%	1 1/16—1 1/16	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¾—7	
Do. 6% Cum. Pref.	5	6	—	6½—6⅞	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—½	
Do. 4% Mort. Deb. Red.	Stock	4	4%	48—48	
Do. 6% Prior lien Debs.	100	—	—	96½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	+1/16
Do. 6% Pref.	2	—	—	0—⅛	+1/16
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	65—70	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	49—53	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5⅛—5⅜ xd	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	107½—109½	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅛—1⅝	
Crompton & Co., Ltd.	3	5	5%	1 1/16—1 1/8	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1 3/32—1 1/32	
Do. 6% Cum. Pref.	1	6	6%	1 1/16—1 1/8	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	1/16—1/8	−1/16
Do. do. (fully paid)	5	4/2	2/6*	1⅛—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	—	1—1½	
Do. 4½% 1st Mort. Deb.	Stock	4	4%	61—65	−4
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7½—7¾	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	83—87	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	11½—12½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—107	
I. R. & G. P. Co., Ltd.	10	10	2½%*	16⅝—17⅜	
Do. 4% Deb. Red.	100	4	4%	97—99	
Tel. Const. & Maintenance Co.	12	17½	10%*	30½—32½	
Do. 4% Deb. Bds. Red	100	4	4%	101½—103½	
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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ELECTRICAL ENGINEERING

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BINDING "ELECTRICAL ENGINEERING."—Vol. IV. of "Electrical Engineering" (July December, 1908) closes with this issue. An index for the volume will be ready on Thursday next, Jan. 7th, and copies may be ordered from any newsagent or bookseller at the price of 1d. each; or they will be sent post free from THE KILOWATT PUBLISHING CO., Ltd., 203-206, Temple Chambers Temple Avenue, London, E.C., for 1½d. Binding Cases, including index, will be ready on the same date, price 2s. each, post free 2s 4d. Readers can have their volumes bound by their own bookseller; or they may send their numbers to us, carriage paid (with the reader's name and address), and a remittance of 4s 6d. under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

THE report of the Departmental Committee on "Fair Wages" Clauses in Government Contracts shows that there are no widespread defects in connection with the enforcement of such clauses. The Committee express the opinion that the resolution passed by the House of Commons on this question in 1891 was not intended to set up new standards of wages, and they therefore cannot see their way to alter the wording of existing clauses in Government contracts. The recommendations of the Committee take the form of suggestions for preventing evasion of "fair wages" clauses, and for giving facilities to trades unions to ascertain the names of firms carrying out Government contracts. (Page 830.)

THE Parliamentary session of 1908 is reviewed from the point of view of electrical legislation in a special article. Apart from the London electric power question, which has at last been placed upon a footing satisfactory to all parties, there is little of special moment to refer to, the session in other respects being quite uneventful. (Page 831.)

ELECTRICAL driving has been adopted in the carpet factory of Messrs. H. Mackay & Co., at Durham. Continuous-current 480-volt motors are used, varying up to 20 b.h.p. in size, and power is taken from the County of Durham Electrical Power Distribution Co. The steadiness of speed obtained results in much more satisfactory operation of the large looms, and a great saving of time in tying broken threads and repairs to looms. (Page 832.)

AN article by Mr. A. G. Ellis deals with the relative weights and costs of alternating and continuous-current generators, and particularly the influence, on these quantities, of the rated speed and the rated output. The curves given are based on designs for a large number of machines, many of which were carried out by the author under the direction of Mr. H. M. Hobart. The conclusions are that high speeds are distinctly more suitable for A.C. generators than for C.C. generators, both as regards operation and manufacturing cost. In both cases there is, for each rated output, a

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certain speed at which the weight and cost reach minimum values. (Page 833.)

A FURTHER letter from Mr. Hugo Herzfeld relating to the German electrical industry is given in our correspondence column. Dr. H. Borns writes to explain further his remarks in the discussion of Messrs. Cramp and Hoyle's Paper on the production of nitric acid by electric discharges. (Page 835.)

ONE of the tendencies in the design of heavy electric locomotives for high speeds, as evidenced by recent developments in America, appears to be a return to the use of radial pony and swivelling bogie trucks, with the consequent sacrifice of adhesion weight in order to obtain better riding qualities. The New York, New Haven, and Hartford Railway is remodelling all its locomotives by adding a pony axle in front of the driving wheels of each motor truck, and the new locomotives of the New York Central Railway have swivelling bogie trucks at each end. (Page 836.)

THE following books are reviewed in this issue:—"An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators," by Dr. J. A. Fleming; "Elementary Dynamo Design," by W. B. Hird; "Elementary Manual on Steam and the Steam Engine," by Andrew Jamieson; "The Elementary Theory of Direct-Current Dynamo Electric Machinery," by C. E. Ashford and E. W. E. Kempson; "The Management of Dynamos," by G. W. Lummis-Paterson; "The Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages; Vol. IV."; and "Field Telephones for Army Use," by Lieut. E. J. Stevens. (Page 838.)

A PAPER by Mr. F. H. Corson was read last week before the Institution of Civil Engineers, describing a series of tests undertaken at the Blackburn Corporation Electricity Works which indicated an average consumption of 5·15 lbs. of coal and an evaporation of 33·9 lbs. of water per kw.-hour. (Page 838.)

AN article by a correspondent investigates the cost of heating by electrical means for such metallurgical processes as the electric furnace is suitable, and points out that owing to the much more efficient way the heat is applied, the actual costs of direct heating by fuel and electrical heating are not so different as might be imagined. (Page 839.)

A SPECIAL committee of an American Electric Railway Association has prepared a report on the use of carbon brushes with traction motors. In this report the various types of brushes are classified, and tests are described which were devised for the purpose of determining the relative strength and durability of different brushes and the current-carrying capacity. (Page 840.)

A PAPER on the utilisation of exhaust steam in low-pressure turbines was read by Mr. R. F. Halliwell last week before the Rugby Engineering Society. The author, after dealing with the historical and theoretical aspects of the subject, described various forms of the Rateau and other heat accumulators, and gave details of some important exhaust steam turbine installations. (Page 841.)

THE early experimental wireless telegraph installation at the Eiffel Tower, the temporary plant with which messages were sent to Casa Blanca, and the powerful permanent equipment now under construction are described in an illustrated article. (Page 843.)

UNDER "Electrochemistry and Electrometallurgy" we notice a new process for obtaining a brilliant deposit of zinc, which, if shown in practice to be really satisfactory, should lead to an increase in the adoption of electro-zincing. The electric steel furnace is recommended to refine steels required for rails and ordnance, as steel so refined is much less apt to develop faults. (Page 844.)

A RECENT article in a French contemporary contains an analysis of a number of replies which have been received from users of steam turbo-generators on the Continent, and contains a good deal of interesting information on the subject. (Page 845.)

AMONG the specifications published by the Patent Office on Thursday last is one by the British Thomson-Houston Co., Ltd., relating to a means of removing the slag from the tips of flame carbons. A patent taken out by W. N. Stewart, E. B. Killen, and F. Harris relates to a petrol-electric power-transmission system for vehicles in which the transmission is always electrical. A dyna-motor with rotating field-system is used, the field-system being coupled to the engine. H. Gray has a specification describing a method of stranding cables to avoid the longitudinal movements with variations in temperature, and a specification by the British Thomson-Houston Co., Ltd., relates to the manufacture of filaments of pure zirconium for electric lamps. A method of improving the commutation of repulsion motors at high speeds has also been patented by the British Thomson-Houston Co., Ltd. Designs for two-way tumbler and press-button switches are described in a specification by A. P. Lundberg, and Siemens Brothers' Dynamo Works, Ltd., have one for a method of cooling commutators. Short abstracts of the above are given in our Patent Record. Among the patents expiring during the current week is one by O. B. Shallenberger for an induction meter, and another granted to J. B. Barton for an enclosed arc lamp. This latter, though communicated by W. Jandus, is not the Jandus master patent. (Page 847.)

THE Victorian Railway Commissioners have considered Mr. Merz's report on the proposed electrification of the Melbourne suburban railway system, but while agreeing with the technical details as to system suitable, they do not concur as to the financial estimates, and do not consider that the large capital expenditure would be justified. They recommend, therefore, that the proposed electrification be not taken in hand at present. (Page 848.)

OWING to the increase of the fares upon certain tramway routes in Colchester, the public are refusing to patronise these lines.—The Devonport & District Tramways Co. have notified the Corporation of their intention to cease running their cars over certain leased lines after January 16th.—During the course of the construction of the pump chamber at the new electricity works at Dundee, the foundations gave way, and the whole of the concrete structure sank a depth of about four feet.—A Board of Trade inquiry has been held into an application by the Farnham & District Electric Supply Co. for permission to erect overhead wires.—The dispute between the Stepney Borough Council and the City of London Electric Lighting Co. as to the lighting of the Tower of London, has been put an end to by the Tower authorities deciding to take their supply from the Borough Council.—The promoters of the proposed tube railway under the River Tyne have suggested that the North and South Shields Corporation should contribute half the necessary capital, namely, £100,000.—The Plymouth Gas, Light, & Coke Co. has invited the Corporation to take part in a public competition for the purpose of demonstrating the relative advantages of gas and electricity for public lighting. (Page 848.)

THE Grimsby Corporation require continuous-current motors and starting panels, and the Oldham Corporation feeder cables, pillars, ducts, &c.—A Local Government Board inquiry has been held at Dover (£5,000).—Tenders are invited with regard to the supply of electricity at the Brussels Exhibition in 1910.—A tender has been placed for the construction of the Watford station of the new Euston-Watford electric railway. (Page 850.)

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The year which closes to-day will be distinguished in the annals of electrical engineering chiefly as the year during which the metal filament lamp came into general use. Besides the furthering of manufacturing facilities which has enabled several of the existing patterns to be put on the market in quantities, a good deal has been done in extending the range of usefulness of the lamps, both for higher voltages and smaller candle powers. Not the least important of the developments, however, has been the opening up of the possibilities of great reductions in the cost of country-house lighting by the extended use of the 25-volt high-efficiency lamp. There has been a good deal of discussion as to the effect of the new lamps on the electric supply industry; but while the immediate effect is to decrease the amount of electrical energy sold for a given capital expenditure, and particularly to attract the smaller consumers, the cost of whose services are disproportionate to the revenue they bring, there can be no doubt that the improvement in the efficiency of illumination available is a distinct step forward in the competition with gas, and cannot fail to lead to ultimate benefit to the supply authority. Progress has, of course, been achieved in other branches of electrical engineering, notably in the design of motor starting and control apparatus in which the Manchester Exhibition, in itself an important feature of the year, was particularly rich. In no other direction, however, have such large strides forward been taken than in connection with the metal filament lamp. Notwithstanding the refreshing remarks of optimists, the British electrical industry has had much to struggle with during the past twelve months, but signs have not been wanting that the coming year may see the commencement of the long-wished-for revival. The year will be to some extent memorable also from the point of view of legislation affecting electrical engineering, both by reason of the clause of the new Patent Act which provides for the revocation of foreign patents not worked in this country coming into force, and on account of a definite conclusion having been finally arrived at as regards the power supply of London. Speaking of the heavier branches of electrical engineering, the marked advances have been rather in the realm of lighting than power or traction, for, while there has been steady progress in both of the latter, no new schemes of any great importance have seen their inception. Single-phase traction has been put into practice experimentally on the Midland Railway, but the general problem of electrification of main line railways cannot be regarded, in this country, at any rate, as being nearer to its solution. Wireless telegraphy may be said to have reached a steadier state, and wireless telephony has progressed far towards emerging from the experimental stage. In the New Year, which we hope will be a prosperous one to all our readers, we may anticipate a continuance of the metal filament lamp "boom," and that a fresh impetus will be given to the applications of electric power, especially in collieries.

The "Fair Wages" Clause in public contracts has always been a favourite topic for discussion and argument by the labour leaders, and some of the more ardent spirits, had they been allowed, would have violated all commercial principles by the insertion in such contracts of words so stringent in character as to render the cost of goods purchased on behalf of the public, out of proportion to their real value. As far back as 1891 a resolution was passed in the House of Commons to the effect that provision should be made in all Government contracts for securing the payment of a fair rate of wages for all work carried out in connection with these contracts, and since then words to this effect have been inserted in all contracts entered into by the various Government Departments. Soon after the present Government took office, however, representations were made that by reason of the defective wording of the resolution of 1891, evasion of its terms was a simple matter, and was more or less practised. The result was that the Treasury, in August, 1907, appointed a Committee to investigate the whole question, and to report whether any administrative changes were necessary in order to enable the objects of the resolution to be attained more effectually. The report of this Committee, which is summarised on another page, shows that since the passing of the resolution of 1891, no widespread defects in the working of the "Fair Wages" Clauses in Government contracts have manifested themselves, and that on the whole there has been no appreciable cause for complaint in this direction. The Committee emphatically reject the proposal of the trades unions to insert ambiguous words in the clause to the effect that the trade union rate of wages shall be paid, and that trade union conditions must be observed. These altogether ignore the varying social and other conditions of different districts, in order to gain advantage of which many firms have moved their works from the large towns to less congested parts. If the apparent ideal of the trades unions to have a uniform rate of wage over the whole of the country is to be granted, then one of the inducements for firms to erect their factories in more congenial surroundings is taken away, with a consequent deprivation of the men of the domestic advantages attached to such conditions of labour. It is well, therefore, that the Committee prefer the present wording of the clause, which provides for the payment of the union rate of wage in the particular district in which the goods are manufactured. For the rest, the Committee make certain recommendations to arrive at further uniformity in the wording of the clauses adopted by the various Government Departments, and generally for the payment of the standard rates in special circumstances. Having in mind the pressure which is often brought to bear upon local authorities in this matter, we trust that they, on their part, will resist any attempt to force upon their contractors clauses which are too stringent to be adopted by Government Departments.

According to the *Times*, the Bureau of Manufacturers at Washington has received the following report from Mr. J. N. McCunn, the United States Consul at Glasgow:—

"With regard to the clause in the Patents Act 'to an adequate extent,' I am informed that it would appear to be perfectly in order, in the meantime, to manufacture the parts of a machine in the United States and have them assembled in the United Kingdom. The ground on which this view is taken is that each part of the machine, taken separately, is not a patented article, the patent merely applying to the machine as a whole. No test case has yet been taken in the British Courts, and I am informed that the above is the generally accepted reading of the law until such a test case is brought."

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We cannot say that we agree with Mr. McCunn's argument, nor will we accept his statement that this reading of the revocation clause is generally accepted. It is, in fact, a point on which it is almost impossible to generalise, and each case must obviously be considered on its merits. The Act is very clear that revocation of patents may be applied for on the ground that "the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom," and that before he can refuse to revoke a patent, the Comptroller must be satisfied that "the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom," or must accept satisfactory reasons for this not having been done. The words "to an adequate extent" obviously apply to the number of articles manufactured, and not to the method of manufacture. As an example of the different constructions that might be placed on the clause in question, we may take two cases. Let us suppose that a patent has been taken out for a method of ventilating the rotors of alternators and motors; if the rotor and all the other parts of the machine were sent over ready manufactured from America, and were merely assembled here, we cannot think that it could be claimed that the patented article was manufactured here simply because the patent was for an alternator or motor with such a rotor. On the other hand, it is clear that in the case of a patent process for making filaments of incandescent lamps, nothing would prevent the maker from buying the globes and caps abroad so long as he manufactured the filaments and lamps here, and if the only new patent about the lamp was the method of suspending the filament, he could obviously buy the filament abroad as well. Doubtless, however, there will be some cases during the next few years which will make the law on this matter a little clearer, but in the meantime, we recommend our friends across the Atlantic to think twice before they follow implicitly the advice of their Consul in Glasgow.

"FAIR WAGES" CLAUSES IN GOVERNMENT CONTRACTS

ON February 13th, 1891, the House of Commons passed the following resolution, which has since come to be known as the "fair wages" resolution:—"That in the opinion of this House, it is the duty of the Government in all Government contracts to make provision against the evils recently disclosed before the Sweating Committee, to insert such conditions as may prevent the abuse arising from sub-letting, and to make every effort to secure the payment of such wages as are generally accepted as current in each trade for competent workmen." This resolution aims at (1) the prevention of the evils disclosed before the Sweating Committee; (2) the prevention of abuse arising from sub-letting; and (3) the payment of current rates of wages.

On August 14th, 1907, the First Lord of the Treasury recommended that a Departmental Committee should be appointed to consider the working of this "fair wages" resolution as embodied in Government contracts, and to report whether any administrative changes, especially with a view to the prevention of evasion, the enforcement of the rate current in the district, and greater uniformity of interpretation and working, was desirable in order to enable the objects of the resolution to be more effectually attained. In pursuance of this recommendation the following Committee was appointed:—

Sir G. H. Murray, K.C.B., Secretary to the Treasury, Chairman.

Mr. H. De La Bere, C.B., Assistant Director of Army Finance, War Office.

Mr. A. Wilson Fox, C.B., Comptroller-General, Commercial, Labour and Statistical Department of the Board of Trade.

Mr. A. F. King, Second Secretary, General Post Office.

Mr. F. W. Black, Director of Contracts, Admiralty.

Mr. R. Bailey, M.V.O., Controller of H.M. Stationery Office; and

Mr. J. B. Westcott, M.V.O., H.M. Office of Works.

Mr. J. J. Wills, of the Board of Trade, Secretary.

On the death of Mr. Westcott, Mr. J. H. Hillier, Controller of Supplies, H.M. Office of Works, was appointed a member of the Committee in January, 1908.

This Committee has now reported the result of their deliberations. Evidence was taken from 68 witnesses, of whom 41 represented trade unions and 22 employers' organisations. In addition, evidence was submitted by four ladies on the question of women's work, and by the Clerk to the London County Council on the working of the "Fair Wages" clauses in the Council's contracts. The Committee also received communications from the Employers' Parliamentary Council, the Parliamentary Committee of the Irish Trade Unions Congress, the London Chamber of Commerce, and the Town Clerks of Bradford, Glasgow, Leicester, Liverpool, Sheffield, and West Ham.

The Committee, in their interpretation of the resolution, point out that in their view it was not intended to set up new standards of wages, but to secure that the wages paid for Government work were those ordinarily paid by good employers to competent workmen in each trade in the district where the work was carried out, and to prevent Government contracts from falling into the hands of employers who were able to quote lower prices by undercutting their competitors in the rates of wages paid. It is also pointed out that the resolution does not contain the word "district," but that the phrase "wages current in each trade for competent workmen" is, in practice (and the Committee think rightly) interpreted as wages current in the district in which the work is carried out. This principle, it is pointed out, is already given effect to in various ways in all Government and other public contracts, and the conclusions arrived at by the Committee are summarised as follows:—

(*a*) We recommend that the present wording of the Fair Wages Clause, which obliges the contractor to pay the current rates of wages for competent workmen in the district where the work is carried out, should be retained.

(*b*) While we do not recommend that words intended to enforce the observance of "Trade Union conditions" should be inserted in Government contracts, we think that such conditions of employment as are generally accepted in the district in the trade concerned must be taken into account when considering the question whether a particular contractor is observing the Fair Wages Clauses.

(*c*) We think that where persons are employed at piece rates of wages on work for which a current time rate exists, the general principle that the piece work earnings for a given period should exceed the standard time wages for the same period on similar work should be recognised; and we recommend that contractors should be enjoined to keep proper records of the time worked by their workpeople in all cases of this kind.

(*d*) In the case of trades which can be identified as unorganised, or in any other cases in which the Department concerned considers that difficulties are likely to arise in ascertaining the "current rates of wages," the following recommendations are made:—

(1) That the Government should fix in the contract the rates of wages to be paid to the various classes of workpeople engaged for the various operations involved in the work.

(2) That a minimum time rate of wages should be fixed, below which no person engaged on the work under the contract shall be paid.

(3) That wages in trades such as those in question should be dealt with by Wages Boards.

(4) That the contractor should be required, when tendering, to furnish a schedule of the rates of wages and hours of labour which he proposes to pay and observe in the execution of the contract.

(*e*) We cannot recommend that Government contracts should be restricted to what are known technically as "fair houses," but we think that great care should continue to be taken in selecting firms to be placed on the list of contractors, so as to ensure that only good employers shall be admitted.

(*g*) We recommend that, so far as practicable and at the discretion of the Departments concerned, the names and addresses of all firms obtaining Government contracts should be published in the "Board of Trade Journal" or "Board of Trade Labour Gazette."

(*f*) We recommend that in all works where Government contracts are being executed a copy of all the labour conditions of the contracts should be prominently exhibited for the information of the workpeople.

(*h*) We recommend that there should be uniformity among the Departments in the wording of all clauses dealing with the conditions of labour in contracts affecting the same trades.

(*i*) We think that every effort should be made to ensure all possible co-operation among the different contracting Departments in such matters as inspection, the investigation of complaints, and the interpretation of the Fair Wages Clauses in difficult cases. With a view to furthering this object we suggest that a Committee should be formed of representatives of the different Contracting Departments, who should meet from time to time for the discussion of matters of common interest, and the settlement of disputed questions.

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ELECTRICAL LEGISLATION IN 1908

MEMBERS of the electrical manufacturing industry, looking back upon the Parliamentary session just closed, will be disappointed if they expect to find in the measures that have been passed any promise of direct benefit. The schemes that have been successful will not call for any large supplies of machinery and plant for their fulfilment, and the promoters of a number of hopeful proposals were forced to withdraw them through the insistence of local authorities upon exercising to the full the rights and powers which Parliament conferred upon them in almost prehistoric times. This more especially applies to tramway undertakings, and although we are supposed to regard the present as a progressive age, the absence of the application of this spirit to the general electrical legislation of the country is one of the most striking features of our governmental ideas. The evil effect of such a condition of affairs upon the expansion of the industry has been urged upon successive Governments for the past ten years without effect, and the diminishing number of electrical Bills with succeeding years is undoubtedly traceable in a large degree to the need for modernising the laws under which electrical enterprises are conducted. When this happy day arrives British capitalists will no doubt be more ready to embark upon schemes at home instead of investing their money in colonial and foreign undertakings which at present offer a greater guarantee of security for their investments.

For the fourth successive year the feature of the past Parliamentary session has been the London Electric Power Bills, but the facts are too fresh in our minds to need recapitulation. The rejection of the "bulk" supply scheme, followed by permission to the existing companies to co-operate to any extent they please—the *quid pro quo* being the substitution of the London County Council for the borough councils, as the purchasing authority—has had the effect of restoring to the companies their prestige of five years ago, and their financial outlook is considerably brighter. The companies may now put their domestic affairs into order, and the linking up of the various electrical undertakings, both company and municipal, may be looked to as the first item on the programme. Already movements in this direction have been made, and it is conceivable that the inherent municipal prejudice to company working will be broken down when it is realised that advantages are more likely to accrue from co-operation than opposition. Two other Bills relating to power supply were dealt with, viz., the South Wales Electrical Power Distribution Co.'s Bill and the Dublin and Central Ireland (afterwards changed to the Central Ireland) Electric Power Bill. A somewhat melancholy interest attaches to the former, inasmuch as it provided for the disintegration of the company's undertaking in South Wales and the disposal of the various power houses, either to the respective local authorities or to local companies, a method of reconstruction which fortunately shows every prospect of putting the company upon a sound financial footing. From the sentimental point of view, of course, the position of the company, having, as it does, a field of operations second, probably, only to the Newcastle district, is to be regretted. The proceedings in connection with the Irish electric power scheme typify the wisdom of numbering a member of Parliament amongst one's friends, for by the good offices of Mr. John O'Connor the promoters of the scheme went through the most uncommon experience of having their Bill referred back to the Committee after it had been rejected "on its merits." In the meantime, they had eliminated what were rightly assumed to be the objectionable features, and succeeded in getting it passed at the second attempt, an opportunity for revision which would be much appreciated by many promoters, but which falls to the lot of exceedingly few. On the engineering side this scheme is interesting on account of the intention to utilise peat to generate gas for the engines which will drive the generators, and it remains to be seen whether the hopes entertained of turning the bogland to the south of Dublin into a second Niagara, from the industrial point of view, will be realised.

A certain amount of legislation has been put upon the Statute Book in relation to the London electric railways, but with the exception of the North-East London Railway Bill, which was for an extension of time for the construction of the line and for the raising of capital, it related to financial adjustments on the part of affiliated companies of the Underground Electric Railways Company of London, viz., the District Railway Co. and the Great Northern, Piccadilly, & Brompton Railway Co.

Quite a number of tramway Bills were promoted, but the only contested one which was passed was that of the London United Tramways, Ltd., for constructing a line over King Edward VII. Bridge at Kew. The remainder were either unopposed or had to be withdrawn. Included in the latter were the London and Windsor Tramroads and Tramways Bill, the West London, Barnes, and Richmond Tramways Bill, and the Croydon and Southern District Tramways Bill. The Belfast Tramways Bill which sought to purchase the undertaking of the Cavehill and Whitewell Tramways Co. at a price of £60,000—in order to prevent the company coming to Parliament to secure reciprocal and compulsory running powers over the lines of the Corporation—was rejected on the second reading debate, a very pronounced opposition to the proposal having been displayed by an influential section of the ratepayers. The tramway Bill of the London County Council did not contain very extensive or important powers, for the reason that authority for constructing tramways over the main routes or for converting important existing lines has already been obtained, leaving little else than small linking up lines to be promoted in the future. The London County Council, however, is proceeding with a number of lines for which it possessed powers previously, so that there will be a certain amount doing in the tramway industry for some time to come. The following provincial corporations and companies were granted, in omnibus Bills, additional tramways, but in no case did the proposed capital expenditure reach considerable proportions:—Liverpool, Blackburn, Rochdale, Wolverhampton, Doncaster, Bristol Tramways Co., and the Nottinghamshire & Derbyshire Tramways Co. The Macclesfield & District Tramways Co. was permitted to abandon the powers granted a few years ago for the construction of tramways, the company having meanwhile disposed of its electric lighting order to the Macclesfield Electric Light & Power Co. The Tramway Company will be wound up.

We give below a list of the Bills promoted, together with the Provisional Orders for tramways and lighting granted by the Board of Trade, and subsequently confirmed by Parliament.

PRIVATE BILLS.

Belfast Corporation (not passed).
Blackburn Corporation.
Bristol Tramways.
Central Ireland Electric Power.
Croydon & Southern District Tramways (withdrawn).
Doncaster Corporation.
Great Northern, Piccadilly & Brompton Railway.
Highgate Hill Tramways (withdrawn).
Liverpool Corporation.

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London & District Electricity Supply (not passed).
London & Windsor Motor Roads, Tramroads, and Tramways (withdrawn).
London County Council (Tramways & Improvements).
London Electric Supply.
London Motor Roadways Approach (withdrawn).
London United Tramways.
London (Westminster & Kensington) Electric Supply.
Macclesfield & District Tramways (abandonment).
Metropolitan District Railway.
Metropolitan Electric Tramways.
North-East London Railway.
Nottinghamshire & Derbyshire Tramways [No. 1] (withdrawn).
Nottinghamshire & Derbyshire Tramways (No. 2).
Rochdale Corporation.
South Wales Electrical Power Distribution.
West London, Barnes & Richmond Tramways (withdrawn).
Wishaw Burgh Electricity.
Wolverhampton Corporation.

ELECTRIC LIGHTING PROVISIONAL ORDERS CONFIRMED.

Electric Lighting Provisional Order Confirmation Bills, Nos. 1 *and* 2.—Bispham-with-Norbreck, Caldy Manor, Carmarthen, Fleetwood, Halesowen, Heswall, Lowestoft (Amendment), and Woking (Extension); Barrhead, Clydebank (Amendment), Dundee (Extension), and Rutherglen (Amentment).

Electric Lighting Provisional Order Confirmation Bill, No. 3.—Bridgend (Extension), Hendon (Amendment), Llandaff and Dinas Powis (Amendment), Llansamlet, Oulton Broad, Sowerby Bridge (Amendment), and Tewkesbury.

TRAMWAY PROVISIONAL ORDERS CONFIRMED.

Tramway Provisional Order Confirmation Bill No. 1.—Manchester Corporation.

Tramway Provisional Order Confirmation Bill No. 2.—Potteries Electric Traction Co., Liverpool Corporation.

AN ELECTRICALLY OPERATED CARPET FACTORY

AN example of an old-established manufacturing works which has recently availed itself of the advantages to be obtained by electric driving is to be found in the electrically equipped carpet factory of Messrs. Hugh Mackay & Co., at Durham. Originally started in 1816 under the style of Henderson & Co. to make "Scotch" and "Brussels" carpets and similar goods, with a plant including steam boilers and engines and a complexity of shafting, the firm five years ago changed its name and incidentally its motive power, and a gas engine was installed, which has more recently been superseded by electric driving.

Before describing the electrical equipment of the works, it may be interesting to mention briefly the process of carpet making as practised by this firm. The wool yarn which is to be made into the rug or carpet is received in an oily state, and has first to be thoroughly washed and "scoured." It then proceeds to the dyeing vats, and is afterwards stored in long hanks or skeins in racks. In the same room there are also stored cotton and linen threads for warp threads and binding wefts respectively. The first step in the handling of the yarn is to place it on a winding machine, which forms the yarn into tightly wound "cops" ready for the shuttle of the loom. The warp of the carpet, whether of worsted, cotton, or linen, is first wound by a "reeling off" machine from the skein on to bobbins, which are then run off through a series of combs on to a slowly rotating warping machine, or large cylinder formed of a series of parallel slats. From this the thread is re-wound in a series of parallel coils on the "beam" or yarn carrier, which goes at the back of the loom and holds the various warps of the carpet.

Some of the carpets being produced at the time of our visit were four-ply, necessitating the arrangement of four wefts vertically above one another at one weaving. In pile carpets, the "pile" or height of the carpet is formed by the wool or worsted passing from frames (directly behind the loom) over a series of wires, held up edgeways. These carry a small knife at the end, which, on being drawn out, severs the wool, and causes the ends to stand up to form a "cut pile." In order to trim these evenly the carpet on leaving the loom is passed through a rapidly revolving shear, which crops the carpet to a fine, even thickness.

Electrical power for the driving of all these machines is obtained from the 480-volt direct-current supply of the County of Durham Electrical Power Distribution Co., Ltd., whose Silver Street sub-station is close to the factory. The whole of the installation is carried out on a surface wiring system, insulated leads held in porcelain clips being used. The original Campbell gas engine of 35 h.p., which, with its cooling tanks, &c., took up a space of about 27 ft. by 18 ft., has been replaced by three motor drives operated by a 17 h.p., 20 h.p., and 8 h.p. Holmes motor respectively, furnished with Reyrolle drum starters. The first drive operates the reeling-off machine, shearing machine, several small looms, and some Wilton looms, together with the stamping machines for the cards. The second drive gives power to a number of large looms and the cop winders, &c. The third motor, which is of a specially low speed, operates the warping mill, and some repair shop tools, such as a lathe, drilling machine, grinder, &c. The reason for the slow speed is that owing to the extremely low rate of revolution of the warping mill the shaft driving it has to run as low as 80 r.p.m. The splitting up of the drive into three sections did away with a considerable amount of cross shafting and bevel gear, which seriously reduced the working economy of the factory.

It may be interesting to note one of the main reasons for adopting electrical drive in this factory. Apart altogether from considerations of economy and space, it was found that the variation of speed of the gas engine produced an erratic action of the hammers which drive the shuttles across the loom. Some of these looms are up to four yards wide, and when the speed failed slightly the shuttle would not travel the full length of the weft. If, however, the speed rose excessively it occasionally happened that the shuttle was driven with such violence that the loom was broken. The adoption of electrical drive produced steady and smooth action, involving a great saving of time in tying broken threads and repairs to looms.

Electric Smelting of Iron.—It will be remembered that two years ago some tests on the electric smelting of iron were carried out at Sault Ste. Marie by Dr. Eugene Häänel. According to *Canada*, a large firm of Swedish iron-smelters, who have since been making extensive experiments, with successful results, are about to make a further trial with a larger furnace consuming some 800 h.p., and have invited Dr. Häänel to be present at the trials. It is said that if the process is carried out on a sufficiently large scale, the cost of producing iron in this way would justify its use in Canada, in some of the districts where energy is supplied at cheap rates.

Manufacture of Nitrates by Electricity.—The British Vice-Consul at Zurich reports that a large firm in Switzerland propose to apply some of their available electric power to the manufacture of nitric acid and saltpetre from atmospheric nitrogen. The firm have recently concluded an agreement with the proprietors of a new patent, by which the patent rights in Switzerland and Austria-Hungary become their property. Extensive works are being built at Chippis, in the canton of Valais, for the manufacture of nitric acid and nitrates, and it is hoped to commence working in the course of the year 1909.

Faraday House Journal.—The January issue of the Faraday House Journal, which has just made its appearance, contains a quantity of items of personal news regarding a large number of electrical engineers who are old students of the Electrical Standardising, Testing and Training Institution, and includes excellent portraits of Mr. C. D. Taite, chief engineer of the Lancashire Electric Power Co., and his wife. The technical articles and notes include an illustrated description of one or two of the stands at the recent Manchester Exhibition.

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COMPARATIVE WEIGHTS AND COSTS OF ALTERNATING- AND CONTINUOUS-CURRENT GENERATORS

By A. G. Ellis

THE investigations described in this article have been carried out chiefly with a view to obtaining more precise information as to the relative weights and costs of alternating- and continuous-current generators, and also as to the influence on these quantities of rated output and speed on the design of C.C. and A.C. generators.

The curves in Figs. 1 and 2 relating to C.C. machines apply to designs for rated outputs not exceeding 1,000 kw., whereas the A.C. curves in Figs. 3 and 4 extend

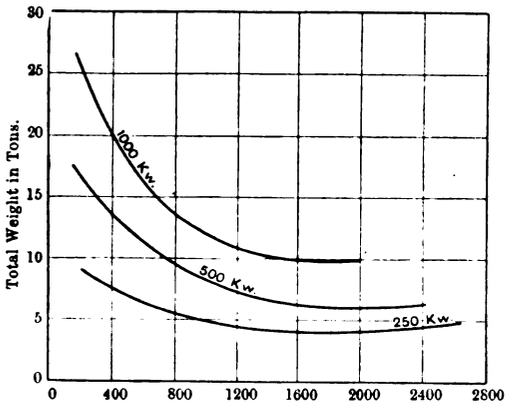

Fig. 1.

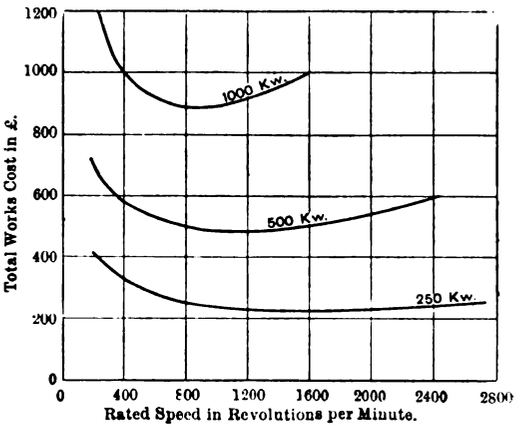

Fig. 2.

Figs. 1 and 2.—Curves for Total Weight and Total Works Cost of Continuous-current Generators.

two of the most important factors in dynamo machine problems, namely, the rated speed and the rated output. The data on which the deductions are based are plotted in Figs. 1 to 4. Figs. 1 and 2 showed respectively the Total Net Weight and the Total Works Cost* for continuous-current generators of 250, 500, and 1,000 kw. rated output, for rated speeds ranging from 200 r.p.m. to 2,800 r.p.m. Similar curves for alternating-current polyphase designs are shown in Figs. 3 and 4 for the same range of rated speeds, but for rated outputs of 375, 750, 1,500, 3,000, and 6,000 k.v.a. These curves are based on designs for a large number of A.C. and C.C. generators, many of which were carried out by the author under Mr. Hobart's direction. Many of these designs were made for the express purpose of arriving at more definite conclusions regarding the effect of the rated output and speed on the design of C.C. and A.C. generators.

* The expression "Total Works Cost," as employed in this article, designates the total manufacturing cost of the machine, as delivered to the stores, *i.e.*, including the material and labour costs of the machine, and the establishment charges. The expression "Total Weight" designates the total net weight of the machine as completed, including the shaft and outboard bearing.

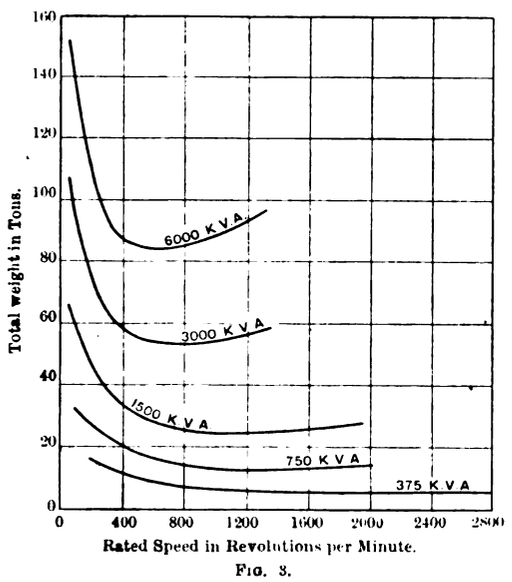

Fig. 3.

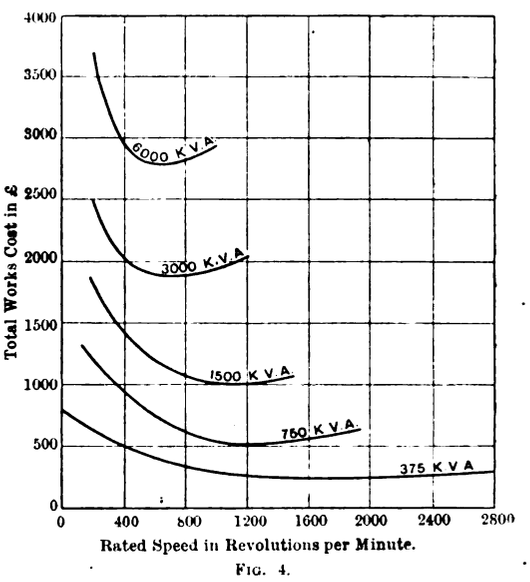

Fig. 4.

Figs. 3 and 4.—Curves for Total Weight and Total Works Cost of Alternating-current Polyphase Generators.

Continuous-current generators, however, are impracticable propositions at high speeds for rated outputs above 1,500 kw., and even for this rating continuous-current designs for pressures of less than 1,000 volts are relatively very unsatisfactory. Continuous-current generators for outputs greater than 1,500 kw. are, however, quite practicable for low and medium speeds when the terminal pressure is high, say 1,000 to 2,000 volts.

In comparing the designs for the purposes of the present investigation, two factors, namely, the rated voltage in the case of both C.C. and A.C. machines, and the frequency in the case of A.C. machines, have not

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been taken into account. These factors may, and usually do, affect the design problem and the weight and cost to a considerable extent. Nevertheless, in the interests of simplicity, and so as not to complicate the present investigation by introducing too many variables, the author has taken the step of employing average representative values for each class of machine. The curves may be taken as roughly representative of the more customary ranges of voltages and periodicities.

In the case of alternators, nearly all designs—at any rate, for other than the smallest rated outputs—are for moderately high voltages. The voltage chiefly affects the design in that the greater the voltage, the greater is the amount of the armature periphery which must be devoted to slot insulation. Consequently a high-voltage machine has to be slightly larger than a low-voltage machine. Continuous-current designs, on the other hand, are rarely built for voltages greater than 1,000, and the space occupied by the slot insulation is a much less influential factor. For designs up

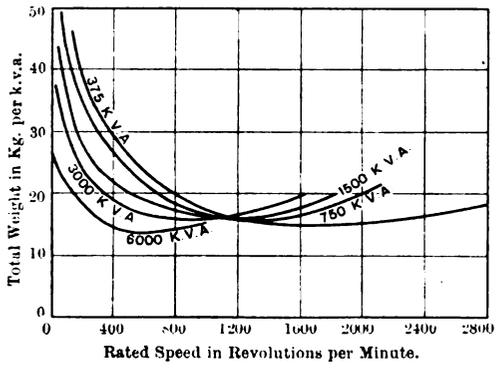

FIG. 5.—ALTERNATING-CURRENT GENERATORS.

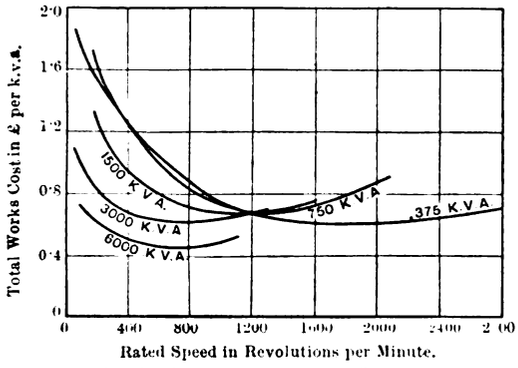

FIG. 6.—ALTERNATING-CURRENT GENERATORS.

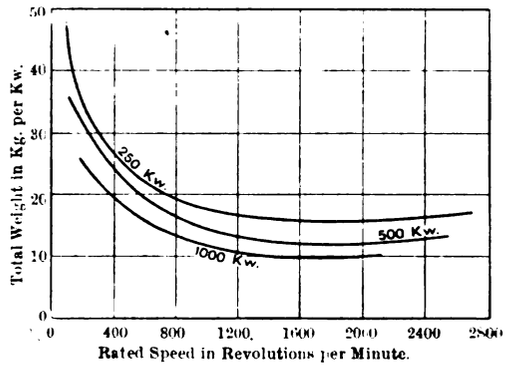

FIG. 7.—CONTINUOUS-CURRENT GENERATORS.

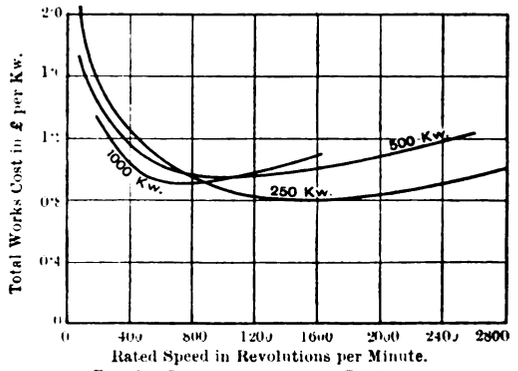

FIG. 8.—CONTINUOUS-CURRENT GENERATORS.

FIGS. 5–8.—CURVES FOR WEIGHT PER KW. AND COST PER KW. FOR CONTINUOUS-CURRENT AND ALTERNATING-CURRENT GENERATORS

to 1,000 volts, the chief difference between low and high voltage continuous-current machines relates to the commutator, which is larger and more expensive the lower the voltage, on account of the heavier currents which have to be collected. Although the actual commutator cost is a very appreciable item in the total works cost, nevertheless the difference in the commutator cost introduced by changing from, say, 250 to 500 volts is not so large a proportion of the total works cost as to prevent employing curves of rough values as representative of the customary range of pressures. Hence we may say that the curves in Figs. 1 and 2 are fairly representative for continuous-current machines of normal voltages. But we must bear these reservations in mind when using the curves for other than the customary range of pressures. In all the curves accompanying this article, *quantitative* values of the weight and cost are employed. It is not, however, to be understood that these values can have any wide application, since special conditions relating to the market price of labour and material, the intensity of competition and of "dumping," the manufacturing facilities of the firm building the machines, the skill of the designers, and the precise terms of the specifications to which the machines must comply, greatly affect these values. While it is the *relative* values which it is the purpose of this article to contrast, it has, nevertheless, appeared desirable to fix ideas by plotting the results to rough *quantitative* values, and the author has endeavoured to make these values reasonably representative.

The frequency, which only enters directly into alternating-current designs, is a more important factor. While the difference in weight and cost of, say, a 25- and 50-cycle design for a given rated output and speed, is quite appreciable, it has nevertheless been desirable in the present investigation to simplify the investigation by regarding the curves in Figs. 3 and 4 as applying to alternators of normal frequencies, say between 25 and 50 cycles. For a given rated speed the number of poles for a 50-cycle alternator is twice the number required for a 25-cycle alternator. Consequently, for a 50-cycle machine a larger armature diameter and a smaller armature gross core length than those for a 25-cycle machine of the same output are usually appropriate. The total weight of a 25-cycle machine is usually rather higher than that of a 50-cycle machine owing to the smaller number of poles and larger pole-pitch. Also where the speed is so high that four poles are required for the 50-cycle design and two poles for the 25-cycle design, the two-pole design is usually considerably heavier. In cases where the number of poles is small owing to the speed being high, the influence of the number of poles on the design is more marked than where the number of poles is great.*

Although the influence of these factors is considerable and presents an interesting study, nevertheless, in order to prevent these investigations from becoming too confusedly involved, the author has limited these comparisons chiefly to the two principal factors of rated output and rated speed. By this means several broad conclusions have been arrived at which would have remained obscure had it been attempted to take into consideration a large number of variables. We may,

* See *Electrical Engineering*, Vol. I., pp. 755, 831, 919, May 2nd, 1907, "The Design of Alternators as Influenced by the Rated Speed," H. M. Hobart and A. G. Ellis.

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therefore, take the present investigation as applying to A.C. and C.C. generators of average pressures and frequencies, and designed to fulfil representative specifications.

It will be seen from the curves in Figs. 1 to 4 that there is a comparatively large range of speed for each rated output, for which the total works cost has practically a uniform value for A.C. as also for C.C. generators. There is, in fact, a certain rated speed for each rated output, for which the cost has a minimum value. Not only for lower, but also for higher speeds, the cost increases. At low and medium speeds, the weight and cost show a continued decrease with increasing speeds. This is, however, less marked the higher the speed, and is by no means in proportion to the speed.

The speeds shown by the curves in Figs. 1 and 2 to be the most economical as far as relates to manufacturing cost, are not the most favourable with regard to performance, their inferiority relating chiefly to commutation. Lower speeds than these, are distinctly to be preferred for continuous-current machines. A similar condition of affairs for A.C. generators is revealed by the curves in Figs. 3 and 4. There is, for each rated output, a certain speed at which the weight and cost reach minimum values. These most economical speeds are, as will appear later, higher for A.C. generators than for C.C. generators of the same rated output. High speeds are distinctly more suitable for A.C. generators than for C.C. generators, from the standpoint of manufacturing cost, and this is also most decidedly the case from the operating standpoint.

These points of minimum weight and cost will be observed for each rated output in the sets of curves in Figs. 1 and 2, as also in those of Figs. 3 and 4. It will also be noted that the most economical speed is greater the smaller the rated output. Here again, as in C.C. machines, there is a considerable range of speeds over which the weight and cost do not vary to any considerable extent. Even at the lowest speeds, where the effect of the speed is most marked, the variation of weight and cost is by no means in proportion to the change in speed. Thus, for example, a 1,500 k.v.a. A.C. generator at a rated speed of 200 r.p.m. weighs some 45 tons; at 400 r.p.m., which is double this speed, the weight is only reduced to some 33 tons; and a further increase of 100 per cent., viz., to 800 r.p.m., only reduces the weight to some 26 tons. The total weight reaches a minimum of 24 tons at 1,000 r.p.m. and increases again with increasing speed until at 1,600 r.p.m. the weight is again 26 tons, which is actually the same as at half this speed, viz., 800 r.p.m. Similar observations may be made for the other rated outputs, and also in regard to the Total Works Cost. For a given rated output in k.v.a. the Total Weight and the Total Works Cost per k.v.a. both decrease as the speed increases until the most economical speed is reached, above which both these quantities increase again. This is shown by the curves in Figs. 5 and 6, where are plotted the weight and cost per k.v.a. for A.C. generators. These curves are derived from the curves in Figs. 3 and 4. For low and medium speeds the weight and cost per k.v.a. rated output are lower the higher the rated output. It will be seen that the 6,000 k.v.a. curve is the lowest of the group, and that the 375 k.v.a. curve is the highest for speeds up to about 1,000 r.p.m. At high speeds, say above 1,000 r.p.m., the weight and cost per k.v.a. are higher the greater the rated output. Hence higher rated speeds are more suitable for machines of small rated output than for machines of large rated output. In other words, the larger the rated output the lower is the most economical speed.

It will be noted further that the weight and cost per k.v.a. at the most economical speed for a machine of 6,000 k.v.a. rated output, are smaller than for a machine of 3,000 k.v.a. rated output. For rated outputs below 3,000 k.v.a. the weight and cost per k.v.a., at the appropriate most economical rated speeds, are of about the same value. Thus the minimum weight per k.v.a. is about 13 kg., and the cost per k.v.a. some £0·45 (9s.) for a machine of 6,000 k.v.a. rated output as against some 15 kg. and £0·6 (12s.) per k.v.a. for a machine of 3,000 k.v.a. rated output and for ratings below 3,000 k.v.a. In Figs. 7 and 8 are given similar curves for continuous-current machines. The weight and cost per kw. are in this case derived from the curves in Figs. 1 and 2. These curves are of the same nature as those given in Figs. 5 and 6 for alternating-current generators. The weight and cost are, at *low* speeds, influenced to a fairly large extent by the rated speed, but when the region of high speeds is reached, the weight and cost are almost independent of the speed. In fact, the cost per kw. commences to increase again after a certain speed has been reached, as in the curves for A.C. generators. A point of considerable interest is that while the cost per kw. reaches a minimum, and commences to increase considerably again in this manner, the weight per kw. does not appreciably increase, but remains at a practically constant value.

CORRESPONDENCE

A COMPARISON OF THE BRITISH AND GERMAN ELECTRICAL INDUSTRIES.

To the Editor of Electrical Engineering.

Translation.

Sir,—Owing to the usual rush at Christmas time, I can only now write to thank you for your kind attention in sending me a copy of Electrical Engineering of the 17th inst., and also to acknowledge the excellent translation which you made of my last letter. There is much to say on the matter, but unfortunately the time cannot be spared for thoroughly testing the statistical material. That this latter is open to attack is evident from an article by Kurt Perlewitz in No. 51 of the *Elektrotechnische Zeitschrift*. The most important point to me, namely, the superiority which I claim for the German electrical industry, is incapable of mathematical proof; personal experience must give the result. But it is a fact that single-phase motors with high starting torque, metal filament lamps, electric driving of winding engines and rolling mills, high-speed motors for centrifugal pumps and flame-proof motors, and apparatus for mines (to name only a few of the most recent examples) have been practically developed earlier in Germany than they have in England. Wishing you a happy New Year, I remain,

Yours very faithfully,

Hugo Herzfeld (*Dipl. Ing.*).

11, Lützowufer, Berlin.
December 25th, 1908.

PRODUCTION OF NITRIC ACID BY ELECTRIC DISCHARGES.

To the Editor of Electrical Engineering.

Sir,—Allow me to point out that some of my remarks on Messrs. Cramp and Hoyle's Paper (see p. 813 of last week's issue) have been misunderstood. According to Rasch and Clement, no ozone (not resonance) is produced when the arc discharge takes place between electrodes of metallic oxides. Such electrodes, mostly Nernst glowers, are used by Haber and Koenig, who, in opposition to Nernst and most other investigators, recommend relatively cold arcs, believing with Warburg that both the thermal and the electric equilibrium have to be considered. I should like to add that my complaint about mixing up British and metric measures was not seriously meant, and that my remarks as to omissions were not made in any critical spirit. It is a pity that the authors cannot continue this promising research, and I said so.

H. Borns.

Chiswick, December 24th, 1908.

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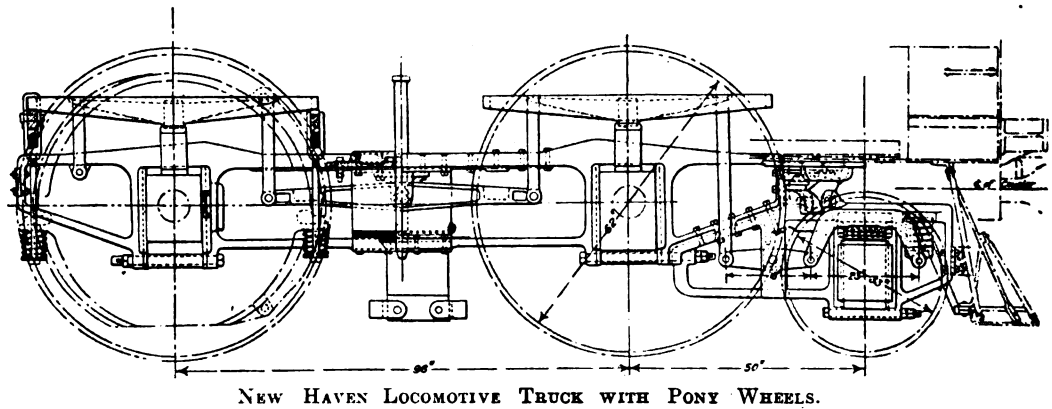
RECENT TENDENCIES IN ELECTRIC LOCOMOTIVE DESIGN

THE mechanical design of high-speed electric locomotives offers a problem of considerable interest and importance to the engineers of the present day, and in view of the rapid development of electric traction in America the following notes on the design of trucks for high-speed locomotives, abstracted from the *Electric Railway Journal* of New York, are of interest.

The first electric locomotives built for high-speed heavy electric traction in the United States were those of the New York Central. These locomotives had a long, rigid wheel base with four driving axles and a radial pony truck at each end. The motor armatures were built up on the driving axles, while the motor fields were supported on the frame. The driving wheels were only 44 in. in diameter, and were not connected with side rods or by any other means. Following this type came that of the New York, New Haven, and Hartford Railway with two separate four-wheel trucks carrying a motor on each axle. This type was fully described in ELECTRICAL ENGINEERING, Vol. II., page 408. An attempt was made to relieve the axles of the dead weight of the motor armatures by carrying the armatures on pins set into spring pockets in the driving wheel centres. These locomotives had no guiding wheels of any kind, the entire weight being available for adhesion. The driving wheels were 62 in. in diameter. The half-unit experimental single-phase locomotive built last year for the Pennsylvania Railroad, and which was tested at very high speeds, is the exact counterpart of the eight-wheel type of steam locomotive, long the standard for passenger service in the United States. It has two driving axles with wheels 72 in. in diameter, mounted in the main frame, and a swivelling four-wheel bogey truck in front. The method of supporting the motor armatures on "quills" mounted in spring pockets in the driving wheel centres is the same as that employed in the New Haven locomotives. The bogey truck carries 45,000 lb., which is nearly one-third of the total weight.



NEW HAVEN LOCOMOTIVE TRUCK WITH PONY WHEELS.

Since these three types of locomotives were built they have been thoroughly tested, and some modifications have been suggested. The New Haven is re-modelling all of its locomotives by the addition of a single pony axle placed in front of the driving wheels of each motor truck, as shown in the accompanying figure. The addition of these pony wheels, which are equalised with the main driving wheels, reduces the adhesion weight somewhat, but has resulted in a marked improvement in the riding qualities of the locomotives. The wheel arrangement of the locomotives is now represented by the following diagram: o O O—O O o. No important structural changes were required in the re-modelled locomotive cab or trucks in adding these pony wheels. The pony truck wheels are 33 in. in diameter, and are carried in a supplementary or extension frame bolted to the main truck frame. The outer ends of the supplementary frames are cross-connected by a heavy steel brace to keep them square. The supplementary pony truck frame being rigidly attached to the main truck frame, it was necessary to provide for some radial movement of the pony truck wheels. This is done by interposing a bevelled brass wedge over the journal box of the pony truck. The wheels, axle, and journal boxes of the pony truck are free to move laterally between the pedestal jaws of the supplementary frames, but in so doing they are met by the resistance of the bevelled bearing plate on top of the journal box. When the pony truck wheels move sidewise they lift through the bevelled bearing wedge all of the weight carried by the equaliser bars; this tends always to restore the pony truck wheels to their normal central position. The equalising system of the pony truck is connected to the equalising system which was formerly used on the motor trucks, but some modifications have been made in the original parts. In the illustration, immediately behind the third-rail shoe fuse-box, can be seen an equaliser bar hung from levers extending over the journal boxes of the main driving wheels. It will be noted that coil spring seats are formed on this equaliser bar. In the original construction, coiled springs were interposed between the top bar of the truck side frame and this equaliser bar on each side of the fuse-box. These springs have been removed and the journal box equaliser bar on the forward motor axle has been extended out, and to its outer end has been attached a hanger, which can be seen in the centre of the circular opening in the step riser A pivoted lever connects this hanger with the pony truck journal box equalising lever, which in turn is confined at its outer end by a small coil spring bearing against the top bar of the pony truck frame. In this manner all the wheels on one side are equalised. The brake gear of the motor trucks has not been modified in any way, as the pony truck wheels are not braked.

The twelve new locomotives now being delivered to the New York Central have swivelling bogey trucks at each end instead of a radial pony truck, and the side-thrust springs on the driving axle boxes have again been applied after being discarded on the experimental locomotive first built four years ago. Provision has been made for braking the main truck by hand in emergencies, and the bogey wheels are fitted with air brakes. The contact shoes have been removed from the main frame to the bogey trucks, where they can follow curves with greater ease. In the electrical equipment of the new locomotives, contactors are used for reversing instead of a reversing switch, as this brings about a slight reduction in the number of parts to be maintained. The General Electric Company has built a high-speed experimental locomotive which has two separate articulated trucks, each consisting of a pair of pony wheels at each end, with two driving axles in the centre. The driving wheels are connected with side rods. These recent developments in the mechanical design of electric locomotives indicate a tendency toward the sacrifice of adhesion weight for better riding qualities. One of the arguments advanced in favour of electric locomotives over steam locomotives some years ago was that the entire weight of the locomotive could be used for adhesion. In the light of the tendency toward the use of guiding wheels this argument no longer has weight. Theoretically, an electric locomotive having no unbalanced moving parts and exerting a fairly uniform tractive effort throughout each revolution of the wheels ought to be easier on the track than a steam locomotive, which actually lifts its wheels off the track when running at high speed, due to the unbalanced forces of the rapidly moving connecting and side rods. It has heretofore been assumed that "nosing" of a steam locomotive was due largely to the imperfect balancing, but this same action develops in the case of electric locomotives. A guiding truck of some kind seems to be necessary, but it is still a matter of doubt as to whether it is necessary to sacrifice such a large proportion of the total weight to load this truck sufficiently to hold it firmly to the track. The Pennsylvania locomotive carries nearly one-third of the weight on the bogey truck, while in the new locomotives of the New York Central the weight of the locomotive has been increased 20 tons, all of which is carried by the two bogey trucks, the adhesion weight remaining the same. This reduces the maximum hauling capacity of these locomotives by the amount of this extra weight, which means practically one car.

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REVIEWS OF BOOKS

An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators. By Dr. J. A. Fleming, F.R.S. 340 pp. 9 ins. by 5¾ ins. Numerous illustrations. (London Longmans, Green & Co.) 7s. 6d.

In his preface the author explains that the book has been written for the benefit of students and practical operators, and for general readers, to whom the author's larger work might seem too advanced. The present is a much more modest work than the well-known large book, but besides being in character introductory to the older work, it is also to some extent supplementary, and will serve to bring its forerunner more nearly up to date.

The first chapter starts at once on the elementary theory of electrical oscillations, and describes broadly the conceptions and experimental facts of high-frequency resistance and high-frequency inductance of wires and circuits. Here are gathered the principal formulæ of utility in calculating the electrical constants of oscillatory circuits of known dimensions; and, besides, the rudimentary theory of resonance, tuning, and coupling is considered. The next two chapters are taken up with descriptions of apparatus and machinery for producing "damped" and "undamped" oscillations. We were surprised to find Prof. Fleming—usually so precise a writer—using the word "undamped," which if it has a meaning at all, is an erroneous one. Both chapters are wholesomely practical, and the second one of the two, which deals with the arc, is well up to date. Chapter IV. deals with the theory of electromagnetic waves. Unfortunately, however, the theory is not always quite sound; for example, we are told that "the expression *curl* signifies the line integral round a unit of area." Chapter V. treats of radiating and receiving aerials, and emphasises the importance of conductive connection with the earth; and Chapter VI. passes to the consideration of oscillation detectors. Here the physics of various detectors is briefly and clearly discussed, but no quantitative comparison of their capabilities as receivers of wireless messages is given, though, of course, the practical performance of a detector is pre-eminently the thing about it worth knowing. In fact, the author lumps together all sorts of detectors without giving any proper notion of their comparative sensitiveness in signalling; and actually devotes several pages to minute descriptions of old detectors that have never detected. On the other hand, the author gives no hint of how to set up for work any of the important modern detectors, such as the crystal rectifiers.

In Chapter VII. we come to the description of commercial radiotelegraphic systems and stations. Chapter VIII. returns to the laboratory, and gives methods of measuring capacity and inductance, wave-length and damping-factor. Much of the matter is from the author's larger treatise; and we note that in repeating the diagram of the Anderson bridge the opportunity has been taken of correcting a misprint.

The last chapter, on radiotelephony, is a very fair and compact statement of the recent progress of that art. We notice, however, one error of some importance. The illustration on page 327, which is offered as a picture of the receiving apparatus in Poulsen's method of wireless telephony is, as the looseness of the coupling shows, an ordinary telegraphic receiving set. In connection with this particular apparatus we might mention that the statement in the text that Poulsen used a crystal rectifier is also misleading.

Looked at broadly, the book is a sound and comprehensive presentation of the laboratory side of wireless telegraphy, and is one to be warmly commended to the strictly technical man. Its appeal to the "general reader" mentioned in the preface is but slight; for the author does not appear to feel in any degree whatever, the glamour his subject possesses for the layman. As for the wide circle of scientific followers of wireless telegraphy, we think they will be disappointed by the complete absence of disinterested suggestion for improvements, and of forecasts as to the direction of future progress.

Elementary Dynamo Design. By W. Benison Hird. 276 pp. 8½ in. by 5¼ in. 128 illustrations. (London: Cassell and Co.) 7s. 6d.

Some of the works of Aristotle are reputed to be notes of his lectures edited by grateful disciples for the benefit of posterity, but the fashion is now changed, and it is the lecturer who himself publishes his notes in book form for the benefit of his pupils. So long as this fashion continues, there will be no dearth of such books as the present. Yet "Elementary Dynamo Design" is a favourable specimen of its class; it is written in a simple and lucid style, with practical knowledge, and it does not err from over-ambition; no attempt is made to go into any of the minutiæ of design, which would appeal only to the scientific or to the proficient designer, and a good sense of the relative proportion between the various parts of the subject is preserved. After a preliminary chapter on general matters, different types of armature and field-magnet windings are considered. The subject of continuous-current dynamos is then taken up in detail, and followed by that of continuous-current motors. A dynamo to give 500 volts, 200 amperes at a speed of 420 r.p.m. is designed throughout, as also a motor to give 10 h.p. at 600 r.p.m. Other specialities, such as variable-speed motors, crane and traction motors, commutating poles, compensating winding, and Sayers' commutator connections are shortly described. Alternate-current machinery is then treated in a similar manner, a general chapter being followed by the complete designs of a three-phase generator to give 300 kilowatts at 2,000 volts, with a frequency of 25 and a speed of 375 r.p.m., and of a three-phase motor for 100 h.p. 500 volts, and 500 r.p.m. The synchronous motor and single-phase motor are briefly described in the final chapter.

Though the book is, so far as it goes, unimpeachable, yet it may be questioned whether there is sufficient justification for its appearance in a field which is already well-covered. The author of a new technical book should either have something original to say, or must bring to an old and well-worn subject some new point of view, method of treatment, or quality of lucidity which is not to be found in his predecessors. In the present book it would be hard to find anything which has not been said before and said in much the same way.

Elementary Manual on Steam and the Steam Engine. By Andrew Jamieson. 12th edition. 355 pp. 7½ in. by 5 in. (London: Charles Griffin & Co.) 3s. 6d.

This, the twelfth edition of Prof. Jamieson's well-known elementary text-book on the steam engine, differs but little from the previous edition, with the exception of minor corrections and the addition of recent examples of examination papers. At the time of the eleventh edition, two years ago, the work was thoroughly brought up to date, and many drawings and descriptions relating to thoroughly modern practice, especially with regard to steam turbines, were added. The principal object of the work is, as is well known, to provide an elementary manual for the use of students preparing for certain examinations, and generally to form an introduction to the study of steam engineering as covered in greater detail by the author's

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larger works, and its success in achieving this purpose is evident from the editions which have been called for. The subject is divided into 19 chapters in the form of lectures, to each of which is appended a series of questions, and, of course, the relative amounts of space given to the theoretical and the practical, and likewise the degree of absence of mathematic knowledge assumed on the part of the reader, are governed by the requirements of the examinations in connection with which the book is intended to be used.

The Elementary Theory of Direct-Current Dynamo Electric Machinery. By C. E. Ashford and E. W. E. Kempson. 120 pp. 7½ in. by 5 in. 73 illustrations. (London: Cambridge University Press.) 3s.

The authors of this little book have not followed the course taken by so many writers of so-called elementary works on the dynamo of trying to give to the student a single small work which shall make him not only a fully-fledged dynamo designer, but also a living catalogue of semi-obsolete commercial machines, but have endeavoured to provide just such a clear presentation of the principles upon which the subject is based, a due study of which may enable the student to understand any piece of electrical machinery which he comes across, not because he has ever seen or heard of it before, but because he can recognise it as a particular case of a general class the fundamental principles of which he has mastered. The course of reasoning is logical and clear, and is entirely free from that looseness of expression degenerating into inaccuracy which disfigures so many text-books. One of the few criticisms to make is that the idea of self-induction might have been introduced to the reader a little earlier in the book. The set of examples at the end is admirably chosen, and a well-arranged index is provided.

The Management of Dynamos. By G. W. Lummis-Paterson. Fourth edition. 285 pp. 7½ in. by 4¾ in. 117 illustrations. (London: Crosby, Lockwood & Son.) 4s. 6d.

This is the fourth edition of this book, which was first published in 1895, and, as the author states in his preface, the construction of electrical machinery has undergone radical changes during the thirteen years that have elapsed since then. The task of revising the work was therefore no easy one, and the result shows that the author would have been better advised had he written an entirely new work. The first three chapters, dealing as they do with merely the elements of electricity and magnetism, are not out of date, but the same cannot be said for other portions of the book.

The Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages. By Alfred Schlomann. Vol. IV.: Internal Combustion Engines. 618 pp. 7 in. by 4½ in. (London: Archibald Constable & Co.) 8s.

The present volume of this series of technical dictionaries is arranged in the same convenient manner as the previous volumes which we have had occasion to review from time to time, that is to say, the ideas are arranged according to subject matter with the German, English, and French expressions on one side of the page, and the Russian, Italian, and Spanish on the other, while suitable illustrations are given in the central space. The latter part of the book consists of alphabetical indices with the Russian words separately, owing to the difference in alphabet. The internal-combustion engine is dealt with in the same elaborate detail that characterised the treatment of the steam engine in the previous volume, and, as is natural for a publication originating in Germany, the illustrations relate principally to the large slow-speed pattern of gas engine. There is, however, a good deal in the volume the connection with which to the internal-combustion engine is but remote, and, as in the former volumes, a good many obvious phrases made up of non-technical words, which no one would look for in a technical dictionary, are included. It is better, however, in a work of this class to err on the side of over-completeness than incompleteness.

Field Telephones for Army Use. By Lieut. E. J. Stevens. 110 pp. 7¼ ins. by 4¾ ins.; 67 illustrations. (London: Crosby, Lockwood & Son.) 2s.

At the risk of being called "old-fashioned," we maintain that correct grammar and accuracy of expression are essential in an elementary book dealing with a technical subject. Lieut. Stevens' book falls lamentably short in this respect. We accept his opinion that officers and non-commissioned officers will welcome a work explaining the principles of field telephony, and we trust that the demand for the present production will be so great that the faults in style, grammar, and arrangement may shortly be remedied in a second edition.

HEAT LOSSES IN ELECTRIC POWER STATIONS

At a meeting of the Institution of Civil Engineers on Tuesday, December 22nd, a Paper by Mr. F. H. Corson, entitled "An Investigation of the Heat Losses in an Electric Power Station," was read. The following is an abstract of the Paper:—

An inquiry, originating from Blackburn, in 1903, showed that the average coal consumption of thirty-four principal generating stations of the United Kingdom was about 7·7 lb. per unit generated. The figures ranged from 3·6 lb. to 15 lb., Blackburn standing at 10 lb. Rough tests on the various sections of the plant resulted in considerable rearrangement. The steam-pipe system was overhauled and more effectively drained, and steam separators and driers were in consequence dispensed with. Engine stop valves were, where possible, attached directly to the main steam-pipes. The steam-ring was discarded, and generally the effective heat-radiating surface was greatly diminished. Better fitting boiler dampers were provided, the condition of the brickwork was improved, and the whole process of combustion was more thoroughly controlled by the institution of flue-gas analysis. These and similar alterations occupied about three years, and the fuel-consumption fell during that time to about 6 lb. of the same coal per average unit generated, a reduction of 40 per cent. Further progress being imperative, it was decided to conduct tests covering the whole operation of the works, viewing the losses peculiar to each part of the plant in their relationship to each other and to the whole; and arrangements were made, and apparatus devised, for their prosecution. After isolated trials of the various types of apparatus had proved their reliability, simultaneous tests were arranged of a duration long enough to embrace all conditions of operation met with in routine work.

The Blackburn undertaking comprises two adjoining stations of 2,300 kilowatts capacity each, containing twelve mechanically-fired Lancashire boilers, six fitted with superheaters; fifteen high-speed engines driving generators from 60 kilowatts to 775 kilowatts in size, controlled from three switchboards; steam piping 3 in. to 14 in. in diameter; ejector and jet-condensers fed from an overhead water-tank above the boiler-house; low-speed steam-driven feed-pumps; four batteries of economisers totalling 1,504 tubes; two chimneys, 150 and 250 ft. high respectively. The test has covered during 168 consecutive hours the combustion of about 230 tons of coal, the evaporation of 3·376 million pounds of water, and the generation of 99,295 electrical units. The net results show a consumption of 5·15 lb. of coal, and a total evaporation of 33·9 lb. of water per average unit.

Observations have been taken half-hourly of the rate of evaporation, and of the temperature of the feed-water at the feed-tank, and the economiser inlets and outlets; of the chemical composition and temperature of the gases in boiler and economiser flues; of the temperature and pressure of steam supplied to and discharged from the engines; of the temperature and quantity of the injection and discharge water of the condensers; and of the electrical units generated. Some of these data have also been obtained by using recording apparatus. The performance is shown on a time basis in curves, and in total in eight balance-sheets relating to the operation of the whole plant and of its constituent parts. So far as possible, the results have also been entered on the form prescribed by the Institution Committee on Steam Engine and Boiler Trials.

New R.E. Wireless Telegraph Station.—A contemporary states that a station is being erected at the Claypit Lane Barracks, Leeds, in connection with the Northern Command Telegraph Companies (Royal Engineers). A wireless telegraph company has been formed under Captain F. E. Johnson, and it includes over sixty non-commissioned officers and men, including amongst their respective callings telegraph operators, electricians, engine drivers, and fitters. Sergeant J. Brown, of the Aldershot School of Wireless Telegraphy, has been attached as instructor. With the apparatus installed it will be possible to communicate with coastguard stations, war vessels in the North Sea, and, it is hoped, Aldershot—a distance, roughly, of about one hundred and sixty miles. The company will also be supplied with a portable station for field work.

"Wireless" Weather Reports.—The Meteorological Office has made arrangements with the shipping companies owning ships on the Atlantic routes, whereby the former will receive weather reports by wireless telegraphy. In order that the position of the ship from which the report is sent may be readily identified, the Atlantic Ocean is divided into imaginary numbered areas, and the number of the area from which the report is sent is included in the message. The Meteorological Office will thus be provided with much more complete information regarding the weather conditions to the westward than hitherto.

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THE COST OF ELECTRIC HEAT

(By a Correspondent)

THE processes to which electrically generated heat can be applied in this country are limited to those in which its superiority in temperature control and effectiveness of application render it either unique in some particular or more efficient as regards cost than heat obtained directly from fuel, whether solid, liquid, or gaseous. In localities, however, where large quantities of cheaply developed water-power or other sources of cheap power are available, the conditions are now such that the commercial utilisation of electric heat may afford the only means of development of the natural resources of those localities. Very little consideration serves to show, moreover, that the number of uses to which it can be put, even in this country, where fuel is so cheap, are not fully realised.

Theoretically the electrical h.p.-hour is equivalent to about 2,545 British Thermal Units, and, if the assumption be made that the load-factor necessary for the best conditions for power generation can be attained, one may expect, on a reasonably large scale, to obtain this quantity of heat for a consumption of 1 lb. of high-class coal, the calorific value of which may be taken as 15,000 B.Th.U., with an efficiency of conversion therefore of 2,545/15,000, or, in round figures, 17 per cent. Remarkable and difficult, though not impossible of attainment, as this efficiency is, the conclusion leaps to the eyes that, when the capital costs involved are considered, it is only in cases where the losses of heat in the direct furnace are extremely high, or where exceptional conditions of temperature or of control are necessary to the process using the heat, that fuel-generated electrical heat can be considered a commercial proposition. That such conditions exist, however, is proved by the increasing use of the Kjellin, Héroult, Stassano, and other electric furnaces for a variety of purposes, and it cannot be questioned that as investigators widen their field of experiment further uses will be found. As regards ease of control and in cases where very high temperatures are not required, the gas furnace must, however, continue a formidable rival to the electric furnace.

Our knowledge of the subject has now so far advanced that installations for the utilisation of electric heat can be developed on sound engineering lines, and with no element of risk of technical failure, so that, given the condition that coal is dear and water power, or power from waste gas, relatively cheap, in any locality electrical heat is, *cæteris paribus*, the only commercially possible proposition. It is impossible to generalise, as each case must be treated on its own merits, every influencing circumstance, such as the use to which the heat is to be put, the cost in the locality of raw material for the process in contemplation, and the situation of the power with regard to the markets, being given its own place in the general scheme. But it is of interest to bear in mind that, if we assume equal efficiency of application (an assumption generally greatly in favour of fuel), we can arrive at a basis of comparison. The "electrical h.p.-year," which cumbrously expresses a quantity of work, is equivalent to $2,545 \times 24 \times 365 = 22,300,000$ B.Th.U. (nearly). If we take the thermal value of 1 lb. of coal, as before, as 15,000 B.Th.U., we get the coal equivalent of the h.p.-year, $22{\cdot}3 \times 1,000,000$ 15,000 = 1,485 lbs. (nearly), or 0·005 ton. Thus, if the money value of the h.p.-year obtained from water power, waste gas, or other cheap source is in any locality less than that of 0·67 ton of coal of a thermal value of 15,000 B.Th.U., plus the cost of making the heat in it available, then, other things being equal, it is more economical to make use of electric heat. As has been remarked, however, the greater efficiency of application of electric heat makes this figure in general greatly favourable to coal. As illustrating this point the following is of interest.

The electrical work done in refining one ton of steel of the crucible class appears to be from 0·13 to 0·17 E.H.P. years, say, an average of 0·15 or $3{\cdot}36 \times 1,000,000$ B.Th.U. On the other hand, in crucible-steel making by the ordinary method about three tons of coke, which may have a thermal value of 14,000 B.Th.U. per lb. are required, or a total $3 \times 2.240 \times 14.000 = 94{\cdot}2$ million B.Th.U., or 28 times as much heat per ton as is absorbed by the same process carried out electrically. In other words, if the heat usefully applied in the electric furnace be taken as 80 per cent. of that supplied (it is difficult at present to find figures on the point), then the heat wasted in the crucible process must be about 97 per cent. of that supplied, and the lower the assumed efficiency of the electric furnace the greater the loss in the ordinary process works out. Even under English conditions this astonishing heat saving ensures the future of the electrical method. It is said that in regenerative crucible furnaces the fuel consumption is reduced to one ton, but even so, the heat wasted amounts to 91 per cent. of the whole, on the same basis. The case shows what has already been done in the matter of heat economy by electrical means, and indicates what may be expected in the future in other directions.

The cost of heat obtained from burning coal, on the theoretical basis, varies in this country according to the cost of the coal and its thermal value from 4d. to 7d. per million B.Th.U. The lowest published cost of generating energy is somewhat under ½d. per kw.-hour, and this is equivalent to about 12s. per million B.Th.U.; on the large scale about one-half of this might be represented by fuel, or say, 6s. per million B.Th.U., or 13 to 26 times the cost of the same heat given to the boiler by burning the fuel in its furnaces. It has to be borne in mind, however, that figures such as have been quoted are obtained from plants not primarily designed to deliver electrical heat and working on a load factor of from 15 to 20 per cent., whereas the first aim in the arrangement of electric furnaces is to ensure that the source of power shall work at its full capacity at all times, which would very materially reduce this cost, in many cases so far as to enable the electric furnace with its vastly superior efficiency to compete successfully with the directly burnt fuel. In considering the cost of fuel-generated electrical heat, it has also to be remembered that the reiterated statement that the cost of electrical supply is entirely a matter of capital, is only to a limited extent true. There is a certain irreducible minimum representing fuel cost, and the better the capital involved is utilised the more closely does the total approximate to this minimum and the larger does the proportion of cost due to fuel become. It is thus unlikely that a large power scheme, handicapped with distribution costs, could successfully compete with a relatively insignificant heat plant working on a 100 per cent. load factor.

In localities where blast-furnace gas is available, the conditions are still more favourable to electric heat. A blast-furnace is said by Gruber to produce gas in such quantity that, after the requirements of the works have been met, about 23·5 h.p. per ton of pig produced in 24 hours is available externally, the thermal value of the gas being taken by him as about 101 B.Th.U. per cubic foot. This figure is probably too high, as an average, and it is safer to figure on 70 B.Th.U. per cubic foot, equivalent to 16·5 h.p. per ton produced in 24 hours, or for a furnace producing 100 tons, 1,650 h.p. From this, taking the efficiency of the electric generators as 90 per cent., we can do electrical work at the rate of nearly 1,100 kw., or in the 24 hours 26,400 kw.-hours = 90·0 million B.Th.U., the cost of this heat being the cost of making it available, the fuel being obtained without cost. Now, if the capital cost of making this power available be taken as £20 per kw., a reasonable figure, and the annual capital charges 12 per cent. on this sum —leaving wages out of consideration as being assumed the same in the two cases—the cost for the 1,100 kw. for the day would be £7·3, or about 0·133s. per kw. per day, which is equivalent to 1s. 5½d. per million B.Th.U., or three times the average cost of the theoretical heat to be obtained from burning coal.

In localities where cheap water power is available and a demand for heat exists, or can be created, the conditions are most favourable of all. But it is important to recognise the fact, so often overlooked, that water power is not necessarily cheaper than other sources of power, whether it is so or not depending upon the cost of making a regular output available, this cost varying enormously in different watercourses. Thus, for instance, in Scandinavia the cost of the "electrical h.p.-year" varies, according to circumstances, from 33s. to about 220s., or from 1·47s. to 9·85s. per million B.Th.U. Equally low costs have been attained in Italy and in Switzerland, but in America the average cost appears to be materially higher than in Europe. Obviously, however, from what has been said it is clear that the superior efficiency of the electric furnace should render electric power under conditions making in any way possible the lower of the above-mentioned figures, or anything approaching it, a very much cheaper source of heat than any other. Naturally the cheaper water powers have been, in the majority of cases, long ago equipped for various purposes, but there still exist, within the knowledge of the writer, large undeveloped Scandinavian falls which have been thoroughly investigated by competent engineers and shown capable of producing power at an exceptionally low rate.

Metallurgical uses of electric heat are increasing year by

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year, and in them will doubtless the largest developments take place, but there would appear to be a large field for its application in those cases where a closed chamber contains the object to be heated, the heat being transmitted from without inwards through the walls of the chamber, such as pottery ovens, and kilns, bakery ovens, and so on. It has been calculated, for instance, that in certain types of pottery kilns in regular use, the total mass of material actually heated is about 100 times that of the mass of the material that is the object of the heating, a large part of the body of the kiln attaining a much higher temperature than its contents.

In these cases it is, of course, essential that flame and products of combustion should be entirely isolated from the object to be heated, and electrical heat, chemically clean, capable of accurate control, and of application exactly where it is wanted, would seem to fill all the requirements of the case, even though the cost of the electric power employed be not the lowest possible.

CARBON BRUSHES FOR TRACTION MOTORS

THE American Street and Interurban Railway Engineering Association, at a recent meeting held in New York, discussed a report on carbon brushes for traction and other motors, which had been prepared by a Special Committee on the maintenance and inspection of electrical equipment. In the report, an abstract of which was given in a recent issue of the *Electrical World* (New York), motor brushes are classified under three different types, namely, coke, part coke and part graphite, and graphite. Assuming this classification, the report states that coke brushes are generally suitable for railway motors of approximately 50 h.p. and less, with ungrooved commutators operating on low-speed service, such as city service, shunting locomotives, air compressors, or other service where the abrasive and polishing quality of the brush is necessary. The composition of the brush is mainly coke. By ungrooved commutators are meant commutators in which the mica insulation between the segments extends to the surface of the commutator. Part coke and part graphite brushes are generally suitable for motors of 50 to 100 h.p. in interurban and suburban service, and are normally used with grooved commutators. Should the commutator require only a moderate amount of abrasive effect to keep polished, these brushes may operate on the above sizes of motors without the mica being grooved. Since a commutator having grooved mica requires less polishing effect, this brush may be used to considerable advantage on motors of less than 50 h.p. in city or low-speed service, provided the commutators are grooved. Graphite brushes are suitable for general use on grooved commutators and on motors of 100 h.p. and over. The graphite brush inherently has large lubrication properties, and has the power of carrying a large current per square inch. The lubricating quality of the graphite brush serves to reduce or obviate chattering and constant breakage of brushes. The abrasive effect of graphite brushes is generally low; they have not the power to polish the commutator and wear away the mica, and therefore should be used only on commutators with grooved mica. The composition is mainly graphite.

A mechanical test is recommended in the report for the purpose of determining the strength and hardness of the brush, and an electrical test for the purpose of ascertaining the current the brush is capable of carrying before glowing, is also proposed. The abrasive effect, while very important, is not definitely set forth in the report for the reason that it has not been possible as yet to find a short, concise method of determining this effect.

In the mechanical test the brush is subjected to a series of mechanical shocks to determine how tough or brittle the brush may be. The vibrator consists of a ratchet wheel, with a diameter of 8 in. There are eight teeth, the depth of each tooth being $\frac{1}{8}$ in. Adjacent to the wheel a standard brush-holder is mounted so as to allow the brush to bear on the wheel with a standard pressure of 7 lb. per square inch of the bearing surface or cross-section of the brush. The speed of the ratchet wheel should be 250 r.p.m. With this speed the brush will receive 2,000 blows per minute. The ratchet wheel revolves backward so as to slip under the brush, and drop the same down $\frac{1}{8}$ in. as each tooth passes. It has been found that a brush which breaks badly in service will hardly run on this wheel more than 5,000 revolutions, and one which is fairly satisfactory in service will run 20,000 to 50,000 revolutions. A brush which is of excellent mechanical quality will run 100,000 revolutions and show no breakage or chipping. It is suggested that coke brushes should stand 20,000 revolutions on the vibrator wheel; part coke and part graphite brushes, 30,000 revolutions; and graphite brushes, 50,000 revolutions.

In the electrical test the current is passed through the brush to a slip-ring to determine the maximum amperes per square inch which the brush can carry without glowing. The slip-ring should be a wheel of hard copper 8 in. in diameter, $\frac{1}{2}$ in. thick, with a width of face sufficient to test the widest brush. The speed of the slip-ring should be approximately 500 r.p.m. The pressure per brush should be 7 lb. per square inch of bearing surface or cross-section. The periphery of the slip-ring should have a true and smooth surface. Twelve or fifteen samples of each quality of brush should be tested. The current should pass from the brush to the slip-ring. The maximum of 25 volts will be suitable for testing ordinary railway brushes. The following requirements are suggested :—Coke brushes, 100 amp. per square inch without glowing; part coke and part graphite brushes, 150 amp. per square inch without glowing; graphite brushes, 200 amp. per square inch without glowing.

In the discussion on the report, Mr. E. GINDRE (Le Carbone Company, of Paris) said that he considered a good brush should show a fracture of uniform appearance both crosswise and lengthwise, and must be free from shrinkage cracks. He did not think that the vibrator test corresponded closely enough with the conditions of practice. He considered the slip-ring test a valuable one. An important feature of every carbon grade is its friction coefficient, and the friction losses should be measured. The rational abrasion test would consist in running different brushes on a soft material, the wear of which measured by the decrease in weight would be proportional to the abrasive coefficient.

Mr. E. T. MUNGER (member of the Committee) said there had been some objections made to the vibratory test, and the Committee had agreed to reduce the depth of tooth from $\frac{1}{8}$ in. to 1-16 in., and to increase the diameter of the wheel from 8 in. to 9$\frac{1}{4}$ in.

Mr. H. H. ADAMS (New York City Railway) pointed out that the brush must fit properly when testing for the current that will make the brush glow. With the vibrator wheel, if one brush is destroyed at 10,000 revolutions and another at 50,000 revolutions, the inference should not be drawn that one will last five times as long as the other, as the vibrator test as proposed is not a correct measure of the service.

Mr. BRADY (National Carbon Company) thought that most of the tests advocated were laboratory tests. Carbon, being of a cellular structure, has only a few points of contact, unless extreme care is taken in working the brush down to a true surface. This is one point which gives trouble, particularly on the slip-ring test, which is more a matter of contact resistance than anything else. A brush with a high contact resistance will glow more quickly than a brush with a low contact resistance. A brush with a high contact resistance is a good brush to have in some cases, while one with a low contact resistance is good in other cases. It is all a question of the fit of the brush. In his own laboratory slip-ring test he found it necessary to run anywhere from 24 to 36 hours steadily on a smooth wheel to get the brush down to a true surface.

Mr. WINSOR thought the vibration tests were a step in the right direction. The Committee did not recommend a standard of how many vibrations a certain brush should make, but said that under certain conditions if it was found able to make 20,000 revolutions before breaking, it will stand up under certain conditions.

A New Primary Battery.—A new form of double-fluid zinc-carbon battery has been brought out by Mr. W. A. F. Bleek, of Brisbane. An E.M.F. as high as from 2·5 to 2·7 volts is claimed for the cell, which is stated to be suitable for giving current continuously for long periods.

Charges for Wireless Telegraphic Messages in Germany.—The charges for wireless telegraphic messages at the German coast stations are as follows :—Besides the regular telegraph rates in Germany of 5 pfennigs (0·6 pence) a word, minimum price 50 pfennigs (6·0 pence), there is a charge of 15 pfennigs (1·8 pence) a word, minimum 1·5 marks (1s. 6d.), and if the message is sent to a steamer which can be reached from the coast station an additional toll of 35 pfennigs (4·2 pence) a word, minimum 3·5 marks (3s. 6d.), is charged. An international list of wireless telegraph stations and their governments is now being prepared by the International Wireless Telegraph Bureau at Berne, but it has not yet appeared. Until this list, which is to contain the charges for sending wireless messages, is published, the fee for coast stations outside of Germany, according to information obtained from the *Gesellschaft fur Drahtlose Telegraphie* of Berlin, has been fixed at 48 pfennigs (5·9 pence) a word, with a minimum of 4·8 marks (4s. 10d.). If the fees at the said coast stations are in excess of those stated in the new list, the difference will be returned to the senders when the new list goes into effect.

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EXHAUST STEAM TURBINES

A PAPER entitled "The Utilisation of Exhaust Steam in Low-pressure Turbines" was read by Mr. R. F. Halliwell before the Rugby Engineering Society at the last meeting before the Christmas recess.

The author mentioned that as long ago as 1837 a patent was taken out by Sir James Anderson for a turbine to utilise the exhaust steam from a reciprocating engine to which the turbine was to be connected by means of a belt; in 1846, also, Sir H. Bessemer took out a patent for a somewhat similar apparatus, but there seems to be no record of such machines having been actually constructed. The first exhaust steam turbine to be put in practical operation in the British Isles would appear to have been made by the Hon. C. A. Parsons in 1902; while abroad an exhaust steam turbine plant designed by Professor Rateau was installed in the same year at the Bruay mines in France.

Some curves were then given showing the thermodynamic features of the expansion of steam, and it was argued that theoretically the most economical system would be a combination of reciprocating engines to deal with the high-pressure steam, and turbines to receive the steam at a suitable pressure, and extract the remaining available energy. In the case of a new installation this system is generally impracticable, and the putting down of turbines alone is preferable. In the case of existing reciprocating plants quite a different case is presented; it only remains to add the low-pressure turbine to obtain, at small additional capital cost, a combination that will add from 30 per cent. to 80 per cent. to the capacity of the plant with the same amount of steam.

The applications of exhaust-steam turbines to reciprocating plants may be divided broadly into three main classes. Those in which the supply of exhaust steam is continuous and practically constant in amount; those where the steam supply, although continuous, is liable to vary in quantity; and those where it is intermittent.

In the first case it is generally found that the output required from the turbine is also practically constant, and all that is required is a relief valve to discharge surplus steam, and possibly some form of reducing valve to admit high-pressure steam on occasions when the exhaust steam may be insufficient. In the second case, it is usually necessary to instal a turbine of a mixed pressure type, having high pressure stages, in which the live steam may do work and keep the turbine running during the periods of insufficient supply of exhaust steam, without loss of energy entailed by the use of a reducing valve. This complication is, however, not required when the work consists of the supply of electrical power, and the reciprocating engine and turbine dynamos can be connected in parallel, as under these circumstances the supply of steam to the whole plant is controlled by the governor of the reciprocating engine.

In the third case, examples of which are rolling mill engines and colliery winding engines, neither of the above systems are suitable. To get over the difficulty, Professor Rateau designed an accumulator to store up the surplus heat supplied when the engines are running, and deliver it in the form of steam when the engines are stopped. This he accomplished in his early form of accumulator by providing a closed vessel, through which the exhaust from the engines passed, which contained a large number of heavy cast-iron trays filled with water. The exhaust steam circulating among the trays condensed, and in doing so gave up its latent heat, thus raising the temperature of the cast-iron and the water in the trays. As long as the supply of exhaust steam was in excess of the quantity required by the turbine, the pressure and temperature in the vessel would increase up to the limit fixed by the relief valve. When the supply of steam stopped, the turbine still drawing out its required amount, the pressure and temperature in the steam space would gradually fall, causing the water in the trays to evaporate by reason of the higher temperature of the water and the cast-iron. Professor Rateau also employed another type of accumulator, in which the heat-storing medium consisted of scrap rails stacked inside a boiler shell, with spaces between the rails to permit the steam to circulate. A scrap-metal accumulator of this latter type has been installed at Hucknall Torkard Colliery; it is 6 ft. in diameter and 24 ft. long, and contains 50 tons of old rails, and supplies a 175 h.p. Rateau turbine during engine stops of 40 seconds.

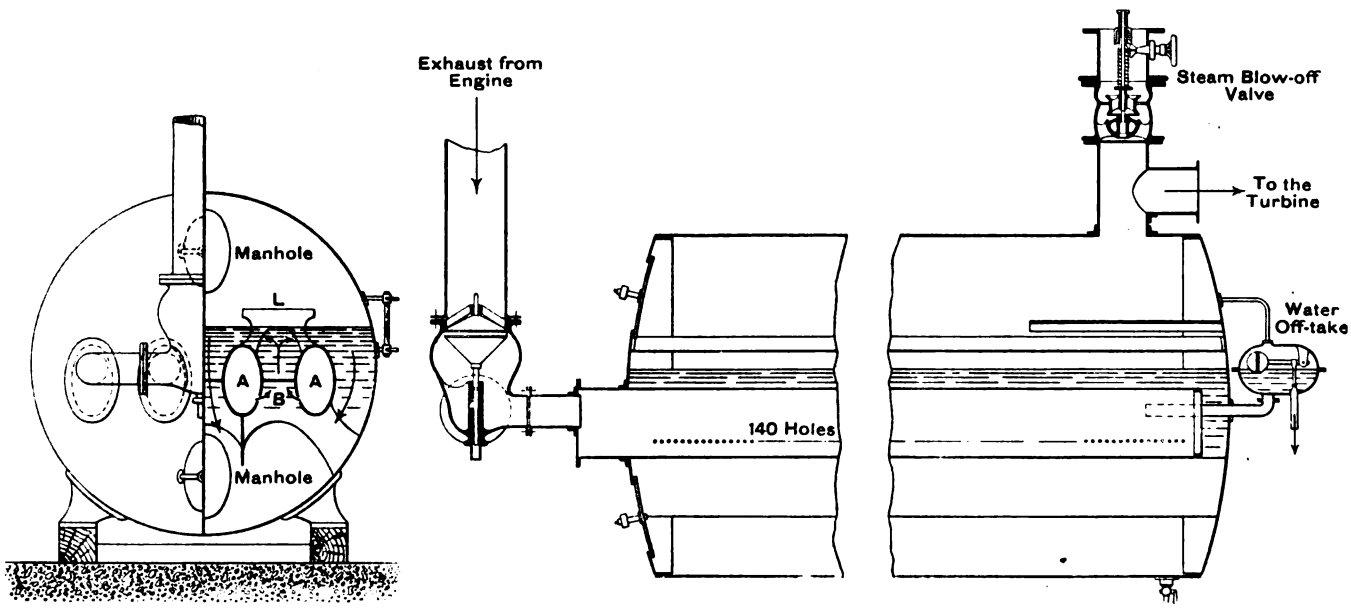

FIG. 1.—RATEAU ACCUMULATOR, LATEST WATER TYPE.

As the specific heat of water is about nine times that of iron, any form of iron accumulator is very heavy and expensive, and their use has been practically given up in favour of those which depend solely on water.

In the latest Rateau water accumulator, shown in Fig. 1, the horizontal shell is fitted with longitudinal flues of oval section, with the major axis vertical or of inverted U-shaped section; these flues are placed with their tops about one foot below the water-line, the accumulator being about two-thirds full of water. The exhaust steam is admitted to the flues and escapes through numerous holes in the vertical sides, and rising to the surface, establishes a vigorous circulation upwards, baffle plates being arranged to guide the water back again to the bottom of the accumulator. By this means practically the whole body of water in the accumulator is brought into the path of the steam, a condition which is absolutely essential if the temperature of the water is to be raised to correspond with the pressure, as otherwise the surplus steam would not be condensed and would escape through the relief valves.

Another form of accumulator which is coming into use is that patented by Messrs. Louis Schwarz & Co., of Dortmund. The steam is not forced through the water, but the necessary amount of water is pumped to the top of the accumulator and exposed as efficiently as possible to the action of the steam. The accumulator consists of a vertical shell with several diaphragms, each with a large number of short tubes projecting upwards;

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water lies on the diaphragms to the height of the tubes and also for a few feet at the bottom of the accumulator, whence it is continuously pumped up to the space above the top diaphragm by a small centrifugal pump, and overflowing down the interior of the successive sets of tubes, a large surface is exposed to the heating action of the steam. The steam is led to the bottom chamber of the accumulator and rises through the tubes to the top chamber, where is situated the relief valve and outlet pipe. It is stated that the power required to drive the pump is a very small percentage of the total power developed by the exhaust steam. A similar loss occurs with a Rateau accumulator through having to force the steam through the water. An interesting patent has been taken out by Mr. Samuelson, of the B.T.-H. Co., for a form of accumulator which has no such loss inherent in its design. This is simply an application to steam of the ordinary gasometer, with the necessary modifications. It consists of a bell to contain the steam with its lower edge water sealed in an annular trough, with escape and admission valves to prevent the bell rising too high or falling too low.

The first plant in this country to supply the modern type of turbines. The turbine runs at 3,000 r.p.m., and drives an alternator delivering current at 3,000 volts. The maximum continuous output with high-pressure steam is about 900 kw., and the set has an overall length of 15 ft. 6 in. and a width of 6 ft.

Mention was also made in the Paper of an interesting scheme which is being developed in the North of England by Messrs. Merz & McLellan for the group of power companies for whom they act as consultants. This scheme consists of purchasing the exhaust steam from ironworks and similar concerns to run low-pressure turbines located in small power stations adjacent to the works, the current being delivered into the network of mains in the north-east district, and the condensed steam being returned to the works.

Some further examples of installations in this country and America were described, including the plant at the power station of the Philadelphia Rapid Transit Company, where the introduction of exhaust-steam turbines has given the company nearly 20 per cent. more power, and, in addition, return about 3¾ per cent. on their cost.

The following particulars regarding the low-pressure turbine

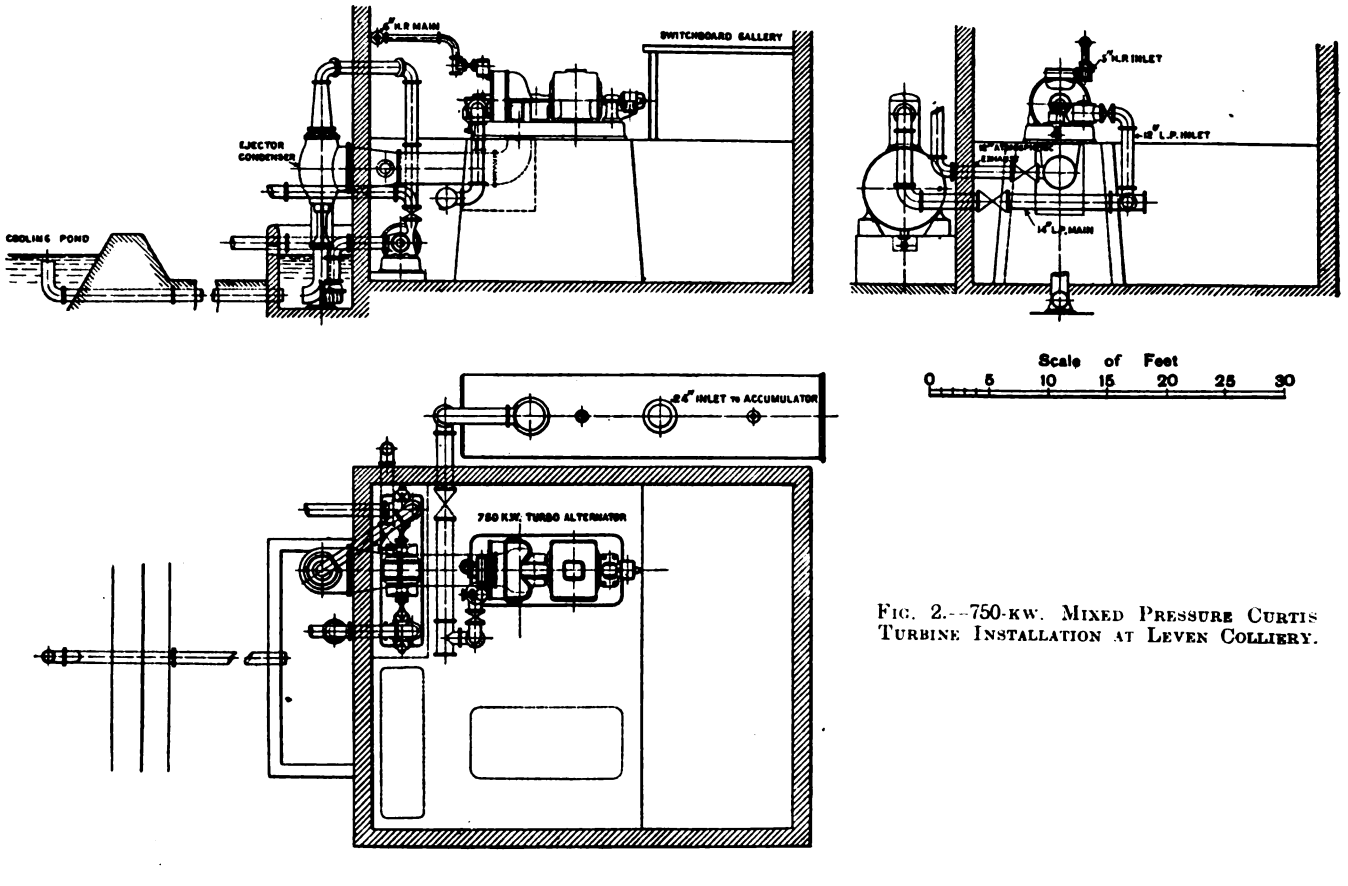

FIG. 2.—750-KW. MIXED PRESSURE CURTIS TURBINE INSTALLATION AT LEVEN COLLIERY.

Rateau accumulator was the Hallside works of the Steel Company of Scotland. This plant was installed in 1905 by Mr. P. J. Mitchell, the licensee for Rateau accumulators in this country, to whose energy is largely due the growing interest in exhaust steam utilisation. Steam is taken from cogging and finishing mill engines and two or three small engines and steam hammers, and is delivered into an accumulator 11 ft. 6 in. by 34 ft., the outlet from the accumulator being connected to two 450-kw. D.C. turbo-accumulators. In this way 900 kw. is obtained from steam which was formerly blown away into the atmosphere, as owing to the intermittent character of the load a satisfactory condensing plant would have been almost impossible to instal.

As an example of a mixed pressure installation, Fig. 2 shows the exhaust turbine plant now being supplied to the Leven Colliery of the Fife Coal Company by the British Thomson-Houston Co. through Messrs. Selby Bigge & Co., consulting engineers. At this colliery steam is collected from two winding engines, a fan engine, and several small pumps, and is delivered into a Rateau accumulator 7 ft. 6 in. by 30 ft. The amount of steam available for the turbine is only 16,000 lb. per hour, sufficient for about 400 kw., and since the maximum normal load on the turbine is 750 kw., the requisite amount of high-pressure steam to produce the additional load is admitted through groups of nozzles as in ordinary Curtis high-pressure plant which has been installed for the Edinburgh Corporation show that an even greater saving may be expected where the reciprocating engines are not so economical. In this station there are eight Willans & Belliss engines, each of 1,200 i.h.p., originally intended to operate with 25 in. vacuum, but always run non-condensing owing to lack of water. To deal with the exhaust from four engines, two Rateau turbines, running at 1,250 r.p.m., and coupled to Brown-Boveri D.C. generators at 490/550 volts, have been put down, each capable, when supplied with 45,000 lb. of steam per hour, the amount available from two engines at full load, of developing 1,250 kw. The two engines have a total output of 1,500 kw., consequently the increased output, without deducting the power required for auxiliaries, is no less than 80 per cent. The steam is admitted to the turbines at atmospheric pressure, the condenser pressure being 1·6 lb. absolute. The condensers are of the contra-flow type made by Messrs. Richardson, Westgarth & Co., and it is interesting to note that owing to the absence of any water it has been necessary to use sewage for circulating purposes.

Another example of a large American exhaust-steam turbine installation is a 5,000 h.p. vertical Curtis turbine in the power-house of the Rapid Transit Co. of New York, which is said to result in a saving of 93 tons of coal per day, sufficient, with the prevailing cost of coal in New York, to pay for the whole cost of the turbine in little more than one year.

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THE WIRELESS TELEGRAPH STATIONS OF THE EIFFEL TOWER

THE concluding article of a series which has recently appeared in *Le Genie Civil* gives a description of the various wireless telegraph installations which have been constructed and are projected in connection with the Eiffel Tower in Paris. It has been long realised that the Eiffel Tower, from its height and situation, presented unique opportunities from a wireless telegraph point of view, but it is only comparatively recently that long-distance communication has been carried out from it.

One of the first experimental installations of any importance was a small equipment constructed in 1905 by M. Eiffel, which was placed at the disposal of Captain Ferrié. Communication was established from this installation to distances ranging up to nearly 250 miles. At first the single aerial wire which was used was suspended from the second platform of the tower, but later, as the distances experimented with became longer, the upper end of the wire was attached to an ebonite insulator near the summit, and the lower end of the wire taken to a hut on the ground at some distance from the tower. With this arrangement communication was successfully carried out in 1905 with Belfort. The influence of the larger metallic mass of the tower, however, prevented such good results being obtained as might have been expected, considering only the height of the aerial. An alteration in the anchoring of the lower end of the wire improved matters, and the arrangement shown in Fig. 1 was adopted first, with the single wire pulled off further from the tower of the wire *AV* attached to an insulator *i*, and a conducting wire leading down to the hut *P*. Three wires

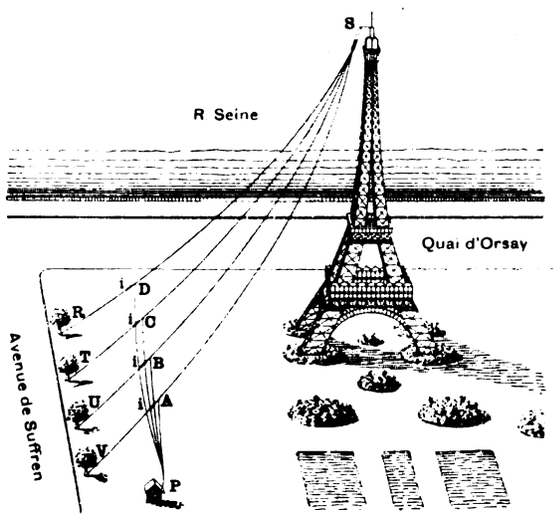

FIG. 1.—ARRANGEMENT OF TEMPORARY INSTALLATION.

more fixed in a similar way were afterwards added, as shown in Fig. 1. In the earlier experiments direct excitation of the antenna was employed, but an improved arrangement with a transformer was afterwards used. With this installation, temporary as was the nature of all the apparatus, communication was carried out at night with ships at distances of about 1,500 miles, with an expenditure of only 10 kw. The actual apparatus was enclosed in a roughly-made hut, and other temporary buildings served for the accommodation of the staff. It was with this installation that the famous series of communications with French warships at Casa Blanca were carried on.

Power for working the station was supplied from the generating station of the "Secteur" of the left bank of the Seine, at 3,000 volts 42 cycles, and transformed down to 220 volts in a sub-station at the base of the tower, from which an overhead wire was taken to the apparatus hut. A diagram of connections of the system is given in Fig. 2. The supply current passes through the key *M* and a variable inductance *I* to a step-up transformer *B*, the secondary (*H*) of which is connected across the condenser *K*. The pressure at the terminals of the condenser reaches about 50,000 volts, and the currents dealt with by the key range up to 100 amperes. The arrangement of the oscillation circuits with its air transformer, which has one primary and one five secondary turns, is shown in the diagram. The spark-gap is between the two large zinc cylinders *O*. The condenser *K* has a capacity of about half a microfarad. The earth connection was made to plates of zinc with a total surface of 1.620 sq. ft. buried in the ground.

As has been seen in Fig. 1, the aerial consists of the four wires, *SAP*, *SBP*, *SCP*, *SDP*, held as far away from the tower as possible by the pull-off wires, *RD*, *TC*, &c., insulated by ebonite insulators *i* from the antennæ themselves, and attached to trees adjoining the Avenue Suffren. These are so placed that the distance between the points *A* and *D* is about 300 ft. The actual conductors forming the antennæ are steel cables 4 mm. in diameter, and are attached to a short projecting beam at the summit of the tower by a special form of porcelain insulator. The potential at the top of the antennæ is said to reach hundreds of thousands of volts, and a wave-length of 1,600 metres

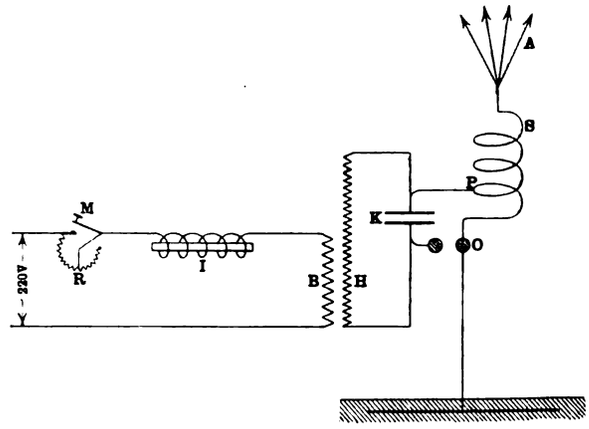

FIG. 2.—DIAGRAM OF CONNECTIONS OF TEMPORARY INSTALLATION.

A. Antenna.
B. Primary of Transformer.
H. Secondary of Transformer.
I. Variable Inductance.
K. Condenser.
M. Sending Key.
O. Oscillator.
OP. Oscillation Circuit.
S. Secondary of Antenna Circuit.

is produced. Special arrangements are made for lowering the whole system to the ground in case of repairs or alterations.

The reception of messages is made, as a rule, telephonically by means of an electrolytic detector coupled inductively. Communication has been carried on with Poldhu, with Nauen (near Berlin), with Morocco, Algiers, and stations in various parts of France. Messages have also been picked up from the Transatlantic Marconi stations at Clifden (Ireland) and Glace Bay (Canada).

Following the success of this temporary installation, negotiations were entered into for the construction of a permanent station, and in the spring of this year an arrangement was arrived at between the War Office, the Paris Municipality, and the owners of the tower. The work has been commenced, and it is hoped that the new station will be in operation during the early part of next year. In view of the fact that the

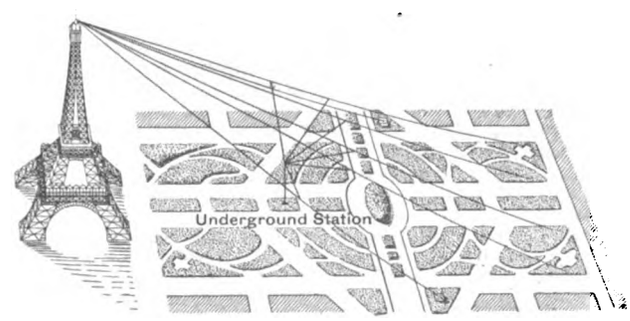

FIG. 3.—ARRANGEMENT OF PROJECTED PERMANENT INSTALLATION.

Champ de Mars is to be laid out as a public garden, and for other reasons, it was decided to put all the apparatus in an underground chamber instead of constructing a building above the surface. This will have the additional advantage of deadening the noise made by the apparatus. The projected arrangement of the aerial wires is shown in Fig. 3.

The underground station near the centre of the Champ de Mars will consist of a group of buildings surrounding a small sunk courtyard covered by a grille on a level with the ground

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and reached by a staircase, the top of which will be hidden among vegetation. The supply of power, which, as the new station is to be much more powerful than the old installation, will reach over 100 h.p., and will be taken as before from the generating station of the Secteur de la Rive Gauche, but a stand-by supply from the machinery used for the lighting of the tower will also be available.

The antennæ will be composed of six steel cables from 4 to 6 mm. diameter, connected, as shown in Fig. 3, to a single cable, which passes vertically down to the underground court-yard. In view of the great tension on the wires, which amounts to about 6 tons in high winds, special care has been taken in their attachment at the top of the tower. Each wire is to be fixed by means of a substantial insulator to a special crossbar on the tower, and arrangements will be made so that any one wire can be lowered to the ground independently of the others. The pull-off wires will be anchored to concrete foundations. The two outside wires are anchored to short masonry towers in order to keep them a sufficient height above the carriage-way.

The wave-length will probably be 2,000 metres, and it is expected that communication will be possible over distances up to about 3,750 miles by day, and even further by night.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

MANY attempts have been made to bring in on a really commercial scale, electrolytic zincing. As a matter of fact there are several processes in limited operation, but it cannot be said that this method at all enters into competition with hot galvanising. Probably one of the chief reasons against the electrolytic process is to be traced to the appearance of the deposit. Hot galvanising gives a most artistic finish, owing to the large crystalline appearance of the coating of zinc. On the other hand, articles electrolytically coated have a matt-grey appearance, due to the fact that the deposited metal is in the form of very minute crystals; the best description of the coating is to say it appears to have been sand-blasted. In the *Electrochemische Zeitschrift* of December, Carl Richter describes a method by which he is able to obtain a bright deposit by electrolytic means. The bath employed is a modification of that of Pfannhauser, and consists of zinc sulphate and ammonium sulphate, but whereas that of Pfannhauser is employed neutral, Richter adds small quantities of sulphuric acid; the amount, however, is extremely small, varying from 1/38 to 1/20 normal. The temperature of the bath was usually kept at that of the atmosphere, a current density of about 80 amperes per square decimeter (about 740 amperes per square foot) was employed, the E.M.F. being between 0·75 and 0·85 volt. Electrolytic zincing has so much in its favour, at any rate for small articles, and for articles which require to be bent about, owing to the extremely adhesive condition of the zinc, that given a method for depositing it in a bright form, it should rapidly come in use on a large scale. One of the objections to hot galvanising is the large amount of spelter which requires to be kept in use, and the deterioration which takes place by alloying with the articles which are dipped, and the necessity to keep the bath molten meaning the employment of a large amount of fuel.

The Chemische Fabrik Griesheim-Elektron are arranging to erect a plant for storage of hydrogen for filling balloons. The gasometer is to have a capacity of 1,500 cubic meters, and the gas is to be obtained by electrolytic means.

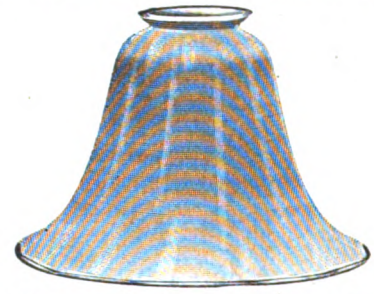
In the *Electrochemical and Metallurgical Industry* of December there is an interesting letter by Mr. R. H. Wolff, dealing with the electric furnace for rail and ordnance steel. Mr. Wolff considers that there would be much fewer flaws and faults in steel, such as were described by Mr. W. Rosenhain in his Paper before the British Association. The faults are generally attributable to traces of slag or of manganese sulphide becoming pocketed in the steel. Mr. Wolff points out that such faults rarely exist in crucible steel, but crucible steel is much too expensive for railway companies to purchase it for rails, but "with modern power-producing plants, hot metal from oxidising furnaces can be purified and deoxidised in a Héroult electric furnace in a short time, producing a very pure metal free from slag and other injurious bodies; in fact, a material equal to the best crucible steel, only more uniform, *at a reasonable extra cost over open-hearth steel.*" All, therefore, that is necessary in steel works, is to add a Héroult furnace equipment to the already existing Bessemer and open-hearth steel plants without any radical change whatsoever. Although quite in agreement with Mr. Wolff as to the high efficiency of the Héroult electric furnace, we would not necessarily confine ourselves to this particular form of furnace. For example, the new three-phase Roechling-Rodenhauser Electric Induction Furnaces are also extremely suitable for this class of work. There are also the Girod and Stassano electrode furnaces, which have given great satisfaction in the preparation of high-grade steels.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

RIVETED STEEL POLES.—A leaflet from Messrs. Francis Morton & Co., Ltd., of Hamilton Ironworks, Liverpool, and 17 Victoria Street, S.W., calls attention to the "Hamilton" pattern of riveted steel plates for telegraph arc lamps and other purposes, and a special type of channel steel insulator arm.

ELECTRIC FITTINGS AND GLASS WARE.—The latest edition of the General Electric Company's catalogue of fittings and shades is a most handsome and complete production. The opening accessory section contains a very full list of such small but important articles as cord grips, nozzles, hooks, ceiling plates, cord ornaments and shorteners, adapter ball fittings, and a host of other necessary appliances which only too often are but incompletely dealt with in such catalogues. In the succeeding portion many hundreds of illustrations of fittings are included dealing with every conceivable requirement, and ranging from the plainest workshop pendant to the massive ormolu and cut crystal electrolier. The illustrations give an excellent idea of the artistic nature of these productions, among which attention should be drawn to a beautiful series of French bronzes.



The section dealing with shades shows that a great deal of attention has been paid to shades and reflectors suitable for metal filament lamps, with long bulbs, and amongst the novelties we notice the two special reflecting shades illustrated above. In the first, the horizontal rays are reflected downwards by ribs in the glass. The second shade, although transparent, is finished inside with silver, which reflects the light very effectively.

POCKET-BOOKS, DIARIES, &c. for 1909.

THE annual pocket-book issued by Simplex Conduits, Ltd., forms, in addition to a pocket diary, a useful compendium of information on the well-known installation, material, &c., supplied by the firm.

Messrs. Venner & Co. are sending out a very artistic stamped metal table calendar for 1909, adorned with a representation of a hunting scene. The firm have adopted the novel course of omitting all advertising matter on the calendar itself in deference to the desires of some of their friends, who last year experienced difficulty in removing the advertisement, and finding a suitable picture to go in its place. We are asked to state that, owing to the breakage of a die, there may be a slight delay in completing the issue of these, but that all the firm's customers will be supplied by about the middle of January. Should any of our readers who are not already customers of the firm desire one of these calendars, they are requested to forward a shilling with their request.

The monthly tear-off calendar, which is being issued by the London electric firm of George Street, Croydon, is embellished with a number of illustrations of the various forms of arc-lamp lowering-gear which the firm specialise.

Flame Arc Lamp Electrodes.—Drops of melted material sometimes form on the ends of flame arc lamp carbons, and this causes flickering of the arc. To remedy this, it has been proposed to add a certain amount of silicon carbide to the impregnating material, which causes a covering of unfused silicon carbide to form on the carbon ends. According to the *Electrical World* of New York, an American patent for this has been granted to a Berlin inventor.

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RESULTS OF CONTINENTAL EXPERIENCE WITH TURBO-GENERATORS

THE following notes are taken from a recent article in *La Lumière Electrique*, and deal with a number of replies received by Mr. Müller-Köhler from users of steam turbo-generators. These are classified by the author as follows :—(1) Sets of under 290 kw. (2) Sets between 300 and 590 kw. (3) Sets between 600 and 900 kw. (4) Sets between 1,000 and 2,400 kw. (5) Sets of over 3,000 kw.

Group (1) contains 13 turbo-dynamos, mostly of the Brown-Boveri-Parsons type, of which seven are direct-current machines running between 2,500 and 3,500 r.p.m. The steam pressure lies between 110 and 120 lb. sq. in. in most cases, while eight of the machines use steam superheated 65° to 130° C. (115° to 235° F.). About half the condensers are of the surface type. On the whole, the steam consumption of the machines in this class has been less than that guaranteed, being, on the average, 25·3 lb. per kw.-hr. using superheated steam, and 27·0 lb. per kw.-hr. using saturated steam. In one case the consumption fell to 19·1 lb. per kw.-hr. The annual oil consumption is from 140 to 440 lb. for the turbine alone, and from 770 to 1,000 lb. for the combination (turbine and dynamo). In general the overload capacity specified does not exceed 30 per cent. According to the replies given, in spite of the uninterrupted running imposed on the machines, mishaps are very rare. In most cases the repairs necessary have been *nil*, or very slight and cheaply effected; in two cases only have stripped blades been reported. For the 100-kw. class the cost of installation amounts to about £12 per kw. without condensers, and to £16 per kw. including condensers; for the 250-kw. class the cost of installation varies from £6·6 to £8·4 per kw. non-condensing, and from £10·4 to £12 per kw. with condensers. The figures given appear to refer to full load tests.

The replies received concerning the second group (300 to 590 kw.) include 22 installations, of which six are direct current, 14 three-phase alternating, and two single-phase alternating (high tension). In this group Parsons' turbines again predominate, 19 being installed, as against two of the Zoelly type and one by the Allgemeine Elektricität-Gesellschaft. Apart from a few exceptions the r.p.m. is 3,000. More than half (13) the turbines in this group use steam superheated from 41° to 150° C. (74° to 270° F.); the remaining nine use saturated steam. Two of the turbines utilise the exhaust steam from reciprocating engines at a pressure of 2·84 lb. per sq. in., while the other machines use steam at pressures varying from 105 to 185 lb. per sq. in. In twelve installations surface condensers are used, in nine jet condensers are employed, while the exhaust of one turbine is used for heating.

The steam consumption per kw. hr. is 22·0 to 24·2 lb. for the 300 to 385 kw. machines using superheated steam, and 24·5 to 25·0 lb. where saturated steam is employed. For the 400 to 550 kw. sizes the consumptions are, respectively, 19·7 to 22·0 lb. and 22·6 to 27·5 lb. per kw.-hr. This guaranteed consumption has not been attained during trial runs. In one case, using superheated steam, a consumption of only 18·7 lb. per kw.-hr. has been certified. The two exhaust turbines referred to consume respectively 38·3 and 39·2 lb. steam per kw.-hr. The turbine running non-condensing (with superheat 50° C. (90° F.) and pressure 190 lb. per sq. in.) consumes, on full load, 112 lb. steam per kw.-hr. The annual cost of lubrication of the turbines is £3 to £20·5, and the cost of cotton waste, &c., varies from 5s. to £5·2.

Overloads of 6 to 10 per cent. are common; one of the turbines ran continuously for one month on an overload of 34 per cent., the output then being 740 kw Although the majority of the turbines in this class have been running five years, no mishaps, beyond the most trivial, are reported. Three turbines have shown slight deterioration of the blading, the most serious of which caused shut-downs for 24 hours and 72 hours respectively. The maximum cost of repairs rose to £26 (for an admission valve). In eight cases accidents to the dynamos have been reported, usually in connection with the commutator and brush gear. In one case a turbine seized, in consequence of a defect in the main valve; the generator rotor was destroyed, but the turbine was not further injured. In this class the costs of installation varied from £6 to £10 per kw. for the turbo set, including the dynamo and exciter machine but without condenser. The cost of the latter varies from £6·2 to £12·8 per kw. Turbines working on the exhaust of reciprocating engines cost from £8 to £10 per kw.

(3) Machines from 600 to 900 kw. This group includes eight Parsons turbines and three Zoelly machines, of which eight drive three-phase alternators and three are coupled to direct-current generators. The speed is 3,000 r.p.m. for machines of less than 700 kw., and 1,500 r.p.m. for the others. Practically all these turbines work with superheated steam—the superheat being 70° to 140° C. (=126° to 252° F.). The steam pressure varies from 105 to 170 lb. per sq. in., and surface condensers are usually employed. On the average the steam consumption reported, again less than the guarantee value, varied from 21 lb. per kw.-hr. as maximum, to 17·5 lb. per kw.-hr. as minimum. The annual weight of lubricating oil per turbine varied from 460 lb. to 2,460 lb., the corresponding costs being £9 and £26 respectively. (These amounts include the oil necessary for dynamos and condenser plant.) In general the overload to be dealt with is 30 per cent., maintained during several hours.

In this class only six cases of trouble have been experienced; the most serious caused a stoppage of five days, and was due to broken blades, from an unknown cause, in a Parsons machine. In three cases only have slight derangements to the dynamos been reported. In the class 600 to 670 kw. the cost of installation amounts to from £6 to £6·6 per kw. without condensers, and from £7·4 to £8 per kw. with condensers. For machines from 750 to 900 kw. these costs are £4·2 to £4·4 without condensers to £7 to £7·2 with condensers.

Group (4) includes 15 machines from 1,000 to 2,400 kw., there being nine Parsons machines, four Zoelly, and two by the Allgemeine E.-G. With the exception of one single-phase set all the machines supply high-tension three-phase alternating current (2,000 to 6,000 volts). With two slight exceptions the speed is 1,500 r.p.m. Four of the turbines use saturated steam, while all the others use superheated steam—superheated 45° C. to 110° C. (=81° F. to 193° F.)—at 105 to 170 lb. per sq. in. pressure. In three cases jet condensers are used; in the other cases surface condensers are installed. The condensing water per hour varies from 12,500 to 26,100 cu. ft. On the installation trials the steam consumption was found to be less than guaranteed, actually being from 17·9 to 18·2 lb. per kw.-hr. for the machines of 1,800 to 2,000 kw. output. The annual consumption of lubricating oil varied between 2,100 and 5,500 lb. for the turbine and dynamo combined (annual costs being £40 to £55 respectively).

Overload specifications include 10 to 20 per cent. overload for several hours, and 32 per cent. overload for 20 minutes. There have been few derangements to the turbines and none at all to the dynamos in this class. The installation costs varied from £4·2 to £5·7 for the 1,000-kw. type, excluding condensers; including the latter raises the cost to £7·5 per kw. For the 1,100 to 1,200 kw. sizes the cost of installation was found to be £6·20 to £6·25 per kw., while for the 1,800 to 2,000 kw. class these costs were £6·90 to £7·04, condensers being included in both cases.

Under heading (5) only two installations are dealt with. Both machines are of 6,000 kw., and generate three-phase current at 5,500 volts. The speeds are 960 and 1,000 r.p.m. respectively. Steam is superheated by 300° C. (540° F.); one set is provided with an "ordinary" condenser (presumably of the jet type), while the other has a surface condenser. The cooling water per hour in the two cases is 63,400 cu. ft. and 71,900 cu. ft. respectively. The water temperatures are 5° C. and 25° C. at inlet and outlet respectively; one of these installations contains a water-cooler to deal with the air-pump discharge.

From actual trials the certified consumptions are :—14 lb. per kw.-hr. at full load (guarantee = 14·3 lb. per kw.-hr.); 14·8 lb. per kw.-hr. at half-load, and 15·65 lb. per kw.-hr. at ¼ full load. The consumption of oil by the turbine alone is stated to be "practically *nil*." One of these two machines has been overloaded daily to 7,500 kw. (25 per cent.). As for derangements, one has had damaged blades, while the condensing plant has given trouble in the other; the first damage caused a shut-down of nine days, though the repair cost little to effect; the repair to the condensing plant cost £21. The costs of installation amounted to about £3·84 and £4·28 per kw.-hr. respectively, this including turbine, dynamo and condensing apparatus.

M. Müller concludes by stating that all the owners of steam turbines, with the exception of a very small minority, give a glowing account of these machines. Hence as *résumé* of the replies received, one may conclude that both owners and engineers in charge of steam turbines are extraordinarily satisfied with this simple type of prime mover.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10½—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10	
Do. 6% Cum. Second Pref.	10	6	6%	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	103—107	+1
Bromley (Kent) E.L.& Power Co.,Ltd.	5	5⅜	4½*	4⅜—4⅝	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co.,Ltd.	5	10	5½*	8½—9	
Do. 7% Cum. Pref.	5	7	7%	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	4⅜—4⅝	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—4⅝	
Do. 4% Deb. Red	Stock	4	4%	97½—99½	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	4½	3⅝—4⅜	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3¾—4¼	
Do. 4½% Deb. Red	Stock	4½	4½	103—106	+2
City of London Elec. Lt. Co., Ltd.	10	6	6%	10¼—10½	
Do. 6% Cum. Pref.	10	6	6%	12¼—13	
Do. 5% Deb. Red	Stock	5	5%	123—125	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—103	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3½—4	
County of London Elect. Sup. Co. Ltd.	10	5	—	8¼—9⅜	+⅛
Do. 6% Cum. Pref.	10	6	6%	10½—11½	
Do. 4½% Deb. Red	Stock	4½	4½	107—110	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102	+1
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—¼	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	62—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8¾	4/-	6¾—7⅛	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	88—91	
Kensington & Knightsbridge E. L. Co.	5	10	4%	7⅞—8¼	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	—	1⅜—1¾	
Do. 6% Pref.	5	—	6%	4¾—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—93 xd	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	5⅜—5⅝	
Do. 4½% Cum. Pref.	5	4½	4½	4¾—5¼	+⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	86 - 89	+1
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	88—92	
Newcastle-upon-Tyne Elec. Supply.	5	—	2½%	4⅜—5⅛	
Do. (fully paid)	5	8	2½%	4¾—5⅛	
Do. 5% Pref. Do.	5	5	2½%	5⅛—5⅜	
Do. Do.	5	5	2½%	5—5⅜	
Notting Hill Elec. Lt. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅜—6⅜	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	8⅜—9⅛	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½	87—91	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅞—1⅛	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅝—3	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—¾	
Do. 7% Cum. Pref.	1	7	7%	1⅞—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100 -103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—83	
Victoria Falls Power Co. Pref.	1	—	—	⅞—⅞	-1/32
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8⅝—8⅞	
Do. 4½% Cum. Pref.	5	4½	4½	5⅜—5½	+⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	94—96	
Central London	Stock	3	3%*	64—66	
Do. 4% Preferred	Stock	4	4%	84 - 86	
Do. Deferred	Stock	2	—	50—52	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	86—88	
City and South London Cons.	Stock	4½	1¾%	25½—26½	-2
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112 -114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	106—109	
Great Northern & City Pref. "A"	10	11½d.	—	¼—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	3½%*	7¼—7⅜	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	¼%	35½—36½	+½
Do. 3½% Preference	Stock	3½	3½%	86—88	+1
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	74—77	
Metropolitan District	Stock	—	—	13½—13¾	
Do. 6% Perp. Deb.	Stock	6	6%	124—127	
Do. 4% Deb.	Stock	4	4%	81—84	+1
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—27	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	93½—94½	+½
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—104	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	—	1⅛—1⅛	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	—	93 - 96	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅜	
Do. 6% Cum. Pref.	10	6	6%	3½—4	-⅛
Do. 5% Perp. Deb.	Stock	5	5%	92—97	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%	%		
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅜—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	56—61	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	93—95	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	⅜—⅞	
London United Trs., Ld., Cm. Pf.	10	5	—	4¼—5	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	68—72	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅜—⅝	
Do. % Cum. Pref.	1	5	5%	¾—⅞	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—¼	-⅛
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅜—½	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅝—¾	
Do. 3½% Mort. Deb.	100	3½	3½%	95—100	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	1½%*	4¼—4⅛	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—80	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	81—85	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅛—1⅜	
Do. 6% Cum. Pref.	5	—	—	2¼—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—87	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	56—59	
Do. 6% Pref. Ord.	Stock	6	6%*	97—99	-1
Do. Def. Ord.	Stock	1	—	15⅝—15⅝	-⅜
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	87—89	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	101—104	+1
Direct United States Cable Co. Ltd.	20	4¼	4¼	12⅞—13⅜	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	102—104	+1
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	101—103	+1
Do. do. (Mauritius Sub.)	25	4	4%	100—102	+½
Eastern Ext. Australasia & China	10	7	5%	11½—12	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½%*	128—133	
Do. 3½% Pref.	Stock	3½	3½%*	82—85	
Do. 4% Mort. Deb.	Stock	4	4%	103¾—105⅛	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	18	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅛—⅜	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6%*	116—118	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	101—103	+½
Western Telegraph Co., Ltd.	10	7	6%*	12½—13	
Do. 4% Deb.	Stock	4	4%	102—104	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	1	6	3%*	2½—2¾ xd	
Babcock & Wilcox, Ord.	1	20	16%*	3¾—4	
Do. 6% Pref.	1	6	6%	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¾—7	
Do. 6% Cum. Pref.	5	6	—	6¼—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	0—⅛	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	65—70	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	49—53	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5½—5⅝ xd	+⅛
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	108—110	+⅛
Consolidated Electrical Co., Ltd.	1	3½	—	1¼—1⅜	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	98—101	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅝—1⅝	
Do. 6% Cum. Pref.	1	6	6%	1⅞—1⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅞—1⅛	
Do. do. (fully paid)	5	4/2	2/6*	1⅜—1½	
Do. 4% Deb. Red.	Stock	4	4%	76—79	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—½	
Do. 7% Cum. Pref.	2	7	—	1—1⅛	
Do. 4½% 1st Mort. Deb.	Stock	4	4%	61—65	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	—	7¼—7⅜	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	83—87	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	11⅜—12⅛	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105½—107½	+½
I. R. & G. P. Co., Ltd.	10	10	2½%*	108—112	
Do. 4% Deb. Red.	100	4	4%	98—100	+1
Tel. Const. & Maintenance Co.	12	17½	10%*	30½—32½	
Do. 4% Deb. Bds. Red.	100	4	4%	101½ 103½	
Willans & Robinson, Ord. Shres.	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Dec. 24th, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.
Names in italics indicate communicators of inventions from abroad.

1907 Patent

27,132, **Arc Lamp.** BRITISH THOMSON-HOUSTON CO., LTD. (*Allgemeine Elektricitäts-Ges.*). In flame-arc lamps with inclined carbons which contain mineral matter, the slag which is formed on the carbon tips frequently prevents the arc from striking when the circuit is closed. According to this invention, a metallic bridge with a knife edge is arranged at right angles to the plane of the carbons so that, when the lamp is switched on, the carbons strike this bridge. Any slag on the carbons is then removed, and the bridge forms a conducting path between the carbons so as to assist in striking the arc. Two claims, one figure.

1908 Patents

1,751, **Petrol-electric Transmission System for Vehicles.** W. N. STEWART, E. B. KILLEN, and F. HARRIS. In this system of power-transmission for vehicles, the petrol engine is connected through a flexible coupling to the rotating field system of a "dynamotor," and can also, by means of a clutch, be connected to the armature; it is never in direct mechanical connection with the driving gear, however. At normal speed, the engine drives the field system in one direction, while the armature, which is then in mechanical connection with the driving gear, is driven in the opposite direction by means of a storage battery. On downward gradients, the speed of the armature increases so that it returns current to the battery, and when standing still, the armature is disconnected from the driving gear and driven direct by the engine for the purpose of recharging the battery. The field system is both shunt and series wound. The petrol supply is automatically controlled, and the throttle is mechanically connected to the clutch. Four claims, one figure.

5,199, **Cables.** H. GRAY. This specification describes a method of construction for stranded cables, which is said to prevent movements of the cable due to expansion or contraction of the strands. The conductor is so stranded that the wires in every layer do not form a complete sheath round the preceding core or layer. Spaces are thus left between the wires comprising each layer, which may or may not be filled with loosely packed material. Two claims, two figures.

5,415, **Manufacture of Metal Filaments.** BRITISH THOMSON-HOUSTON CO., LTD. (*General Electric Co., U.S.A.*). This invention relates to the production of filaments of pure zirconium or alloys of that metal. A squirting solution of zirconium oxalate (which is itself gelatinous in nature), is prepared by precipitation of hot zirconium nitrate solution with ammonium oxalate. Sufficient powdered carbon is then mixed with this to combine with the whole of the residual oxygen of the oxalate during the heat treatment. The absence of pitch or other carbonaceous binder ensures freedom from volatile hydrocarbons in the furnace, and consequently a filament entirely free from carbon is produced. In the case of filaments of an alloy of zirconium, the gelatinous zirconium oxalate forms the only binding agent for the mixture. Three claims.

6,960, **Alternating Current Commutator Motor.** BRITISH THOMSON-HOUSTON CO., LTD. (*General Electric Co., U.S.A.*). Commutator motors in which both inducing and exciting windings are arranged on the stator, may be started with the armature short-circuited, and, for high speeds, have a shunt voltage impressed on the armature to reduce the strength of the inducing field which has an injurious effect on commutation at high speeds. It may happen that the armature ampere-turns exceed the inducing ampere-turns in the latter case, and the object of the present invention is to prevent this from having a bad effect on the commutation, by arranging the inducing winding so that it is concentrated near the pole tips, where commutation occurs. Five claims, five figures.

17,410, **Switches.** A. P. LUNDBERG, G. C. LUNDBERG, AND P. A. LUNDBERG. This specification relates to that type of switch in which the contact-carrying arm is mounted on two independent pivot pins, and in which the actuating spring, which engages at one end with one of the pivots, and at the other end with a pin that works in a slot in the arm, holds the arm in either of its end positions. Two designs are described in the specification, one with a double-acting tumbler arrangement, and one with two press-buttons. Two claims, fifteen figures.

17,417, **Method of Cooling Commutators.** SIEMENS BROTHERS' DYNAMO WORKS, LTD. (*Siemens-Schuckertwerke*). A special construction of commutator is described in this specification. The bars are of the usual dovetail shape, and are held by clamping rings at either end, but a hollow space is provided between the bars and the hub, and a fan-shaped construction is arranged at one end to ensure a strong draught of air through this annular passage. Plates are let into the under surface of the bars and project into the air space, thus offering a large cooling surface. Two claims, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.
Names in italics indicate communicators of inventions from abroad.
Summaries of some of the more important of these patents will appear in our next issue.

1907 Patents

26,294, HARRISON. Means of supporting filaments in electric lamps.
27,034, DAVY. Arc lamps.
27,038, BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). Motor-starting devices.
27,095, RYAN. Electrical welding-machines.
27,140, HAILWOOD. Ignition of miners' safety lamps.
27,559, MURPHY. Electrode for use in the purification of water.
27,632, ERICSSON. Prepayment meter.
27,675, HATFIELD. Electromagnetically-operated apparatus.
27,682, AYLEN. Portable electric burglar alarm.
27,830, GIBBS. Electrolytic cells.

1908 Patents

2,153, BUCKTON. Incandescent lamp caps.
4,372, FELTEN & GUILLEAUME-LAHMEYERWERKE AKT.-GES. Regulation of the pressure of electrical machines.
6,520, DARNLEY. Attachments for telephone mouthpieces.
7,328, ALLGEMEINE ELEKTRICITÄTS-GES. Arc lamps.
8,427, COLLIS. Reflectors for portable lamps.
12,682, ALLGEMEINE ELEKTRICITÄTS-GES. Arc lamps.
13,136, SCHULZE. Measuring instruments having an electromagnetic brake.
13,539, HAACK. Mercury vapour lamp.
13,893, CHAMBERLIN & HARRINGTON. Points for tramways.
14,259, DIAZ & AZAROLA Y GRESILLON. Apparatus for preventing the theft of electrical energy.
14,332, VAN DEN BOSSCHE & VAN DEN BOSSCHE. Railway signalling systems.
14,538, BERG. Turbo-electric generator systems.
14,554, ALLMAN & LEESON. Electric vulcanising apparatus.
14,776, SCHWENKE. Automatic electric projectile igniters operated by admission of water.
15,376, RAINS. Electrical water-heaters.
15,818, AITKEN. Telephone cordless switchboards.
15,949, RORKE & RORKE. Make-and-break devices
16,910, SCHATTNER & AMBERTON. Prepayment meters.
17,336, EISIG. Method of securing tramway rails.
19,311, SIEMENS & HALSKE AKT.-GES. Manufacture of incandescence bodies of tungsten.
24,414, HAILWOOD. Apparatus for igniting miners' safety-lamps.
25,596, HAILWOOD. Apparatus for igniting miners' safety lamps.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

1908 Patents

17,611, SIEMENS & HALSKE AKT.-GES. Process for improving the ductility of tungsten.
26,120, JACKSON. Electrical distribution systems.
26,502, WANDREY. Electric shutter indicators.

Expiring Patents

The following patents expire during the current week after a life of fourteen years:—

148, of January 2nd, 1895. **Induction Instruments and Meters.** O. B. SHALLENBERGER. This specification covers an application of the induction principle to alternating-current instruments, and describes indicating instruments and meters in which a metal disc is acted upon by two coils. One of these carries the main current, and the other a current proportional to and in quadrature with the impressed E.M.F. The movement of the disc is retarded by a magnetic field.

437, a, of January 7th, 1895. **Enclosed Arc Lamp.** J. B. BARTON. (*W. Jandus.*) This patent relates to the method of prolonging the burning life of arc-lamp carbons by enclosing them in a nearly gas-tight chamber, thus causing the arc to be formed in an atmosphere of CO. It is not the Jandus master patent, over which there was a law case a few years ago, but a later patent covering a special construction of globe with inner and outer chambers.

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ELECTRIFICATION OF THE VICTORIAN RAILWAYS

Adverse Report by the Commissioners

ACCORDING to the *Australian Mining Standard*, the report of the Victorian Railway Commissioners (Messrs. Thos. Tait, chairman, W. Fitzpatrick, and C. Hudson) on the report made by Mr. C. H. Merz upon the application of electric traction to the Melbourne suburban railway system (see ELECTRICAL ENGINEERING, September 24th, page 451) was presented to the Legislative Assembly during November. It will be remembered that Mr. Merz recommended the electrification of the Port Melbourne and St. Kilda lines to be undertaken first, and the other lines in three different stages. The Commissioners accepted his conclusion that the best system of electric traction to adopt for the lines was the direct current protected conductor rail system, working at 800 volts. The Commissioners also concurred as to the site of the power station and other technical details in Mr. Merz's proposed scheme.

After some remarks regarding the possibilities of increasing the effectiveness of the existing steam rolling stock, the Commissioners, however, regret that their examination of such of the estimates as they have been able to check shows that electrification would result in a considerably greater financial loss in all stages in the year 1912 than indicated by Mr. Merz in his report. The alterations in the estimates made by the Commissioners have not been submitted to Mr. Merz. The Commissioners make the estimated total capital expenditure required for electrification in excess of that required for continuance of steam working for the Port Melbourne and St. Kilda lines, and the interest charges, and the three different stages, as follows :—Port Melbourne, &c., £315,482, instead of £314,999; first stage, £687,628, instead of £651,935; second stage, £1,152,601, instead of £1,087,992; third stage, £1,801,460. Interest charges :—Port Melbourne, &c., £12,619, instead of £12,600; first stage, £27,505, instead of £26,077; second stage, £46,104, instead of £43,520; third stage, £72,058. Annual working expenses, including the antiquation fund—with electric traction—Port Melbourne, &c., £22,951, instead of £18,563; first stage, £83,567, instead of £73,571; second stage, £160,079, instead of £140,362; third stage, £251,625, instead of £219,700. With steam traction—Port Melbourne, &c., £149, instead of £4,537; first stage, £2,310, instead of £12,306; second stage, £18, instead of £19,735; third stage, £4,658 (loss), instead of £27,267.

The result of these alterations on the comparison of the increased cost of electric service with the increased revenue, due to improved facilities, in Mr. Merz's report, is to make considerable changes in Mr. Merz's figures for the actual percentage increase of revenue above the assumed normal growth of 20 per cent. necessary to balance the financial loss in the year 1912, as shown in the table opposite.

The amended figures in each case include provision for the antiquation fund, but do not provide for minor corrections or considerations.

After reviewing the proposed electric service, the Commissioners state that practically all the gain in traffic and revenue to be derived from electrification would be during what are known as the slack hours of the day, and "it would require a large increase during the slacker portions of the day, which it is estimated will be carried in 1912 with a steam service, to amount to a 5 per cent. increase on the whole traffic."

The Commissioners cannot see their way clear to conclude that the electrification of the railways is of sufficient importance or value to justify the incurrence of the large estimated capital expenditure, and the annual financial loss which it is estimated would be involved in the year 1912 by electrification.

	Mr. Merz's figures.	Amended figures.
Port Melbourne and St. Kilda Lines only	16·1 per cent.	25·0 per cent.
Stage I. of the electrification ...	6·2 ,,	11·3 ,,
,, II. ,, ,, ...	5·8 ,,	11·2 ,,
,, III. ,, ,, ...	7·8 ,,	13·3 ,,

The report concludes :—"We therefore beg to recommend—'That the electrification of the Melbourne suburban lines be not either in whole or in part undertaken at the present time'; 'That the financial results of the electrification of the Melbourne suburban lines, and the advantages which will be obtained by such electrification as compared with steam working, be reviewed at reasonable intervals, special consideration being given to the aspect of the likelihood of increased tramway competition'; 'That the possible ultimate electrification of those lines be always borne in mind in the rearrangement or provision of additional tracks, stations, engine-sheds, turn-tables, and other locomotive facilities, and, in fact, in connection with all alterations and additions, including rolling stock, which might be affected by electrification'; 'That additional steam locomotives be constructed as may be required from time to time to meet the increasing requirements of the suburban traffic—such locomotives in the event of future electrification being easily and cheaply convertible to engines for general service on country lines, where there will be for some time ample scope for the useful absorption of locomotives of this class'; 'That the work of lengthening and strengthening such of the existing bogie coaches as are suitable for the suburban traffic be proceeded with as fast as the finances will permit; such lengthened and strengthened coaches being suitable for electric traction, and permitting of the gradual withdrawal from the regular suburban service of most of the large number of small fixed wheel base stock now necessarily utilised in that service, and which can be used for holiday traffic, instead of seated and covered trucks'; and 'That the existing platforms be lengthened and the existing block sections be shortened as may be found necessary from time to time to provide for the safe and efficient movement of the traffic (an automatic or semi-automatic system to be adopted in shortening the block sections, provided such a system be found to be safe, efficient, and economical.)'"

LOCAL NOTES

ASTON: *The Tramway Question.*—Reviewing the work of the year, *The Birmingham Post* states that tramway matters have again engaged attention, and some important steps have been taken, with the result that most of the outstanding questions with the British Electric Traction Company, which involved claims amounting to between £12,000 and £15,000, have been settled. These claims, although independent of the actual reconstruction account, arose from the difficulties experienced at that period, the company claiming compensation for losses sustained owing to the alleged delay in the work of reconstruction. In May it was decided to allow the company to carry forward the sum of £10,000 in respect to losses incurred by them in working the tramways during the four years ended December 31st, 1907. Whilst the representatives of the Council were unable to admit the claim of the company that they were by law entitled to carry forward the losses, it was felt that as a matter of equity they had a strong claim for consideration. Moreover, it appeared to be the best solution of the difficulty in the interests of the ratepayers, for unless the terms had been agreed upon a most costly arbitration or litigation must inevitably have ensued. Under the arrangement the proportion of the capital expenditure upon which interest and sinking fund was to be charged to the company from January 1st was permanently settled at £200,000. At the same time, the company not only abandoned their claim to the disputed item of £13,693 (extras on No. 1 contract), but consented to the addition of the sum of £5,571 to the capital account, thus bringing up the total to the sum named, whilst various points in dispute respecting the amount to be paid to the Council for the purposes of a renewals fund and the price to be charged by the Council for electric current supplied for traction purposes were also settled. Since the fresh agreement was entered into tramway matters in the borough have been working smoothly, except in relation to the Perry Barr route, in respect of which friction still exists regarding fares and through running. This, however, is now a matter outside the jurisdiction of the Aston authorities.

Electricity Works.—During the year just ended extensions at the electricity works have been carried out at a cost of £33,000.

BARKING: *Electricity Charges.*—The Electricity Committee have decided in favour of the following scale of charges after January :—Up to 100 units per month, 2 1/2d. per unit; 101–1,000 units, 2d.; 1,001–3,000 units, 1 7/8d.; 3,001–4,000, 1 3/4d.; 4,001–5,000, 1 5/8d.; 5,001–6,000, 1 1/2d.; 6,001–7,000, 1 3/8d.; 7,001–8,000, 1 1/4d.; 8,001–10,000, 1 1/8d.; over 10,000, 1d.

COLCHESTER: *Boycott of Tramways.*—As the result of the Corporation raising the fares upon certain routes owing to the loss of £3,000 upon the tramway undertaking last year, the inhabitants are boycotting the cars, preferring to walk rather than pay the increased fares.

CONSTANTINOPLE: *Introduction of Telephones.*—The authorities are being urged not to work the proposed telephone system themselves, but to grant a concession to a company. At present there is a disposition to entrust the undertaking to the Ministry of Posts and Telegraphs, which is charged with being a long way behind European proficiency in its administration.

DEVONPORT: *Corporation and Tramways Co.*—The Devonport and District Tramways Co. have intimated to the Corporation their intention to discontinue running cars on certain of the leased lines on and after January 16th next, for the reason that the working of these lines is unremunerative. The Tramways Committee have referred the matter to the Town Clerk, who will report at a special meeting of the Committee, which will be held previously to the January meeting of the Council.

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DUNDEE: *Charge for Tramway Current.*—The charge for energy made by the Lighting Committee for tramway purposes was under discussion at the last meeting of the Council. The allegation is that it is being supplied at less than cost, viz., 1·5d. per unit up to 200,000 units and 1d. per unit for all energy over that amount, whereas the total costs work out to 1·63d. per unit. After a lenthy discussion the matter was referred to the two committees for further consideration.

Accident at the New Electricity Works.—An accident, which, fortunately, was not attended with serious results, occurred last week on the construction work in connection with the new power station at Carolina Port. The erection of the pump chamber, which is situated at the north-east corner of the Fish Dock, has presented some difficulties. According to the *Dundee Advertiser*, it consists of a cylinder of reinforced concrete, the walls of which have a uniform thickness of 6 in. From above the cylinder is moulded, and by its own weight is sunk to the desired level. Work on it has been in progress for many weeks, and up till the other day the rate of descent was slow—not at all commensurate with the internal excavation. Suddenly, however, the mass of concrete coming upon what was in effect a quicksand suddenly descended a distance of nearly 4 ft. As a result there was an inrush of water. Five men at the moment were employed in the interior. Four of the workers made a rush for safety, ascending by means of the hoisting gear. The fifth was in a sense trapped, but was eventually rescued by the same means. At the time of the mishap the tide was high, hence the inrush of water. Having regard to the shifting nature of the soil, the pump chamber will require to be sunk to a lower level than was at first contemplated. At the moment its lower edge has attained a depth of about 32 ft. below the level of the made-up ground, but the pump chamber will now have to be sunk to the rock bottom.

DURBAN: *Electricity Report.*—The eleventh annual report for the year ending July 31st, 1908, of the Borough Electrical Engineer, Mr. John Roberts, says that the number of private consumers now amounts to 3,931, compared with 3,702 in the previous year The number of power users is 244 compared with 222 in the previous year. A scheme is outlined for the wiring and fitting of consumer's premises, on the basis of the consumer paying 4 per cent. interest on the capital outlay for three years.

FARNHAM: *Overhead Wires.*—A Board of Trade inquiry was conducted last week at the Council's offices into an application by the Farnham and District Electric Supply Co. for permission to erect overhead wires, the company having been granted an order in 1905. The Hon. T. H. W. Pelham presided, and was accompanied by Mr. A. P. Trotter, electrical adviser to the Board of Trade. It appeared from the proceedings that a petition signed by 437 ratepayers objecting to the erection of overhead wires has been sent to the Board of Trade, this number representing one-third of the ratepayers of the district. The Board of Trade consequently ordered a local inquiry. Without prejudicing the question in any sort of way, the Hon. T. H. W. Pelham pointed out that the general principle of the Board of Trade was not to give sanction for the overhead wires except in unpopulous places or in populous places where there was a great deal of waste land and moorland, as was the case very often in large manufacturing districts. There was a feeling in the country very much against overhead wires in populous places. They all knew that the overhead system was a great nuisance and annoyance in towns where there was a great deal of traffic. The onus lay on the company, because the feeling of the Board of Trade was rather against overhead wires for electric lighting purposes in an urban district or in a populous place. The case for the company was that the methods adopted for obtaining signatures to the petition were not all that could be desired, in many cases the wife of a ratepayer being allowed to sign for him in his absence, and in other cases the signature was not that of a ratepayer at all. The real question, it was pointed out, was whether electric light by means of overhead wires was better than no electric light at all, because the company could not afford to lay underground mains. It may be said that the Council itself is not opposed to overhead wires, the company having agreed to their conditions, and that the objections have been raised through a fear that the amenities of the district will be spoiled. The inquiry terminated, and a decision will be given later.

FRANCE: *The Electrical Industry.*—An American Consular report states that in the past few years very important changes have been made in the street-railway systems in and around Roubaix, as well as in connection with electric lighting. Large central stations have been installed and are now supplying mills, industrial establishments, cafés, private houses, and small workshops for light and for running machinery. Great attention should be given by those interested in this industry, as further changes are soon to take place and prospects for the sale of electrical supplies are extremely bright.

HASLEMERE: *Electricity Supply.*—The Special Committee appointed to consider the proposed application to the Board of Trade by the Hindhead & District Electric Light Co. for powers to extend their area to include Haslemere, Thursley, and Witley, have recommended that no objection be raised to the company extending to Haslemere, but that they should be asked to lay mains in streets other than those specified. The committee had had before them the terms of certain other places, and the price appeared usually to be 6d. per unit, and not 8d., as in this case, and the committee recommended that they should ask if the maximum price could not be 6d. per unit. There was a clause in the Order that, notwithstanding anything which appeared in the Order, the company should not be obliged to give a standard supply of current, or should not be obliged to give any current at all between sunrise and sunset. The committee recommended that the attention of the Board of Trade should be called to those conditions.

KIRKCALDY: *Proposed Tramway Extensions.*—The borough electrical engineer and tramways manager has reported upon the advisability of constructing a number of new tramways, including joining up with Dysart. The whole of the Council's statutory powers have now been exercised or have expired, and as the new lines proposed are not extensive, it is thought possible that the Council will not incur the expenditure necessary for promoting them. The matter is to receive further consideration.

LIMERICK: *Threatened Strike of Electricity Employees.*—The workers at the Corporation electricity works have threatened to strike unless a certain switchboard attendant is dismissed. The local Labour Council has taken the matter up, and in order to avoid trouble, the Corporation has decided to ask the man in question to resign.

LONDON: *London County Council. Tramways.*—The annual report of the Council contains particulars of the tramways undertaking. In their report, the Highways Committee state that all possible progress is being made with the electrification of the tramways, but that it is less rapid than formerly, because those lines of the narrower routes have been left to the last owing to the difficulties presented in regard to widenings.

Highgate Hill Cable Tramways.—It is announced that the London County Council will take over the Highgate Hill cable tramway undertaking on March 31st next, and will at once proceed with its conversion to electric traction.

Lighting of the Tower of London.—For some time past there has been an argument as to the legal rights of the City of London Electric Lighting Co. to supply the Tower of London, the Stepney Borough Council contending that the greater portion of the Tower, at any rate, came within their area. It is now stated that the company have decided to abandon the contest, and thus the threatened legal proceedings will not be taken. A supply of electrical energy will therefore be taken from the Stepney Borough Council.

LUCAN: *Proposed Extension of Electric Railway.*—The Judicial Committee of the Irish Privy Council has granted an order for an extension of the Dublin and Lucan electric railway to Leixlip.

MORECAMBE: *Electricity Works Staff.*—In consequence of the suggestion by the Electric Light Committee that the staff of the electricity works should be reduced, the Borough Electrical Engineer has informed the Committee that he will not be responsible for any mishap at the works through an insufficient staff.

Tramways Arbitration Adjourned.—The arbitration proceedings which have been going on in London in relation to the purchase of the horse tramways in the town by the Corporation have been adjourned until January 8th. The estimates of the value of the undertaking are about £9,500 by the Corporation expert, and £16,000 by the company's witnesses, who include Mr. Stephen Sellon.

NORTH SHIELDS: *Electric Railway Under the Tyne.*—The promoters of the electric railway under the Tyne between North and South Shields have placed a proposal before the North and South Shields Corporations to contribute £100,000 of the £200,000 which is necessary for constructing the railway. The intention is that the promoters should pay the interest and sinking fund charges upon the sum loaned.

NOTTINGHAM: *Death from Electric Shock.*—An inquest was held on Monday into the death of C. W. Thomson, who received a fatal electric shock in the power-house of the Moorgreen Colliery, Nottingham, a few days ago. The deceased was superintending the erection of the switchgear on behalf of the British Westinghouse Co., and appears to have touched some live metal in one of the cubicles at the back of the main switchboard. It was understood that he was working in the second cubicle where there was no live metal, but for some reason he appears to have gone into the next cubicle where the current was not cut off. Mr. R. Nelson, the Electrical Inspector of Mines to the Home Office, said that, in his opinion, the accident was due to momentary forgetfulness on the part of the deceased, and that no blame was attaching to anyone. At the same time, there appears to have been a certain laxity in the handling of the keys of the cubicle doors, for it should not have been possible for the deceased to have obtained possession of these without the knowledge of the man in charge of the switchboard. He, therefore, strongly recommended that definite rules should be drawn up in respect of the handling of the keys. The jury returned a verdict that the "deceased was accidentally killed by coming in contact with an electric terminal," and considered that the accident was due to some oversight on the part of the deceased himself.

PLYMOUTH: *Challenge by Gas Company.*—The Plymouth and Stonehouse Gas Light and Coke Co. have written to the Cor-

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poration in reference to an instruction to the electrical engineer to bring up a report dealing with street illumination by electric light, with special arc lamps in prominent points in the centre of the town. The company ask for facilities for demonstrating what can be done with gas, offering at the same time to defray the expense of such a demonstration. The company add that they feel justified in making this application, inasmuch as all ratepayers in Plymouth who are gas consumers are partners in the undertaking. By their Act of Parliament, approximately nine-tenths of the profits made by the company, after paying 5 per cent. to the shareholders, go to the consumer. Consequently, they say, if by the substitution of electric light for gas in the public streets of Plymouth a loss of net revenue is made by the company to the extent of £100 or £500, the ratepayers who are gas consumers will have to pay about nine-tenths of that loss in the gas bills. The letter concludes with a suggestion that the spots in the town selected to be illuminated by electricity and gas respectively should be agreed upon by the borough electrical engineer and the gas company's engineer, and that some impartial expert, or persons, be instructed to investigate the respective cost to the ratepayers by each method of lighting.

PAIGNTON: *Electric Supply.*—The Paignton and District Electric Supply Co. put their works into operation on Christmas Eve. The plant consists of a "National" suction gas-producer and gas-engine, of approximately 100 h.p., and a Crompton belt-driven dynamo with storage battery. Fourteen Crompton-Blondel flame arc lamps have been installed for public lighting. A refuse destructor is now being constructed adjacent to the power station.

SOUTHEND: *Electricity Finances.*—The district auditor, in his report upon the electric lighting accounts, states that, as the Council have, in the current year, dealt with the machinery which it was necessary to supersede and placed the works in a thoroughly satisfactory condition, he was for the first time able to express a definite opinion as to the leading results of the undertaking; inasmuch, however, as the machinery has not in the past been properly maintained out of revenue, nor, in the alternative, have revenue allocations been made to a depreciation and obsolescence account, one year's results cannot properly be compared with another. The auditor states that, in his opinion, the net loss on the undertaking since its inception in the year ended March 31st, 1902, has been £10,511. The capital expenditure at March 31st last was £116,715 19s. 1d.

WIGAN: *Colliery Equipment.*—The Moss Hall Colliery Co. are now proceeding with the erection of a generating station at the Maypole Colliery, Abram, near Wigan.

YORK: *The Tramways Undertaking.*—The Tramways Committee have reported that by the terms of the agreement between the Corporation and the City of York Tramways Co. for the purchase of the company's undertaking, it was provided that the company should continue to run the existing tramways for a period of three months after the date of the granting of the Light Railways Order. The order was made on October 19th, 1908, and consequently the company's obligation to run the tramways will continue until January 19th next. The company have been asked whether they would continue to work the tramways for a further period, but no terms have been agreed upon up to the present. The committee have considered the question, and recommend that the Council should take over the tramways from the company on the date mentioned or on the date of the actual completion of the purchase of the undertaking, and to run the same under their own management. In the event of the Council deciding to do so, the committee further recommended that they be authorised to make all needful arrangements for that purpose.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Miscellaneous

AYR.—The extension of the tramway system to Hawkhill has been decided upon.

GRIMSBY.—The Corporation invite tenders for the supply of continuous-current motors and starting panels, sizes ¼ to 15 h.p. Particulars from Mr. W. A. Vignoles, Borough Electrical Engineer. (See an advertisement this week.)

ITALY.—The *Board of Trade Journal* calls attention to the good openings presented in Naples and South Italy generally for electrical appliances and insulating material, much of which is apparently intended for Italian warships.

LONDON: *Hammersmith.*—Schemes and tenders are invited for altering the lifts and fans, at present worked by continuous current, to work from single-phase alternating current. Firms tendering are to specify what allowance they would be prepared to make for the present transforming plant and continuous-current motors. Particulars from the Clerk to the Guardians, 206 Goldhawk Road, Shepherd's Bush, and tenders by January 19th.

OLDHAM.—The Tramways Committee invite tenders for the supply, delivery, and laying of feeder cables, feeder pillars, ducts, &c. Specifications, &c., from Mr. Lewis Slattery, the tramways manager (fee two guineas, returnable), and tenders to the Chairman of the Tramways Committee by January 6th.

ROUMANIA.—The municipal authorities of Bucharest contemplate the construction of a new series of tramways. A company is to be formed with a capital of about £600,000, of which £200,000 will be provided by the municipality.

RUSSIA.—A loan has been authorised to the Town Council of Pskoff for the construction of tramways to the value of £80,000.

SWITZERLAND.—A decree has been issued granting to the company controlling the electric railway from St. Gall to Trogen a concession for the construction and working of an electric railway (1) from Trogen to Heiden, with a branch from Kaien to Rehetobel, and (2) from Heiden to Walzenhausen. The decree will come into force on January 1st, 1909. The cost, says the *Board of Trade Journal*, of the two sections is estimated at 2,900,000 francs (£116,000).

M. Spillman, of Zoug, has been granted a twenty-four years' concession for the construction and working of a section of one-metre gauge electric railways which will run from (1) Zoug to Nidfurren and Oberägeri, (2) Zoug to Baar and Talacker, and (3) Nidfurren to Edlibach and Menzingen: The total length of line, we learn from the *Board of Trade Journal*, will be 22·950 kilometres, and in the estimated cost of the work, viz., 1,730,000 francs, 450,000 francs (£18,000) have been apportioned for rails, and 362,000 francs (£14,480) for rolling stock.

Generating Stations, Sub-stations, Mains, &c.

AUSTRIA HUNGARY.—The *Board of Trade Journal* states that an electric supply works will be erected at Villach.

BELGIUM.—Tenders will be received, says the *Board of Trade Journal*, at the offices of the "Compagnie de l'Exposition de Bruxelles, 1910," Rue des Douze-Apôtres 34, Brussels, until January 15th, in connection with the supply of the necessary electricity for the purposes of the Exhibition.

DOVER.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £5,000 in connection with an extension of the electricity supply to St. Margaret's.

ITALY.—The *Board of Trade Journal* states that the Prefecture of Milan has, by decrees dated respectively November 10th, 15th, and 17th, authorised work to be carried out by the following companies:—(1) "Società Lombarda" to erect an electric power installation in the township of Gallarate; (2) "Società Ellettrica di Vergiate" to equip and work an electric light and power installation in the township of Cerro Maggiore; (3) "Società Lombarda" to erect an electric light and power installation in the township of Castano and Arlano.

LONDON: *Islington.*—The London County Council has sanctioned the borrowing of £5,541 for extensions to the Council's electricity undertaking, and offers to lend this sum at £3 17s. 6d. per cent. per annum.

RUGBY.—Tenders are invited for 440 yards or more of three-core low-tension paper-insulated lead-covered cable. Particulars from the Clerk to the Council and tenders by January 4th.

YARDLEY.—The Council's consulting engineer is now preparing a report upon the introduction of electric supply into the district.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

Battersea.—The Guardians have decided to expend ten guineas on a report dealing with the adoption of electric lighting.

N.W.—Enlargement of Bell Lane School (750 places), Hendon. Architect, Mr. Wilson, Hendon Education Committee.

PROVINCES.

BARNSLEY.—The question of the electric lighting of the market is under consideration.

BIRMINGHAM.—Police station, Allison Street (£17,000). E. O. Smith, Town Clerk.

Fire station, Albion Street (£11,170). Architect, Thomas G. Price, Union Chambers, Temple Row.

CARDIFF.—Laboratory and art block at Canton Municipal Secondary School (£3,800) for Town Council.

CHELMSFORD.—Council School (£10,500). Architect, W. H. Pertwee, Bank Chambers, New Street.

CHICHESTER.—School (£10,000). Architect, F. Lobley, Guildhall, Chichester.

DARWEN.—Extension of Infectious Diseases' Hospital (£2,600). R. V. Smith, Surveyor to Town Council.

DROYLSDEN.—School (800 places). C. Hall, Surveyor to Urban District Council.

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FOLKESTONE.—New Grammar School. A. M. Nicholls. Borough Engineer, Folkestone.

HEREFORD.—Additions to Corn Exchange. Architects, Groome & Bettington, Palace Chambers, King Street, Hereford.

HOUNSLOW.—Laundry, London Road. Architects, C. H. Samson, The Laurels, Taunton.

LLANELLY.—Alterations to Old Castle Inn for Buckley Brewery, Ltd. Architects, J. Davies & Son, Llanelly.

Rebuilding Boar's Head Inn for Buckley, Ltd. Architects, J. Davies & Son, Llanelly.

Rebuilding Bear Inn, Felinfoel, for Buckley Brewery, Ltd. Architects, J. Davies & Son, Llanelly.

LUTON (BEDS.).—Pumping station. S. F. L. Fox. Borough Engineer, Luton.

School (£1,000). Architects, Brown & Sons, 9 Castle Street, Luton.

MANCHESTER.—New lending library in Cheetham Hill Road. H. Price, City Architect.

MERTHYR.—Alterations, Temperance Hall, for the proprietors.

NEWCASTLE.—Proposed the Queen's Hall and Buildings, Northumberland Street. Architects, Graham & Hill, Newcastle.

NORWICH.—Alterations and additions to Guildhall. A. E. Collins, Engineer to Town Council.

STOURBRIDGE (WORCESTER). — School. Worcester County Council.

SURBITON.—Special subjects buildings for Surrey Education Committee. Secretary, Ramsay Nares, Kingston.

UXBRIDGE.—A Committee has been appointed for considering the need for more efficient lighting in the infirmary.

WOOLWICH.—Police station. J. Dixon Butler, Surveyor to Metropolitan Police, New Scotland Yard, S.W.

TENDERS RECEIVED AND ACCEPTED

ABERDEEN.—The following tenders have been accepted for the supply of stores to the electricity department:—D. Richmond & Sons, Glasgow, wrought iron; J. M'Adam & Sons, carting; Clyne Mitchell & Co., cast-iron work; Duthie Bros., ropes, &c.; J. Blaikie & Sons, brass, lead, &c.; Shirras, Laing & Co., tallow; Glegg & Thomson and Shirras, Laing & Co., ironmongery goods; G. Donald & Sons and Farquhar & Gill, paint, oil, glass, &c.; G. Gordon & Co., timber.

BLACKPOOL.—For the supply of coal for the electricity works 23 tenders were received, and that of Mr. C. Hindle, of Blackpool, for "Pearson & Knowles" Standish Arley rough slack to the amount of 5,000 tons was accepted. The balance of next year's requirements has been left over until the Electrical Engineer has made tests on two or three selected fuels.

CARDIFF.—The Corporation have accepted the tender of Messrs. Willans & Robinson for a 2,500-kw. Willans-Siemens turbo-alternator.

GLASGOW.—The Corporation have accepted the tenders of Bryden & Middleton for an ash chut at Pinkston; Alexander Jack & Co., travelling crane at the new sub-station; the National Conduit & Cable Co., Ltd., trolley wire; and Siemens Bros. Dynamo Works, Ltd., dry cells.

LONDON: *City of London Gardens.*—An order has been placed with Pinching & Walton for 1 gross 16-c.p. lamps at £5 5s.; ½ gross 8-c.p. ditto at £2 12s. 6d.; ¼ gross 25-c.p. ditto at £1 6s. 3d.; ¼ gross 32-c.p. ditto at £1 9s. 3d.; and 1 dozen Osram lamps, £2 8s.

Marylebone.—The Council have renewed the contract for the maintenance of the Aron wattmeters used at the generating station with the Aron Meter Co. for a further period of twelve months at £28.

MERTON.—The District Council, upon the recommendation of the Fire Brigade Committee, have decided to adopt the "Gamewell" system of fire alarms, which the Post Office authorities are to supply and maintain for ten years at an annual rental of £66.

WATFORD.—The tender for the construction of the terminal station at Watford of the new Euston to Watford Electric Railway has been placed by the London and North Western Railway Co. with a local firm of builders, viz., Messrs. C. Brightman and Sons. It is expected that the work, which will be put in hand immediately, will be completed by January, 1910.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 65 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £66 to £66 10s. (Last week, £65 to £65 10s.)

CHANGE OF ADDRESS.—Messrs. Pritchetts & Gold, Ltd., inform us that, owing to the large and continued increase in their business, they are removing their sales department to larger premises at No. 58 Victoria Street, S.W., and all orders and correspondence with reference to that department should be sent to that address on and after the 29th inst. Telegraphic address and telephone numbers will remain unaltered.

DISSOLUTIONS OF PARTNERSHIP.—Sir Home Gordon, Bart., has retired from the firm of Messrs. Buchan & Partners, consulting electrical and mechanical engineers, Parliament Chambers, Westminster, London, and 16 Rutland Square, Edinburgh. The business will be continued as before by the remaining partners, Messrs. M. Buchan and R. W. Hogarth.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of creditors of the Buenos Ayres Electric Tramways Co. [1901] (in voluntary liquidation) will be held at the company's offices, 62 London Wall, London, E.C., on January 7th, at 12 noon. Notice is also given that all claims should be sent in not later than February 1st.

The statement of accounts in the bankruptcy of Messrs. Marten & Jellicoe, Ltd., Sumner Road, Thames Ditton, electrical engineers, &c., shows that the gross liabilities amount to £6,588 8s. 1d., of which £5.026 17s. 5d. is unsecured, and assets estimated at £1,358 12s. 7d., the whole of which is absorbed by debentures. The cause of the company's failure is said by the directors to be lack of sufficient working capital.

The Eldon Electric Co. is to be wound up voluntarily. Mr. William Sparks, of Newcastle, has been appointed liquidator.

MISCELLANEOUS CITY NOTES

HALIFAX AND BERMUDAS CABLE CO.—An interim dividend of five per cent. per annum, free of tax, for the past half-year, has been declared.

MELBOURNE TRAMWAY & OMNIBUS CO.—Cable advices have been received of the declaration of a dividend of 4½d. per share for the quarter ending December 31st, equal to 15 per cent. per annum.

SHAWINIGAN WATER & POWER CO.—Cable advices state that the earnings for November were $58,100 against $54,500 for the corresponding month of last year.

SOUTH LONDON ELECTRIC SUPPLY CORPORATION.—Letters of allotment for the issue of £100,000 5 per cent. first mortgage debenture stock have been posted.

Dissipation of Fog by Electricity.—With reference to the statements recently made that the Westminster City Council had granted facilities for experimenting with Sir Oliver Lodge's system of dissipating fog by electricity, Sir Oliver has written to *The Times*, pointing out that the publication of this fact was without his knowledge or consent. He would have preferred silence until after a large-scale experiment had been tried—if it was going to be tried. But even as to this he had no information. Sir Oliver Lodge takes the opportunity, however, of stating his connection with this subject as follows:—In the year 1884 I observed, and exhibited to the British Association, then meeting in Montreal, the extraordinary clarifying action of a high-tension electric discharge on fog or mist or smoke produced in a bell jar and electrified by a point. The particles of smoke coagulate, as iron-filings do near a magnet; they form themselves into large aggregates—clusters, flakes, or streamers—and then either fall or cling to the walls of the vessel. In a few seconds the space is clear, and the sides thickly covered with deposit. The nature of the smoke is immaterial; and a cloud of steam is by the same agency converted into Scotch mist or fine rain. I thought at the time that this was a new, though small, discovery; but, subsequently, I ascertained that something of the same sort had been observed by a Mr. Guitard long ago, and published by him in a short paragraph in the *Mechanics' Magazine* for 1850, this paragraph being referred to in that most industrious compilation, the late Professor Gustav Wiedemann's 'Galvanismus und Elektromagnetismus.' . . . I also tried it on a rather larger scale - clearing a cellar of turpentine smoke, for instance, and erecting an arrangement at Liverpool on the roof of the old University College there for applying a discharge of electricity to the open air." In a later paragraph Sir Oliver Lodge says:—"I have never regarded electrification as the ideal method for removing the incubus of town fogs These artificial nuisances ought not to be manufactured; improved methods of combustion are the way to reduce them. But in certain important local centres, such as railway stations and harbours, it may be worth while to experiment on the electrical method of clearing. Accordingly, when a few years ago the engineer to the Westminster City Council approached me with an inquiry, I said that I was willing to help. And when a year or so ago Mr. Walford called and said that he would like to put down money to try on a fairly large scale, I again expressed readiness if I thought the conditions hopeful. Since then I have heard no more. . . . If I see any reasonable hope of success in any scheme that is independently mooted—whether for influencing the weather or for clearing local fog—I will do what I can in my scanty leisure to help with advice, and may be able to relegate one of my assistants to the job."

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NEW COMPANIES

DENNISON, KETT & CO.—This company was registered on December 19th, with a capital of £3,000 in £1 shares, to carry on the business of mechanical and electrical engineers and contractors carried on at 11 Queen Victoria Street, E.C., and 61–3 Lant Street, S.E., as "Dennison, Kett & Co." The subscribers are:—E. W. Dennison, Fairmead, Grove Park, Kent; F. Stur, 62 Sandrock Road, Lewisham, S.E., engineer; F. S. Stephens, 49 Queen Victoria Street, E.C.; G. Kett, 108 Gordon Road, Peckham Rye, S.E., engineer; H. G. Stimson, 10 Moorgate Street, E.C. Private company. The number of directors is not to be less than two nor more than five. E. W. Dennison is one of the first, and may retain office while holding £100 shares. Registered office: 11 Queen Victoria Street, E.C.

RESIDE & CO.—This company was registered on December 22nd, with a capital of £3,000 in £1 shares, to acquire the business carried on by Reside & Co., to adopt an agreement with J. Reside and W. Barraclough, and to carry on at Brighouse and elsewhere the business of electrical, mechanical and motor engineers, millwrights, tool makers, ironmongers, general merchants, &c. The subscribers are:—J. Reside, Close Lea, Rastrick, Brighouse, engineer; W. Barraclough, Bankfield, Raynor Road, Brighouse, engineer; H. T. Whiteley, The Rookeries, Old Lane, Brighouse. Private company. The number of directors is not to be less than two nor more than five; the first are J. Reside, W. Barraclough, and H. T. Whiteley. Qualification £10. Registered office: Perseverance Works, Huddersfield Road, Brighouse, Yorks.

A. L. M. SYND.—This company was registered on December 23rd, with a capital of £100 in 1s. shares, to acquire and dispose of the English and German patents in connection with the process for the manufacture of flexible aluminium foil, with a view thereto to take over the benefit of two contracts (1) dated November 4th, 1908, and made between Aluminiumfabrik Gontenschweil A.G. of the one part, and A. J. Faulding of the other part, and (2) dated November 3rd, 1908, and made between A. J. Faulding and others of the one part, and the Aluminium Corporation, Ltd., of the other part, and to carry on the business of aluminium foil manufacturers, &c. Private company. The number of directors is not to be less than three nor more than ten; the first are A. J. Faulding, J. W. Sidley, and J. Leemann-Abderhalden. Registered by A. O. Warren, 2 Broad Street Place, E.C.

THOMAS TRANSMISSION.—This company was registered on December 11th, with a capital of £5,000 in £1 shares, to acquire from J. G. P. Thomas a British patent relating to an electro-mechanical power transmission system, to turn the same to account, and to carry on the business of manufacturers of and dealers in motor-cars and vehicles, electrical and mechanical engineers, &c. The subscribers are: W. A. Tritton, 43 Anson Road, N., engineer; H. J. Thomson, 121 West Parade, Lincoln, engineer. Private company. The number of directors is not to be less than three nor more than seven; the first are W. A. Tritton, H. J. Thomson, and A. R. Mitchell, of 3 Balfour Road, Walmer, Kent. Registered office: Monson Chambers, Corporation Street, Lincoln.

TRANSVAAL HYDRAULIC POWER SYNDICATE.—This company was registered on December 12th, with a capital of £20,000 in £1 shares (15,000 "A" and 5,000 "B"), to exploit and investigate water power in the Transvaal and elsewhere, to pay preliminary, engineering, and other fees and expenses in connection with the acquisition of any option contracts, rights, and benefits, and to take over from the Transvaal Power Development Syndicate, Ltd., or others, contracts, rights, options, agreements, privileges, and benefits, to carry on the business of electricians and mechanical engineers, &c. Private company. The number of directors is not to be less than two, nor more than seven; the subscribers are to appoint the first. Qualification, 500 shares. Registered offices, 24 Coleman Street, E.C.

"Black" Smoke Prosecution.—At the South-West London Police Court last week the County of London Electric Supply Co. were summoned for contravening a prohibition order requiring them to abate a nuisance arising from the issue of "black" smoke from the chimney-shaft of their Wandsworth power-house. On behalf of the company, it was stated that the sum of £2.000 has been spent on smoke-consuming appliances, but that the issue of "black" smoke was unavoidable at times. In the present instance the smoke lasted about five or six minutes. A penalty of twenty shillings was imposed, the maximum penalty being forty shillings per day whilst the nuisance lasts.

Telegraph Traffic.—An interruption of the submarine cable between Medan and Penang occurred on the 22nd inst. Telegrams for Kotaradja and Sabang will be sent by telephone from Pangkalanbrandon, or by post from Penang. We are also able to announce the reopening to international telegraphic communication of the offices in Hayti, which were closed during the recent revolution. Owing to the terrific earthquake in Italy, communication with Messina is cut off. The lines of the Indo-European Telegraph Company between Tiflis and Tauris were also down on the 29th inst., but were repaired on the same day.

COMPANY MORTGAGES

VERITY'S.—A memorandum of satisfaction in full of debentures, dated January 9th, 1906, securing £40,000, has been filed. Particulars of £60,000 debentures, created by resolution of October 27th and secured by a trust deed dated October 31st, 1908, have also been filed pursuant to Section 10 (3) of the Companies Act, 1907, the whole amount being now issued. The above-mentioned trust deed has also been registered. Property charged—manufactory, warehouse, and premises at Aston, known as the Plume Works, works and premises at Plume Street, known as the Victoria Works, wharf and other buildings in Plume Street aforesaid, and the company's other assets, present and future, including uncalled capital. Trustees, Trustees Executors and Securities Insurance Corporation, Ltd., Winchester House, Old Broad Street, E.C.

FLEETWOOD & DISTRICT ELECTRIC LIGHT & POWER SYNDICATE.—Charge, dated December 8th, 1908, to secure £1,125, and further sums not exceeding in all £1,700, created by receiver appointed on behalf of debenture holders. Property charged—assets and undertaking, ranking in priority to a trust deed dated October 31st, 1899. Holder—W. C. Johnson, Broadstone Farm, Coleman's Hatch, Sussex.

CITY OF OXFORD ELECTRIC TRAMWAYS.—Debenture, dated December 14th, 1908, to secure £15,000. Property charged—The company's undertaking and property, present and future, including uncalled capital. Holders: Lloyds Bank, Ltd.

OFFICIAL ANNOUNCEMENTS AND SMALL ADVERTISEMENTS.

Official Advertisements are charged at the rate of **9d.** per line (column width).

Small Prepaid Advertisements of Situations Vacant and Wanted, Plant for Sale or Wanted, &c., are inserted at the rate of **1/-** for the first 12 words and 1d. per word afterwards. Three insertions for the price of two. Advertisements can be received up till Wednesday morning first post.

Letters should be addressed to The Kilowatt Publishing Co., Ltd., 203–6, Temple Chambers, London, E.C.

ELECTRICALLY-DRIVEN AIR-COMPRESSING PLANT FOR SALE.

2 INGERSOLL-RAND Belt-Driven Air-Compressors. Capacity 2637 c. ft. free air per minute each machine.

2 ditto, ditto. Capacity 1414 c. ft. free air per minute each machine.

1 Ingersoll-Sergeant Belt-Driven Air-Compressor with automatic unloader. Capacity 285 c. ft. free air per minute.

1 Holman Compressor, Belt-Driven. Capacity 300 c. ft. free air per minute.

Electric Motors for driving above complete with starters, switches and fuses.

1 205-H.P. 400-volts Single-Phase Motor.

2 110-H.P. 400-volts D.C. Motors.

2 14-H.P. Electric Motor Hoists.

All above Machines are in excellent order.

Further details and prices from:—

The Tilbury Contracting & Dredging Co., Ltd.,
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COUNTY BOROUGH OF GRIMSBY.

THE CORPORATION are prepared to receive tenders for the supply of continuous current motors and starting panels, sizes ¼ to 15 H.P. Full particulars and specification on application from the undersigned. Last date for Tenders, January 16, 1909.

W. A. VIGNOLES, M.I.E.E.,
Borough Electrical Engineer.

Electricity Works,
Grimsby.

December 30th, 1908.

CABLE JOINTER wanted for Valencia. Must be good worker, under 30, and have thorough knowledge of high tension sleeve jointing. If satisfactory, permanency as foreman. State salary required and past experience to Box A 68, Electrical Engineering, 203, Temple Chambers, London, E.C.

WANTED, an Engineer having a practical acquaintance with modern electrical developments. Such engineers are in demand, and command large salaries. You can qualify at home, under experts, and by a unique system. Prospectus free, The British Correspondence School of Electrical Engineering, Dept. M., 36, Maiden Lane, Strand, London.

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